

A-0003 Histopathologic evaluation of flexor tenosynovium in recurrent carpal tunnel syndrome

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Purpose: To evaluate histopathologic findings in the flexor tenosynovium of patients with true, idiopathic recurrent carpal tunnel syndrome (CTS) to determine if there are consistent abnormal inflammatory or pathologic findings.

Methods: Thirty-five patients (19 women and 16 men; mean [range] age, 72 [52-88] years) underwent revision open carpal tunnel release (CTR) more than 6 months after primary CTR (32/35 >1 year). Recurrence was confirmed by recurrent symptoms, positive provocative tests, electrodiagnostic testing, and (in some cases) temporary response to corticosteroid injections. All patients had median nerve neurolysis and tenosynovial biopsy. In addition, Congo red staining for amyloid was done in 29 of 35 specimens.

Results: Histopathologic findings of the tenosynovium were unremarkable (noninflammatory, fibrous connective tissue) in 31 (89%) of 35 patients; mild, chronic inflammation (without granulomas) was seen in 4 (11%) of 35 patients. Nine (31%) of 29 patients had positive results for amyloid, and subtyping typically confirmed transthyretin amyloid seen in localized (senile) amyloidosis. Only one light-chain subtype was noted in a patient subsequently diagnosed with myeloma. No patients were diagnosed with systemic amyloidosis.

Conclusion: The flexor tenosynovium in patients with recurrent CTS does not appear to substantially differ histologically from that described previously in primary idiopathic CTS, although a higher incidence of amyloid was seen in this group (31%) compared to reports in patients with primary, idiopathic CTS (2-7%). As our population was older (mean age 72), this likely represents localized senile amyloidosis. Routine tenosynovial biopsy or tenosynovectomy is unnecessary in revision CTR.

A-0006 IL-33 is a novel therapeutic target in Dupuytren's disease

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Objectives: The ideal treatment for Dupuytren's disease (DD) would be aimed at preventing the progression of the early nodular phase to flexion contractures of the digits. Currently, there is no approved therapeutic agent for early disease and, based on studies in our lab which identified TNF as a therapeutic target, a phase II clinical trial is on going. Tumor necrosis factor (TNF) can drive the differentiation and activation of myofibroblasts, the cells responsible for matrix deposition and contraction in DD. However, the cause of persistence of the localised inflammation remains unknown and the anti-TNF would need to be injected on multiple occasions. Any rational future therapy will also require inhibition of other molecular drivers of chronic inflammation upstream of TNF secretion, namely, interleukin 33 (IL-33), or both. This study aimed to identify the role of IL-33 in driving for chronic inflammation and fibrosis in DD. By controlling the local cytokine environment in DD, we will be able to offer patients novel therapies other than surgery. Furthermore, any findings from our study could translate to other localised fibrotic disorders, including frozen shoulder, Ledderhose disease, Peyronie's disease, and endometriosis, affecting more than 10% of the UK population.

Methods: Surgically excised DD nodules were investigated using a combination of immunohistochemistry, immunofluorescence, FACS, CyTOF, RT-PCR, and Western blotting.

Results: DD nodules comprise mainly myofibroblasts and immune cells, including macrophages and mast cells, which are attracted by locally secreted chemokines. The nodular cells secrete cytokines, including low levels of TNF and IL-33. Addition of IL-33 to mast cells and M(IL-4) macrophages resulted

in secretion of ~50–100 pg/ml TNF. TNF exposure at this concentration led to differentiation only of palmar dermal fibroblasts but not non-palmar fibroblasts from DD patients or palmar fibroblasts from normal individuals into myofibroblasts. The myofibroblasts secreted IL-33 and addition of neutralizing antibodies to IL-33 or small-interfering RNA inhibition led to downregulation of the myofibroblast phenotype, with the combination of TNF and IL-33 inhibition being the most efficacious.

Conclusions: We demonstrate that IL-33 has an important role in perpetuating localised inflammation in DD and targeted inhibition of TNF combined with IL-33 blockade offers a novel therapeutic approach.

A-0007 The indications, operative technique, and outcomes for 267 dermofasciectomy with advanced Dupuytren's disease

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Dermofasciectomy is regarded by many hand surgeons as a revision procedure for those patients with recurrent disease only. We sought to explore the existing literature and evaluate the historic outcomes achieved with this technique. We commonly use the dermofasciectomy technique as a primary procedure, especially in those patients demonstrating aggressive, bilateral disease with dense cutaneous involvement. On review of 267 dermofasciectomy performed by a senior hand surgeon and his supervised registrars, we found no evidence of disease recurrence under the graft. There were only 3 (1.1%) graft failures; 2 (0.7%) patients demonstrated junctional disease recurrence and 9 (3.4%) patients required z-plasties for tight linear scars. This has led to a more aggressive resection techniques ensuring regional excision extend to the mid-axial line of the digit and beyond the cordal disease. All patients were followed up for 2 years with a good functional outcome.

A-0017 The using of perforator-based bilobed flap in reconstruction of complex hand defects

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Introduction: Complex defects in the hand, and especially in multiregion, continue to be a challenging task for hand surgeons. The bilobed flap was first

designed by plastic surgeons, using the small lobe to cover the first donor site which left by harvesting the larger lobe. Our refinement with the bilobed flap is to harvesting a double-lobe flap on a single perforator. The purpose of this study is to describe the anatomy, flap design, and the technique of the perforator-based bilobed flap in the reconstruction of complex hand defects.

Patients and methods: A total of 22 patients with complex soft tissue defects of hands were included from March 2006 to Dec 2015. There were 13 males and 9 females. The main etiology was work-related injury. The donor sites included lower extremity which uses the perforator of the peroneal artery and dorsum pedis which uses the perforator of the dorsalis pedis artery. Donor site is covered with split thickness skin graft. Postoperative follow-up period was 10 to 22 months.

Results: The procedure is uneventful in all 22 cases. Complete survival was achieved in 21 cases, and partial flap necrosis occurs in 1 cases due to venous congestion. Secondary healing was achieved with dressing change. No complications were noted during the follow-up.

Conclusion: The advantages of the perforator-based bilobed flap include (1) enlarge area of flap harvesting, (2) reliable blood supply, (3) flexible in flap design and inset, and (4) reduce donor site morbidity by preserving the main artery for its entirety. We believe that the perforator-based bilobed flap can provide a good alternative to some other sophisticated free flaps.

A-0018 Stop neuroma: Surgical treatment of symptomatic neuroma

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Objective: Symptomatic end neuroma may develop after a nerve dissection following any trauma to a peripheral nerve. The incidence of symptomatic neuromas after peripheral nerve injury is estimated to be 3–7%; however, certain surgeries (neurectomy, autograft procedures, and digital amputations) may have an incidence rate up to 30%. Neuroma-induced neuropathic pain and morbidity seriously affects patient's daily life and socioeconomic functioning.

There are several surgical procedures possible to treat symptomatic end neuromas, but none are considered gold standard for both treatment and prevention. The most common procedure is surgical removal of the neuroma and surrounding scar tissue and placing the proximal stump into an area subjected to minimal mechanical stimulation. Unfortunately, patients with symptomatic neuromas have an average of 2.8

reoperations to treat pain, and surgeries have a failure rate of 10% or more.

A resorbable poly-DL-lactide-caprolactone nerve capping device has been developed for treatment of neuromas (Polyganics, The Netherlands). By implementing this conduit with a closed end (cap), it is expected that the amount of axonal sprouting is lowered due to the fact that neurotrophic hormones cannot easily reach the nerve stump. Also, the material is known for formation of a thin organized fibrotic layer around the cap, which lowers the risk of adhesion of the nerve stump in scar tissue and sensory reinnervation of the overlying skin.

Methods: A prospective European multicentre, non-randomized trial has been started in which patients with primary or secondary end neuroma of the upper limb are enrolled. Diagnosis was confirmed with a nerve block. Postoperative VAS pain score, Quick DASH score and use of pain medication were monitored. Follow-up will be 1 year.

Results: Ten patients will be enrolled in total. The preliminary results of the first seven patients are known at this moment. Four patients were treated for an SRN neuroma, two had a neuroma of the dorsal branch of the ulnar nerve and one had a radial nerve neuroma. Mean VAS score decreased significantly (69 mm before surgery and 26 mm at 6 months FU). Also, Elliot score decreased significant (12 preoperatively and 5 at 6 months FU). No adverse events have been encountered.

Conclusions: Several surgical techniques have been described for treatment of end neuroma. Ranging from simple excision up to covering the nerve end by a microsurgical flap. Using the Neurocap® device is simple. No extra tissue has to be sacrificed. All patients showed a significant decrease in pain after surgery. No serious adverse events have been seen, and the preliminary results are very promising. A postmarketing surveillance study has been started.

A-0019 A randomized controlled trial of ultrasound-guided cubital nerve block for management of distal radius fractures

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Objective: Distal radius fractures are commonly treated nonoperatively through closed fracture reduction. Analgesia during this procedure is usually provided through injection of a local anesthetic into the fracture hematoma. Despite a fracture hematoma block (FHB), pain during fracture reduction is

still quite extensive for patients. In this study, we compared analgesia effects of the FHB, to an ultrasound-guided peripheral nerve block at the elbow, the cubital nerve block (CNB).

Methods: Patients with a radiographic-proven dislocated distal radius fracture were included and randomized for either FHB or CNB. After randomization, pain was sequentially measured through a numeric rating scale (NRS): during physical examination, analgesia procedure, finger-trap traction, fracture reduction, after cast application, and after control radiography. The degree of fracture reduction and loss of reduction during follow-up (1 week, 5 weeks, and 3 months after trauma) was measured using plain wrist radiographs. Functional outcome was measured through quickDASH and PRWE questionnaires, physical examination, and JAMAR grip strength test. And patients were inspected for signs of complex regional pain syndrome (CRPS): edema, hyperesthesia or allodynia, skin color, and trophic changes (e.g. hair and nails).

Results: Fifty patients were included: 25 patients were enrolled for FHB and 25 patients for ultrasound-guided CNB. Pain during physical examination was comparable between both the groups ($p = 0.89$). CNB-treated patients experienced less pain during analgesia procedure ($p = 0.002$), finger-trap traction ($p = 0.007$), fracture reduction (0.00001), after cast application ($p = 0.01$), and after control radiography ($p = 0.01$). Radiographic control after fracture reduction showed a slightly more optimal correction of palmar tilt ($p = 0.07$) and radial height ($p = 0.03$) for CNB-treated patients. However, this effect was lost after 1 week of follow-up. There were no differences between both groups with regard to functional outcome. Also, no patients were identified with signs of CRPS in either group.

Conclusions: Analgesia for nonoperative management of distal radius fractures is more optimally achieved with ultrasound-guided CNB. It is previously stated that more optimal analgesia allows superior fracture reduction due to more proper muscle relaxation. This study supports this theory immediate after fracture reduction; unfortunately, this effect is lost during follow-up. Furthermore, not all patients were completely pain free. In CNB, the radial, median, and ulnar nerves are blocked above the elbow. However, the musculocutaneous nerve is not treated. This nerve innervates the lateral side of the forearm, and exclusion of this nerve might explain why several CNB patients still experience extensive pain during fracture reduction. Additional analgesia of this nerve might enhance the effect of CNB for patients suffering a distal radius fracture.

A-0020 Distal pin length of locking plate for distal radius fracture: Ordinary vs shorter

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Objective: Locking plate fixation for distal radius fracture is widely accepted; however, postoperative extensor pollicis longus tendon rupture was reported by some authors. Recently, we changed the distal locking pin length shorter in order to prevent extensor tendon rupture. This study compared plate stabilities of ordinary or shorter distal locking pin after volar locking plate fixation for distal radius fracture.

Methods: A retrospective, noninferiority trial included 53 adults patients (54 wrists) treated with a volar plate with ordinary or shorter distal locking pins. Ordinary pin group (distal locking pin length is just below dorsal cortex), 34 wrists, and shorter pin group (in advance, each pin length was decided by approximately 80% of the volar-dorsal length of the distal radius, referring to lunate length on lateral X-ray), 20 wrists, were included. The radiographic changes between just postoperation and the final follow-up were compared among two groups. The primary end point was the increase in ulnar variance, with a noninferiority margin of 1.0 mm. Secondary end points included the changes in volar tilt and radial inclination.

Results: Ulnar variance extended 1.0 mm in the ordinary group and 0.6 mm in the shorter group (90% confidential interval, 0.0–1.0; $p = 0.18$). The change in volar tilt was 1.2° in the ordinary group and 0.1° in the shorter group ($p = 0.71$). The ordinary group had 0.1°, and the shorter group had 0.1° in loss of radial inclination ($p = 0.41$). All three measurements had no significant differences in the two groups.

Conclusions: Shorter locking pins of volar locking plate were not inferior to ordinary length locking pins in terms of postoperative stability for distal radius fracture. To prevent extensor tendon injury, shorter distal locking pins can be a better option of volar locking plate fixation for distal radius fracture.

A-0021 Staged Finkelstein test for identification of intracompartmental septum in patients with deQuervain's disease

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Introduction: The intracompartmental septum isolating extensor pollicis brevis (EPB) has been reported to affect the patient's response to nonsurgical treatment in de Quervain's disease. Simple physical examination, the so-called staged Finkelstein test, was developed to evaluate the septum, and the result of this test was compared with those of preexisting physical examination (EPB entrapment test) and ultrasonographic (US) examination of the septum.

Materials and methods: We retrospectively analyzed 52 patients who underwent two clinical test, including staged Finkelstein test and EPB entrapment test, and US examination for de Quervain's disease. In the first stage of staged Finkelstein test, only the wrist is deviated to ulnar side, and the intensity of pain was recorded. In second stage, thumb was further passively flexed to differentially load to EPB, and if the pain elicited by second stage is greater than first stage, we assumed that there might be septum. Clinical tests were correlated with US finding and sensitivity, specificity as well as positive and negative predictive values were calculated.

Results: The proportion of wrists with a separate septum was 50% (26 patients) in US examination. The sensitivity and specificity of staged Finkelstein test were 88.5% and 73.1%, respectively. Those of EPB entrapment test was 71.4% and 84.2%, respectively. The positive and negative predictive values of staged Finkelstein test was 76.7% and 86.4%, respectively.

Conclusion: Staged Finkelstein test has acceptable diagnostic value for the diagnosis of septum compared with preexisting physical examination.

A-0022 A computational musculoskeletal model of the PIP joint generated with anatomical data from MR, CT and optical motion capture

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Introduction: The PIP joint is complex, with movement and stability controlled by bone contour, ligament tension and a kinetic chain of intrinsic and extrinsic tendons. PIP joint replacement has an uncertain outcome and high failure rate, compromised by

- disruption to normal anatomy by disease,
- surgical inaccuracy in reproducing joint kinematics and
- imperfect prosthetic joint geometry

Better understanding of the complex joint dynamics in health, disease and after arthroplasty through computational modelling will contribute to improved outcomes.

Method: We are developing a computational musculoskeletal model of the index finger which includes

- tendon-muscle: intrinsic and extrinsic muscles;
- ligaments: ulnar and radial collateral ligaments, volar plates and retinacular ligaments and
- bone: distal end of ulna and radius and carpal bones and phalanges.

In 7 healthy volunteers, we obtained bone and soft tissue data from CT and MR and hand kinematics from optical motion capture. All data were acquired in extension, partial flexion and flexion, standardised with 3D printed jig. Using enhanced motion capture markers and AnyBody's force dependent kinematics (FDK), the simulated PIPJ model includes rotations and translations, thus more physiologically accurate than existing models.

Result: We will present high-resolution dynamic 3D images representing the complexities of the PIPJ and its supporting soft tissue structures.

Conclusion: This model will allow better understanding of the PIPJ in health and disease. Pre-operative modelling will inform more accurate surgical cuts and even bespoke implant design. Post-operative analysis of failed arthroplasty will lead to better understanding of the bone and soft tissue imbalances and implant flaws that contribute to failure

A-0023 The efficacy of a scaffold-free Bio 3D conduit on peripheral nerve regeneration in a rat sciatic nerve model

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Objective: Although autologous nerve grafting is the gold standard treatment for peripheral nerve injuries, several alternative methods have been developed, including nerve conduits that use supportive cells. However, the seeding efficacy and viability of

supportive cells injected in nerve grafts remain unclear. Synthetic nerve conduits are also associated with a risk of infection and low biocompatibility. To address these potential problems, we focused on the novel technology of Bio 3D printing and created a completely biological, tissue-engineered, and scaffold-free conduit (Bio 3D conduit). The purpose of this study was to evaluate the efficacy of a scaffold-free Bio 3D conduit on peripheral nerve regeneration in a rat sciatic nerve model.

Methods: We developed six scaffold-free conduits from human normal dermal fibroblasts using a Bio 3D Printer. After mid-thigh-level transection of the right sciatic nerves of rats with immune deficiency, we bridged the nerves with a 5-mm interstump gap using the Bio 3D conduits (Bio 3D group, $n = 6$). In the control group, same size silicone tube was interposed in the same procedure (silicone group, $n = 6$). Several assessments were conducted to examine nerve regeneration 8 weeks postsurgery. Data were analyzed by using Student t test. Values of $p < .05$ were considered statistically significant.

Results: Electrophysiological studies revealed significantly higher compound muscle action potential in the Bio 3D group than the silicone group ($54.4\% \pm 7.0\%$ vs. $2.93\% \pm 1.84\%$, $p < .01$). The kinematic analysis revealed that the toe angle to the metatarsal bone at the final segment of the swing phase was significantly greater in the Bio 3D group than the silicone group (-35.78 ± 10.68 vs. -62.48 ± 6.15 , $p < .01$). Morphometric studies revealed that the Bio 3D group exhibited a significantly greater myelinated axon number compared to the silicone group (6516 ± 1694 vs 2536 ± 1020 , $p < .01$). The wet muscle weight of the tibialis anterior muscle in the Bio 3D group was significantly greater than that in the silicone group (0.544 ± 0.070 vs 0.396 ± 0.001 , $p < .01$).

Discussion and Conclusion: We confirmed that scaffold-free Bio 3D conduits composed entirely of fibroblast cells promote peripheral nerve regeneration in a rat sciatic nerve model. Further studies of the Bio 3D conduits using support cells (e.g. bone marrow stromal cells), and their application for a longer peripheral nerve gap, are warranted. There are several limitations associated with the current study. First, the number of rats in each group was small. Second, the 5-mm nerve gap was not long enough to assess the efficacy of the Bio 3D conduit. Finally, the duration of the observation period after transplantation was insufficient to evaluate nerve function. Bio 3D printing technology has been used in several fields and may be also useful for several neurological disorders, including brachial plexus injuries and severe trauma, in which nerve grafts are needed to treat peripheral nerve defects.

A-0026 Risk factors to develop complex regional pain syndrome type I in patients with fracture of the distal radius

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Purpose: To investigate the role of psychological factors (anxiety and depression) and pain measured on a visual analogue scale (VAS) in the development of complex regional pain syndrome type I (CRPS I) following the fracture of the distal radius.

Methods: A consecutive sample of patients ($N = 60$) with a distal radius fracture was measured for signs of CRPS by Budapest criteria weekly till 8 weeks and then another follow-up 1 year after injury. The patients were treated by closed reduction, cast immobilization, pin stabilization, and/or open reduction and internal fixation. The Beck Depression Inventory-short form, State-Trait Anxiety Inventory, and Numerical pain rating scale were used to determine the patients' psychological features and pain intensity at the baseline and 8 weeks after the fracture.

Results: CRPS I developed in 15 (25%) patients after 8 weeks and just last in 12 (20%) patients after 1 year. No difference was found between the two groups in terms of state (STAI-I) and trait (STAI-II) anxiety and BDI score. Pain was the most important risk factor in developing CRPS (odds ratio [OR] =1.52; 95% confidence interval).

Conclusions: After fracturing the distal radius, patients who have high pain intensity have a higher risk of developing CRPS I. Following these patients closely for the development of CRPS I may be advantageous for early preventative and therapeutic interventions.

A-0039 K wires: To bury or not to bury

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Objective: Infection is the most common complication associated with K wire placement and may range from minor superficial erythema to devastating osteomyelitis. It has been theorized that burying the K-wire under the skin may reduce this risk. Surveys have shown that surgeon preference remains a strong predictor of the fact that a K wire is buried or not. However, there is a paucity of literature that correlates the risk of infection with burying the wire.

Methods: We reviewed a series of 206 consecutive patients who underwent K wire insertion for various conditions in the hand over a period of 12 months at University Hospital Birmingham and compared the rate of infection between buried and unburied wires. Infection was defined and classified according to Oppenheim Classification. Variables such as type of injury, associated comorbidities and time to wire removal were all explored to identify any confounding factors.

Results: Seventeen percent of unburied wires developed some form of infection in contrast to 3% of buried wires. There was no significant association identified with type of injury, comorbidities, or time to wire removal. One patient required amputation while all others recovered with wire removal and antibiotics.

Conclusion: Burying of K wires was found to be the single prevalent predictor of pin-track infection. Although this necessitates a second surgical procedure for removal, we recommend that K wires should be buried under the skin.

A-0040 Outcomes of zone 2 flexor tendon repairs using a most updated treatment protocol in 60 fingers

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Objective: We report the functional outcomes of zone 2 flexor tendon repair using a multistrand core suture repair followed by early active digital flexion protocol and compared them with an earlier group of repairs using a two-strand core suture repair with early passive motion protocol.

Methods: From January 2014 to April 2016, we performed primary or delayed primary repair of completely divided zone 2 flexor digitorum profundus (FDP) tendon in 60 fingers in 41 patients using a most updated treatment protocol. These included 19 index, 17 long, 14 ring, and 10 little fingers in 27 men and 14 women. Their mean age was 37 years (16–60 years). Four patients had flexor tendon repairs in two fingers, six had tendon injuries in three fingers, and one had tendon injuries in four fingers. Thirty-nine fingers had associated digital nerve or artery injuries. All repairs were performed within 7 days after injury except two cases. We repaired the FDP tendons using either a six-strand M-Tang or a four-strand U-shaped Tang core suture with 4-0 looped sutures, followed by a running peripheral suture using a 6-0 nylon suture. Active flexion exercise was initiated in all fingers from day 3 to 5 after repair. We did not repair the

superficialis tendon in any patients and vented the entire A4 pulley in 14 fingers and a part of the A2 pulley in 40 fingers when necessary. A digital extension–flexion test was always performed after tendon repair. We further analyzed a group of zone 2 flexor tendon repairs in 26 fingers of 18 patients which we treated from January 2013 to December 2013 before adopting the updated protocol. In all these fingers, a two-strand modified Kessler technique with 4-0 suture and a running peripheral suture with 6-0 suture were used, followed by early passive digital motion. We did not pay attention to vent the A2 or A4 pulleys and nor did we perform the extension–flexion test after repair. All patients with two different treatment protocols were followed for 6 months to 2 years. The outcomes were evaluated with Strickland criteria or Tang criteria and compared.

Results: All 60 fingers treated with the updated protocol had no repair rupture. In contrast, among 26 fingers with a 2-strand repair and early passive motion, repair rupture was found in 5 fingers (19%). According to the Strickland or Tang criteria, the excellent and good rate was 86% in the fingers treated with the updated protocol but was 65% in the fingers with a 2-strand Kessler repair and early passive digital motion. The differences in the excellent and good rates and active range of motion were statistically significant ($p < 0.05$, both comparisons).

Conclusions: In zone 2 digital flexor tendon repair, strong multistrand core suture repair, pulley venting, digital extension–flexion test, followed by postoperative early active digital motion significantly improves outcomes over a tendon repair with a conventional two-strand repair, no specific attention to pulley venting, without performing extension–flexion tendon during surgery, and early passive motion.

A-0042 Joint distraction for thumb carpometacarpal osteoarthritis: A feasibility study with 2 years follow-up

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Objective: First carpometacarpal (CMC1) osteoarthritis affects 36% of people over 55 years of age. After failed conservative treatment multiple operative interventions can be performed, however, no single operative technique has gained fully satisfactory

results. Joint distraction has been used to treat osteoarthritis in knee and ankle joints with good results, but it has not yet been applied to CMC1 joint osteoarthritis. The purpose of this pilot study was to evaluate the feasibility of joint distraction of the CMC1 joint in patients with CMC1 osteoarthritis. We hypothesized that patients treated with CMC1 distraction will experience less pain and better function after the distraction period.

Methods: Five patients with radiologically confirmed Eaton Glickel grade II or III osteoarthritis who were considered for operative treatment after failed conservative management were treated with joint distraction instead. Age over 65 years, grade IV disease, or > 30% joint subluxation were among the exclusion criteria. An external joint distractor was placed over the CMC1 joint by K-wire fixation in the trapezium and the first metacarpal. The joint was distracted 3 mm during surgery. The device was kept in place for 8 weeks before removal in the outpatient office. Disabilities of the Arm, Shoulder and Hand (DASH) score, Michigan Hand Outcome Questionnaire (MHQ), Visual Analogue Scale (VAS) for pain, and grip strength were recorded preoperatively and at set postoperative intervals.

Results: Five female patients with an average age of 53 years (range 41–61) were included. Two years postoperatively, average DASH, MHQ, and VAS scores improved compared to preoperative values; DASH 53–19, MHQ 48–80, and VAS pain 48–17. Strength measurements also improved. There were no technical problems associated with the device. One patient had a local pin site infection treated successfully with oral antibiotics.

Conclusions: Joint distraction of the osteoarthritic CMC1 joint is technically feasible. In this small, prospective pilot study the results were favorable with less pain and better function for at least 2 years. The results of this study are promising and inspire us to continue research on this operation technique.

A-0044 Favorable outcome of the modified Graner procedure for the advanced Kienböck's disease

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Objective: Kienböck's disease is caused by aseptic necrosis of the lunate. In the advanced stages of the disease, carpal collapse, joint incongruity, and osteoarthritis develop. We performed lunate excision, capitate osteotomy, and intercarpal arthrodesis (the modified procedure of Graner et al.) on 15 patients with advanced Kienböck's disease.

Methods: The subjects ranged in age from 19 to 75 years (mean, 50 years) at the time of surgery. We evaluated the results after 1 year or more, postoperatively (range, 12 to 123 months postoperatively; mean, 66.8 months postoperatively). The Lichtman classifications were graded as Stage III in 12 of the patients with the rest as Stage IV.

Surgical procedure: A skin incision was made on the dorsal side of the radiocarpal joint, and the extensor retinaculum was incised longitudinally between the third and the fourth compartments. After excision of the collapsed lunate, the capitate was osteotomized and the proximal pole was shifted proximally into the lunate fossa. The articular cartilage of the carpal bones surrounding the capitate were excised at all intercarpal joints. The shifted capitate and the other carpal bones were fixed with Kirschner wires, while the dorsiflexed, intercalated segment instability was kept under reduction. Cancellous and cortical bone grafts obtained from the iliac crest were placed in the empty spaces among the remaining carpal bones and used to fill the gap created by the osteotomy of the capitate. The Kirschner wires were removed 3 months postoperatively. After removal of the wires, an exercise program of wrist motion was started and return to work was permitted. Therapeutic results were evaluated according to the scoring system of Evans et al (pain, range of motion of the wrist, grip strength, and return to work) and radiological evaluation (union, osteonecrosis of capitate, and degenerative change).

Results: Pain disappeared after surgery in most patients with the rest experiencing a reduction in pain intensity to a mild level. All patients returned to their original jobs. The grip strength on the affected side had recovered to about 80% of that on the unaffected side. The range of wrist arc (flexion and extension) had recovered to about 85 degrees. The Evans score results were graded as good in eight of the patients, fair in six, and poor in one. Postoperative radiographs showed that no nonunion and necrosis of the capitate were present. Radiographic, osteoarthritic changes occurred in almost all patients, but, except for moderate limitation in range of motion at the wrist joint, these findings did not affect the level of pain, grip strength, or activities of daily living.

Conclusions: Lunate excision followed by capitate osteotomy and intercarpal arthrodesis (the modified

procedure of Graner et al) is a reliable and favorable form of treatment for advanced Kienböck's disease.

A-0045 High precision of model-based RSA in total wrist arthroplasty

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Objective: Radiostereometric analysis (RSA) is a useful tool to study micromotion of joint implants, allowing the prediction of future implant loosening, and thereby detection of low performance arthroplasties. RSA has never been used in total wrist arthroplasty (TWA). We performed a precision study to investigate the feasibility of model-based RSA in two different wrist arthroplasties using reverse-engineered (RE) models.

Methods: RE models of both radial and carpal/metacarpal Remotion® and Motec® TWA components were obtained by laser scanning. One of each implant were solidly fixed in sawbone phantoms, and 10 RSA double examinations with the phantoms in slightly different positions, simulating a clinical situation, were performed. In addition, 34 clinical double examinations in 25 patients (19 Remotion and 15 Motec) participating in an ongoing RCT were obtained by reassembling all equipment and repositioning the patients between examinations. Precision for each of the 4 implants (Remotion radial and carpal, Motec radial, and metacarpal) was calculated for x-, y-, z-translation (mm) and x-, y-, z-rotation (°) as mean absolute value + $t(n-1) 0.005 \times \text{SD absolute value of differences between double examinations}$, where t is the critical value of the 99% confidence level with $n-1$ degrees of freedom. Measured movements above the precision values are certainly caused by true motion and not by measurement error. Since precision differed among the four implants, we present the result of the implant with lowest (poorest) precision for each translation and rotation. Condition numbers (CN) representing the spatial distribution of tantalum bone markers, and thereby influencing the precision, are presented (CN < 150 is recommended). Due to symmetry along the y-axis, y-rotation of Motec is not measurable.

Results: Phantom study translations: Lowest precision along the x-axis was 0.17 mm (Motec metacarpal), y-axis 0.18 mm (Motec metacarpal), and z-axis 0.18 mm (Remotion carpal / Motec metacarpal). Phantom study rotations: Lowest precision along the x-axis was 0.84° (Motec metacarpal), y-axis 1.88° (Remotion radial), and z-axis 0.73° (Motec radial).

Clinical study translations: Lowest precision along the x-axis was 0.17 mm (Motec metacarpal), y-axis 0.17 mm (Motec metacarpal / Motec radial), and z-axis 0.33 mm (Remotion carpal).

Clinical study rotations: Lowest precision along the x-axis was 1.13° (Remotion carpal), y-axis 3.09° (Remotion carpal), and z-axis 0.94° (Remotion radial). Condition numbers differed between 50 (SD 14) (Remotion radial) and 111 (SD 46) (Motec metacarpal).

Conclusions: We found a high precision of model-based RSA in TWA, making the method feasible for clinical use. Precision was better in the phantom experiment than the clinical study and better for in-plane x- and y-translations than for out-of-plane z-translations. Precision was better for the radial than for the carpal/metacarpal component in both arthroplasties due to more visible bone markers and a more favorable scattering of markers in the radius than in the smaller capitate/3. metacarpal (lower radial CN's). Rotational precision, especially along the y-axis, was generally poorer than translational owing to relatively high condition numbers, which are known to affect rotation more than translation.

A-0048 Wide Awake Local Anesthesia with No Tourniquet (WALANT): How it changed my practice for the better, the faster, and the cheaper!

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Background: The Wide Awake Local Anaesthesia with No Tourniquet (WALANT) concept has been proven to be an efficient, safe, and cheap method to operate on various hand pathologies and trauma. We describe our experience with this method in a regional, private health-care hand surgery unit

Objectives: To show our results with the utilization of the WALANT method in aspects of patient satisfaction, safety as well as cost reduction.

Study Design and Methods: In this retrospective study, we present our results from over 100 cases treated with this method in aspect of patient satisfaction, outcomes/complications as well as cost-effectiveness. Cases treated range from carpal tunnel decompressions to ORIF of metacarpals or phalanges using plates and screws, lateral epicondylitis debridement, cubital tunnel releases as well as trapeziectomies. The method followed was administration of local anaesthesia (lidocaine with 1:100000 adrenaline) in the area of the procedure, as advocated by Lalonde et al. No tourniquet was used during the procedure. All the patients were operated on an

ambulatory surgery setting and were discharged immediately after the procedure.

Results: There was a high satisfaction rate among patients, as the procedure was comfortable even for lengthy procedures. Only one patient required sedation during the procedure due to a panic attack and not due to pain. We only had one complication (an infection) which was irrelevant to the method as well as a laceration to a digital nerve. Additionally, there was a significant reduction in costs compared to other methods of anaesthesia, as no anaesthetist is needed as well as no hospitalization for recovery. The mean reduction in costs was 75%, making many procedures affordable for noninsured patients.

Conclusions: The WALANT method of performing hand surgery cases is a safe, efficient as well as cost-effective method and needs very little training as well as very little resources in order to be implemented. It can allow noninsured self-paying patients access to *private health care* in countries that do not provide universal health coverage or in countries where the *public health sector* is severely compromised by long waiting lists.

A-0051 Comparative experimental study of tensile strength in three operative technique for Korean adult metacarpal shaft fracture: A cadaver study

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We purpose to estimate ultimate tensile strength of three operative method of Korean adult metacarpal shaft fracture which are plate fixation, K-wire fixation, and intramedullary headless compression screw. And we intend to compare strong point and weak point of each operative treatment. We acquired 15 metacarpal bones from 2 Korean adult cadaver that have no trauma, operative history, and deformity. Then, we grouped 15 metacarpal bones into 5 groups, each of which was composed of 3 metacarpal bone. Three metacarpal bones were fractured, reduced, and fixed with plate and screws, K-wire, and headless compression screw. We practiced experiment with force testing product and acquired ultimate tensile strength and stress-strain graph. We estimate ultimate tensile strength in five groups: plate and screws fixation are 276.54N (176.7-452.4N), K-wire fixation is 148.24N (131.4-175.0N), and intramedullary headless compression screw fixation is 177.68N (119.2-211.7N). The median of three operative treatment shows statistically significant difference.

According to this experimental measurement, plate fixation is the strongest operative method of metacarpal shaft fracture, and intramedullary headless compression screw fixation is stronger than K-wire fixation. Percutaneous K-wire fixation is brief surgical technique and has low infection rate, but fixation strength is weak. Plate fixation is the strongest method among three operative technique so that it can keep reduction firmly. Weak points of this technique are relatively high infection rate, tendon adhesion, relatively long operative time, and difficult operative technique. In comparison, although intramedullary headless compression screw fixation is weaker than plate fixation, and has risk of joint injury in this surgical procedure, this technique is brief and stronger than K-wire fixation so that it can shorten operative time and make the patient initiate postoperative joint exercise immediately. Compared to plate fixation and K-wire fixation, intramedullary headless compression screw fixation has no protrusion in joint space so that joint exercise could be done easily. We suggest that intramedullary headless compression screw fixation is clinically effective and applicable surgical technique in metacarpal shaft fracture.

A-0055 The management of chronic nonarthritic scapholunate dissociation: A systematic review

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Objective: Numerous techniques have been described for the management of chronic nonarthritic scapholunate ligament (SLIL) injury. We conducted a systematic review to identify the best form of management.

Methods: Studies of all languages were identified by searching EMBASE, MEDLINE, and CENTRAL from 1965 to 2016. A study protocol was followed according to the PRISMA-P guidelines. Series with two or more patients were included. We excluded studies that had inadequate follow-up (<6 months), concomitant injuries, scapholunate advanced collapse arthritis, and acute injuries (<3 months). The primary outcome measure was pain. Secondary outcome measures were wrist motion, grip strength, return to preinjury function, scapholunate angle, scapholunate gap, complications, and outcome scores. Abstracts and full-text articles were screened according to study protocol. A narrative synthesis was performed. Quality

assessment was performed using the revised MINORS criteria.

Results: A total of 1191 citations were identified: 695 after removal of duplicates; 17 full-text articles were available for final analysis. Papers were largely uniform in quality. An international set of studies were obtained for analysis (3 United Kingdom, 3 France, 2 Germany, 1 Belgium, 3 United States, 1 Argentina, 2 Australia, 1 Hong Kong, and 1 China). The techniques described were heterogeneous (7 capsulodesis, 3 tenodesis, and 7 other). In total, the study included 233 males, 104 females, and 342 wrists. Regardless of technique, the overall reduction in pain was from 6.0 to 2.8, with a similar effect from capsulodesis ($N = 170$; 50% improvement) and tenodesis ($N = 56$; 52% improvement). Range of motion in radial to ulnar arc was improved in capsulodesis (+19%; $N = 45$) but deteriorated in tenodesis (-6%; $N = 45$) which coincided with better grip strength in capsulodesis (+31%; $N = 64$ vs. +11%; $N = 56$). Scapholunate gap and angle were better corrected with tenodesis methods, but the clinical relevance is difficult to ascertain. The overall complication rate was 20%. Reoperation rate was 6.7%. CRPS occurred in 3.8% of all patients and were higher in the capsulodesis cohort (5.3%).

Conclusions: All interventions suggest an improvement in pain in the short term (2 years). Overall, studies reflect approximately 54% reduction in pain, 24% increase in grip strength, and 18% loss of flexion arc. There is a high complication rate of 20% overall, and the CRPS rate is notable which has important implications for patient consent. We recommend a minimum data set for recording patient outcomes after scapholunate reconstruction to enable consolidation of data for further comparison.

A-0056 Clinical outcome of modified cubital tunnel reconstruction for cubital tunnel syndrome

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Objective: We have performed modified cubital tunnel reconstruction as an operative procedure for cubital

tunnel syndrome (CuTS) secondary to osteoarthritis (OA) or ulnar nerve subluxation (UNS). Characteristically, the ulnar nerve is retained in its anatomical position and protected against trauma. We aimed to determine the efficacy of this procedure.

Methods: Forty-seven patients (mean age, 53.3 years) underwent this procedure between December 2000 and April 2016. There were 37 OA cases and 10 UNS cases. The mean duration of symptoms was 43 months. The mean follow-up period was 23.3 months. The distribution of McGowan (MG) grades of neuropathy was as follows: grade I in 6 patients, grade IIA in 7 patients, grade IIB in 16 patients, and grade III in 18 patients.

Operative procedure: The cubital tunnel was opened, and the ulnar nerve was released. The osteophytes were resected at the bottom of the tunnel, and a groove was created for the nerve using an air drill. Afterward the nerve was placed back into the cubital tunnel.

Evaluation: Postoperative dislocation of the ulnar nerve; muscle strength of first dorsal interosseous (IOD1) and abductor digiti minimi (ADM) muscles by manual muscle testing (MMT); grip strength; sensory impairment; range of elbow extension and flexion (ROM); score on the Disabilities of the Hand, Arm and Shoulder (DASH); and surgical complications were examined. Outcomes were graded according to Wilson and Krout's criteria (WKC).

Statistical analysis: Changes in postoperative scores compared to the preoperative baseline scores were evaluated using paired *t*-test (muscle and grip strength, ROM, and DASH). Spearman's rank-order correlation was used to evaluate the relationship between MG and WKC grades, with between-grade differences evaluated using a Mann-Whitney *U* test. Kruskal-Wallis test was used to evaluate distribution of age and duration of symptoms between each outcome groups (excellent, good, and fair). Between-group differences were evaluated using a Mann-Whitney *U* test. For all analyses, $p < 0.05$ was considered significant.

Results: Postoperative ulnar nerve dislocation was not observed. Mean muscle strength of IOD1 and ADM increased postoperatively ($p < 0.01$; 3.0 ± 1.4 to 4.3 ± 0.9 MMT and 3.0 ± 1.3 to 4.2 ± 1.1 ADM, respectively). Grip strength increased from 22.6 ± 11.9 to 31.4 ± 11.2 kg ($p = 0.02$). ROM was not changed (extension, $11.3^\circ \pm 10.8^\circ$ to $7.5^\circ \pm 7.3^\circ$, $p = 0.11$; flexion, $126.3^\circ \pm 14.5^\circ$ to $130.4^\circ \pm 10.7^\circ$, $p = 0.22$). Sensory impairment reduced in 41 patients. The DASH score showed improvement (24.5 ± 14.7 to 4.4 ± 3.4 , $p < 0.01$). Clinical outcomes were excellent in 26 patients, good in 7, and fair in 14. As a complication, three patients sustained a medial epicondyle fracture.

The WKC grade was correlated with the MG grade ($p < 0.01$, $r = 0.56$). As for between-grade differences, outcomes for MC grades I and IIA were superior to those for grade III ($p = 0.04$ and 0.02 , respectively). Age distribution was significantly different ($p = 0.01$). Particularly, patients in the excellent group were younger than those in the fair group ($p = 0.021$). There was no significant difference in symptom duration between the groups ($p = 0.39$).

Conclusion: Modified cubital tunnel reconstruction was an effective operative procedure. Outcomes were better in younger patients and patients with mild preoperative symptoms.

A-0057 Plate osteosynthesis of proximal ulna fractures: A biomechanical micromotion analysis

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Purpose: Double plating has been promoted in recent years as an alternative treatment method for proximal ulna fractures. This study aimed to compare the biomechanical properties of double plate osteosynthesis with posterior plate fixation by means of a novel investigational design using a 3D camera system to analyze fracture micromotion.

Methods: Fourteen fresh-frozen specimens were available for this study. Mayo type IIA fractures of the olecranon were created, and internal fixation was performed with either an angular stable posterior plate (VariAx Olecranon Plate, Stryker) or with angular stable double plates (Olecranon Double Plating System, Medartis). Fracture micromotion was evaluated by means of digital image correlation with a 3D camera system before and after dynamic cyclic loading from 15° to 90° of elbow flexion with a pulling force of 25 N to 80 N.

Results: Overall, micromotion of fragments was less pronounced in double plate osteosynthesis when compared to single plates before and after cyclic loading. However, significant differences could not be

obtained. None of the double plates but two of the single plates failed during cyclic loading.

Conclusions: This biomechanical analysis shows that single and double plating results in comparable stability of fixation. While the double plating technique tends to provide more stable fixation, these findings were not significant.

Clinical Relevance: Double plating potentially represents an efficient option for fixation of proximal ulna fractures. It could decrease the risk of soft tissue complications due to their low profile and the superior soft tissue coverage.

A-0059 Ultrasound-guided de Quervain tendon release: Feasibility study and clinical results

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Objective: Hand tenosynovitis-like trigger fingers have been successfully treated with ultrasound-guided percutaneous procedures. The hypothesis of authors was the de Quervain's syndrome could be successfully treated with a specific ultrasound-guided percutaneous procedure, as it is for trigger finger. Authors proposed to assess, in an anatomic study, the feasibility and safety of a new and specific procedure to perform an ultrasound-guided percutaneous release for de Quervain's syndrome and then to assess its efficiency in a clinical prospective series ($n = 11$).

Method: I-Cadaveric lab ($n = 14$): 14 specimen wrists were analysed with ultrasound. We used a specific blade (1.8-mm thin, nondisposable, blunt tip) and an ultrasound device with a high frequency transducer (22 MHz). We performed a 1.5-mm incision 5 mm proximal to the trapezio-metacarpal joint enabling a retrograde section of the two parts of the first retinaculum compartment during an in-plane approach. Then, in every case, we evaluated, with an open approach, the efficiency of the release and safety for the superficial nerves.

II-Prospective clinical series ($n = 11$): Under local anesthesia, 11 patients were operated on, and we reported the outcomes concerning morbidity and efficiency. Dressing was kept for 1 day. Clinical examinations with VAS were performed pre-operatively and post-operatively after 1 and 3 months.

Results: I-Cadaveric lab ($n = 14$): Authors were able to identify with ultrasound the type of first compartment septation (subcompartmentalization) in 13 cases ($n = 14$). The misidentification induced one incomplete release. No damages of the superficial radial nerve were observed despite close relationship.

II-Clinical series ($n = 11$): The duration of surgery was 10 min (5-18), and no kind of morbidities was noticed and no sensitive disorders. All patients were improved and satisfied, but one patient was still painful after 3 months (VAS = 3) in strength work only.

Conclusion: Ultrasound-guided percutaneous release in the de Quervain's disease is a safe and reliable procedure without specific morbidity, but care should be taken to avoid superficial nerves and to identify with ultrasound the correct type of subcompartmentalization.

A-0060 Endoscopic denervation of the wrist: Anatomic feasibility and clinical outcomes

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Objective: Concerning wrist surgery, arthroscopic procedures have increased their indications, but not yet for the denervation technique, which is a common and useful procedure^{1,2,3,4} performed alone or associated with another wrist procedure.^{5,6} Our objectives were to evaluate, in an anatomic study, the feasibility and safety of an arthroscopic selective denervation of the wrist and then to assess its efficiency in a clinical prospective series.

Methods: Cadaveric lab: Five specimens were operated on both sides ($n = 10$). We used a 1.9-mm arthroscope with 35 mm Hg pump pressure, 2- and 3-mm shaver blades, and 2 dorsal portals (one ulnar and one radial) located on the same line 2.5 cm proximal to the Lister's tubercle.⁷ Under arthroscopy, we performed an identification and excision of the posterior interosseous nerve and also the anterior interosseous nerve through the interosseous membrane,⁸ followed by a periosteal excision of the dorsal part of the radius and cubitus. We secondly performed an open control to assess the efficiency and safety.

Prospective clinical series: Fourteen patients were included: 11 arthritis^{6,9} (five SNAC, four SLAC, and two postradius fracture arthritis), 1 Kienbock's disease,¹⁰ and 2 midcarpal instabilities.¹¹ The arthroscopic denervation was always associated with a synovial arthroscopic wrist debridement (four styloidectomies, one ossification excision, three ligament shrinking, and six debridement only). The articular arthroscopy was performed first and then the selective denervation. Clinical examinations with DASH and Mayo Wrist Score were performed preoperatively and postoperatively.

Results: Cadaveric ($n = 10$):

-Efficiency criteria: A 8-mm-length excision of both interosseous nerves was possible in all cases. The

periosteal excision was continuous with a transversal 6-mm-width strip for all.

-Safety: No morbidity on extensors or radial branches was reported.

Per-operative ($n = 14$): The average duration was 24 min (18–35) for the denervation and 42 min (15–98) for the articular arthroscopy, identification, and excision of the two interosseous nerves were performed in all cases.

Clinical outcomes ($n = 14$):

-Efficiency: MayoWristScore went from 15 preop to 60 postop, DASH went from 65 preop to 36 postop.

-Safety : No tendinous or sensitive skin disorders was observed.

Summary Points: This study confirmed the feasibility and safety of an endoscopic selective denervation. Efficiency is present, but further investigations are needed to determine which part of the efficiency is due to the intra-articular wrist surgery or to the selective denervation. A selective endoscopic denervation of both interosseous nerves can be associated with various types of arthroscopic surgery, which extends the therapeutic arsenal of wrist arthroscopy.

A-0068 Comparative outcome analysis of arthroscopic-assisted versus open reduction and fixation of trans-scaphoid perilunate fracture dislocations

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Purpose: To compare union rates and clinical and radiological outcomes of arthroscopic-assisted reduction and fixation with those of open reduction and fixation in patients with trans-scaphoid perilunate fracture dislocations.

Methods: This retrospective study included consecutive patients with trans-scaphoid PLFDs who underwent arthroscopic-assisted reduction and fixation (group A) or open reduction and fixation (group O) and who were followed up for a minimum of 2 years between May 2005 and March 2013. We excluded initially missed patients. Each different surgeon who was on call had performed each experienced operation. These clinical outcomes were assessed: range of motion, grip strength, Mayo wrist score, and Disabilities of Arm, Shoulder, and Hand (DASH) score. For radiologic outcomes, the scapholunate angle, radiolunate angle, and lunotriquetral distance were measured.

Results: The total number of included patient was 20 (11 in group A and 9 in group O). Scaphoid union occurred in all patients except one individual (11 of 11

in group A, and 8 of 9 in group O). At the last follow-up, the mean flexion–extension arc was significantly greater in group A (125.0°) than in group O (105.6°) ($p = 0.028$). The mean grip strength was 81.1% that of the contralateral side in group A and 80.9% in group O ($p = 0.594$). The mean Mayo wrist score was 85.5 in group A and 79.4 in group O ($p = 0.026$), and the mean DASH score was 10.6 in group A and 20.8 in group O ($p = 0.001$); however, only the DASH score showed a minimum clinically important difference. The mean scapholunate angle, radiolunate angle, and lunotriquetral distance were similar between the 2 groups: 47.2°, 1.7°, and 2.0 mm in group A and 48.8°, 5.6°, and 2.1 mm in group O, respectively.

Conclusions: Although both arthroscopic and open techniques achieved stability of the injured wrists in patients with trans-scaphoid PLFDs, it is shown that the arthroscopic-assisted technique showed a clinically meaningful better DASH score and greater flexion–extension arc with other parameters being similar.

A-0069 Comparative outcomes analysis of arthroscopic versus open osteosynthesis for unstable scaphoid nonunion

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Purpose: The purpose of this study was to compare union rates and clinical and radiological outcomes of arthroscopic osteosynthesis and open osteosynthesis for management of unstable scaphoid nonunions.

Introduction: The arthroscopic osteosynthesis of unstable scaphoid nonunion has been alternative surgical method to an open osteosynthesis, with advantages of less invasiveness and concurrent management of associated intrinsic and extrinsic ligament injuries. However, there are lack of studies comparing arthroscopic surgery to open surgery.

Methods: From March 2008 to November 2013, we retrospectively reviewed medical records of consecutive patients with symptomatic unstable scaphoid nonunion who underwent arthroscopic osteosynthesis (Group A) or open osteosynthesis (Group O) and who were followed up for a minimum of 2 years. And patients who met following criteria were excluded: (1) scaphoid nonunion with necrosis of the proximal fragment, (2) advanced wrist arthritis (SNAC stage II or more), and (3) secondary operation or revised surgery. The clinical outcomes were assessed by visual analog scale (VAS) pain scale, grip strength, range of motion (ROM), Mayo wrist score (MWS), and Disabilities of

Arm, Shoulder and Hand (DASH) score at last follow-up. Radiological outcomes were evaluated by union rate, scapholunate angle (SLA), radiolunate angle (RLA), lateral intrascaphoid angle (LISA), and height-length ratio (HLR) of the scaphoid at last follow-up. We also classified each group into subgroups which had patterns of dorsal intercalary segmental instability (DISI) (SLA > 60° or RLA > 10°) and humpback deformity (LISA > 45° or HLR > 0.65) and compared those subgroups.

Results: The total number of included patient was 62 (28 in Group A and 34 in Group O), and mean follow-up period was 39.6 (24 to 84) months. The union rate was 96.4% (27 of 28) in Group A and 97.1% (33 of 34) in Group O with mean union time of 11.7 ± 2.7 weeks and 11.5 ± 2.5 weeks, respectively, and there were no significant differences between two groups. In clinical assessment, there were no significant differences in mean VAS pain scale, grip strength, ROM, MWS, and DASH score at last follow-up. In radiological assessment, HLR was 0.59 ± 0.07 in Group A and 0.55 ± 0.05 in Group O ($p = 0.002$), and SLA, RLA, and LISA were similar between two groups. However, when it comes to subgroup analysis (9 in Group A and 14 in Group O), SLA, RLA, LISA, and HLR showed significant differences between two groups, and those values were 55.7 ± 7.4, 9.1 ± 1.9, 34.5 ± 4.6, and 0.66 ± 0.004 in Group A and 49.2 ± 9.1, 5.7 ± 3.0, 25.6 ± 13.0, and 0.54 ± 0.07 in Group O ($p = 0.049$, 0.005, 0.028, and $p < 0.001$, respectively). The proportion of arthritis of radiocarpal and intercarpal joint did not differ at last follow-up.

Conclusions: Arthroscopic osteosynthesis showed similar clinical and radiological outcomes compared to open osteosynthesis for treatment of unstable scaphoid nonunion. Thus, arthroscopic osteosynthesis can be an alternative surgical option in treatment of unstable scaphoid nonunions.

A-0077 Lunate morphology as a risk factor for idiopathic ulnar impaction syndrome

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Background: The positive ulnar variance is a well-known risk factor for idiopathic ulnar impaction syndrome. However, not all patients with positive ulnar variance develop a symptomatic ulnar impaction syndrome. The aim of present study is to clarify the relationship between the morphology of the lunate and the idiopathic ulnar impaction syndrome.

Methods: The lunate morphologies on the standard wrist radiographs of 95 patients with idiopathic ulnar

impaction syndrome (ulnar impaction syndrome group) and 95 asymptomatic normal patients with positive ulnar variance (control group) were compared. The shape of the lunate was measured in regard to capitata-triquetrum distance (CTD), ulnar coverage ratio (UCR), radiolunate distance (RLD), and radiolunate angle (RLA). The association of the radiographic parameters and lunate types that compared the ulnar impaction syndrome group with control group was investigated.

Results: The percentage of type II lunate, which had medial hamate facet, was significantly higher in the ulnar impaction syndrome group than in the control group ($p = 0.001$). CTD, UCR, and RLD were significantly greater in the ulnar impaction syndrome group in univariate analysis ($p < 0.05$ for all), and CTD and UCR showed positive association with ulnar impaction syndrome in multivariate analysis (odds ratio [OR], 1.516; 95% CI, 1.114–2.061; $p = 0.008$), (OR, 44.776; 95% CI, 5.348–374.899; $p = 0.002$). Estimated cutoff values were 2.5 mm for the CTD (area under the curve [AUC]; 0.65) and 0.4 for the UCR (AUC; 0.64).

Conclusions: The prevalence of type II lunate that had greater CTD was higher in the ulnar impaction syndrome than in the asymptomatic normal ulnar positive wrist group. Ulnar coverage ratio of the lunate was positively associated with idiopathic ulnar impaction syndrome.

A-0078 Arthroscopic transosseous repair for both proximal and distal components of peripheral triangular fibrocartilage complex tear

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This study evaluated clinical results of arthroscopic transosseous suture repair for proximal and distal components of peripheral triangular fibrocartilage complex (TFCC) tear combined with distal radioulnar joint (DRUJ) instability. The proximal component of TFCC was repaired through arthroscopic one-tunnel transosseous suture technique, and the combined distal component tear was repaired to the capsule using the same transosseous tunnel in nine patients. Mean time from surgery to last follow-up was 17 months. All patients achieved stability of DRUJ and demonstrated satisfactory subjective and *objective* outcomes without serious complications. Simultaneous repair of a combined distal component tear could be simply fulfilled using the transosseous tunnel created for foveal repair with acceptable results.

A-0079 A randomized controlled trial comparing NSAID injection to steroid injection in adults with trigger digit

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Objective: The aim of this randomized controlled trial is to evaluate the efficacy of ketorolac trometamol (nonsteroidal anti-inflammatory drug, NSAID) injections compared to triamcinolone acetonide (steroid) injections in trigger digits.

Methods: Patients at an outpatient clinic with trigger digit between January 2014 and June 2016 were screened for recruitment into the trial. Patients were randomized to receive either NSAID or steroid injections. Lignocaine was added to the injectable drug. Patients were followed up at 3, 6, 12, and 24 weeks and monitored for resolution of triggering, pain, and total active motion.

Results: 121 patients were recruited (59-NSAID and 62-steroid) with a mean age of 60 years. At 3 weeks and 6 weeks, 36.5% and 54.0% of patients in the steroid group, respectively, had complete resolution of trigger, whereas no patients in the NSAID group experienced any resolution ($p < 0.0001$). At 12 weeks, 6.7% of NSAID patients had complete resolution of trigger compared to 58.3% in the steroid group ($p < 0.0001$). At 24 weeks, the NSAID and steroid group had comparable rates of resolution at 25.5% and 25.0%, respectively ($p = 0.15$). Patients in the steroid group had better resolution of pain at 3, 6, and 12 weeks ($p < 0.001$), but at 24 weeks, there was no significant difference in pain between both the groups ($p = 0.37$). There was no difference in total active motion between both the groups, but lower extensor lag was reported at 3 weeks ($p = 0.02$) and 6 weeks ($p = 0.05$) in the steroid group. Patient satisfaction was similar between both the groups at 81% ($p = 1.00$).

Conclusions: This study shows that although steroid injections produce a faster resolution of symptoms compared to NSAID; however, due to recurrences, the efficacy of steroid injection is comparable to NSAID injection by 24 weeks.

A-0082 Plasma microRNA-146a and microRNA-155 are potential objective and early biomarkers for acute rejection of transplanted limbs in a rat model

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Background: Limb transplantation is one treatment option for amputees, but some complications including acute or chronic rejection can occur. To assess the rejection, visual skin inspection and histological assessment are used. However, these techniques are largely subjective. We aimed to determine the potential of several microRNAs (miRNAs) as objective and minimally invasive biomarkers for acute rejection of transplanted limbs with a rat model.

Methods: In the allograft group, four Brown Norway rats were used as the donors and seven Lewis rats as the recipients. In the syngeneic (control) group, 11 Lewis rats were used as the 4 donors and 7 recipients. Each harvested hind limb was simultaneously transplanted orthotopically to two recipient Lewis rats. We administered 1 mg/kg per day FK506 intramuscularly to the recipient rats for 7 days since the day of transplantation. Plasma samples were obtained from all the recipients before surgery and on days 3, 7, 10, and 14 posttransplantation. MicroRNAs were isolated from the plasma, reverse transcribed to cDNA, and measured using real-time polymerase chain reaction. MicroRNAs were analyzed using the delta-delta Ct method normalizing sample variation with spike-in of ath-miR159a. All recipients were sacrificed on day 14, and skin tissues were harvested to assess histological study. Thin sections of the skin samples were prepared, stained with hematoxylin and eosin, and assessed the histological immunoreactions using a grading system according to Büttemeyer. The data of miRNAs' expressions were statistically analyzed using student's *t* test, and the differences were considered significant at $p < 0.05$.

Results: The plasma expression of miRNA-146a and miRNA-155 was significantly elevated in the allograft group on days 10 and 14 posttransplantation compared to that in the syngeneic control group. Most skin samples in the allograft group were classified as grade 3 rejection on day 14, whereas most skin samples in the syngeneic group were classified as grade 0 or 1 on the same day.

Conclusions: The plasma expression of miRNA-146a and miRNA-155 were upregulated during acute rejection of transplanted limbs. These miRNAs are potential biomarkers for early, minimally invasive, and objective diagnosis of rejection.

A-0083 Influence of radial deviation deformities in distal radius fractures on distal radioulnar joint instability: A cadaveric biomechanical study

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Objective: It has been reported that the distal interosseous membrane (DIOM) acts as the secondary soft tissue stabilizer of the distal radioulnar joint (DRUJ) which constrains palmar dislocation of the ulna relative to the radius. Under the condition of the triangular fibrocartilage complex (TFCC) tear, dysfunction of DIOM increases DRUJ instability. A purpose of this study is to clarify that radial deviation (RD) deformities in the distal radius fractures lead to DIOM slackening, resulting in instability of DRUJ.

Method: Seven upper limbs of fresh frozen cadavers were denuded of skin and muscles. Radial cuneiform osteotomy of 30° was performed at the distal end of DIOM with custom made cutting device. The distal fragment and proximal fragment were fixed rigidly with a custom-made external fixator to make 10°, 20°, and 30° radial RD deformities with magnetic tracking sensors (TrakSTAR, Ascension technology corp, Shelburne, Vermont). The humerus and the ulna of the specimen were fixed to the custom-made testing apparatus in a neutral position of elbow. We tested passive mobility of DRUJ by translating the ulna relative to the radius in a dorsopalmar direction with a load of 19.6 N in a neutral forearm rotation. We evaluated laxity of DRUJ (stabilized, subluxed, perched, and dislocated) and measured magnitudes of translation of the ulna relative to the radius in different conditions. Testing conditions were as follows: (a) intact TFCC and DIOM with 0°, 10°, 20°, and 30° RD of the distal radius; (b) sectioned TFCC and intact DIOM with 0°, 10°, 20°, and 30° RD; and (c) sectioned TFCC and DIOM with the 0° RD.

Result: All seven cases had DIOM. Under the condition of intact TFCC and DIOM, DRUJ was stabilized and dorsopalmar translation of the ulna was decreased as the increase of RD (significant difference between 0° and 30°). Under the condition of TFCC sectioning and intact DIOM, the ulna was dislocated dorsally but subluxed or perched palmarly. There was no significant difference in dorsal translation of the ulna, but palmar translation was increased

as the increase in RD (significant difference between 0° and 30°). Under the condition of TFCC and DIOM sectioning, the ulna was dislocated both dorsally and palmarly, and palmar translation of the ulna was significantly larger than the other condition.

Conclusion: Our result shows that intact DIOM constrained palmar dislocation of the ulna similar to previous studies. Under the condition of TFCC sectioning, although the ulna dislocated dorsally regardless of RD, palmar instability of the ulna increased as the increase in RD. RD deformity could alter an incongruity of DRUJ and made a gap between the sigmoid notch and the ulna head resulting in DIOM slackening. RD deformity was a possible cause of palmar instability of DRUJ.

A-0084 Psychometric evaluation of a new patient-reported outcome measure for nerve disorders of the hand: The impact of Hand Nerve Disorders (I-HaND ©) Scale

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Objective: Nerve disorders of the hand result in impairments as well as activity limitations and participation restrictions. There are currently no patient-reported outcome measures (PROMs), which evaluate this impact specifically in people with a range of nerve conditions. To address this need the Impact of Hand Nerve Disorders (I-HaND ©) Scale was developed following guidelines for the development of PROMs by the Patient-Centered Outcomes Research Institute (PCORI). A qualitative study and subsequent pilot test using mixed methods resulted in the development of the content of a new 32-item PROM. The objective of the final study was to assess the psychometric properties of the I-HaND

Methods: In a longitudinal repeated measures study, 132 patients with nerve disorders from compression or trauma were recruited. Construct validity was assessed using Principal Components Analysis (PCA) and internal consistency examined using Cronbach's alpha (α). Using the Quick-DASH as a comparator measure, a moderate to strong (Pearson's $r = >0.6$) correlation was hypothesized as evidence of criterion-related validity. Test-retest reliability was calculated using intraclass correlation coefficients (ICC) from repeated administration over a 2-week interval. Responsiveness was tested over a 12-week interval using Cohen's effect size (ES) and the standardized response mean (SRM). A global rating of outcome was used to dichotomize patients into improvers and nonimprovers and receiver-operating characteristic

(ROC) curves used to calculate the area under the curve (AUC).

Results: A single factor structure was confirmed by the PCA. A very high internal consistency ($\alpha = 0.98$) and good criterion-related validity with the Quick-DASH ($r = 0.87$) were demonstrated. The test-retest reliability was excellent (ICC = 0.97; 95% CI = 0.94–0.98). The I-Hand Scale was able to detect change in a group of patients where change was expected (ES = 0.51; SRM = 0.60) and was more responsive relative to the Quick-DASH (ES = 0.42; SRM = 0.56). Furthermore, it discriminated between improvers (ES = 0.75; SRM = 1.2) and nonimprovers (ES = -0.03; SRM: -0.04). The AUC was 0.85 [95% CI = 0.74–0.96], marginally higher than the Quick-DASH (AUC = 0.81; 95% CI = 0.63–0.93).

Conclusions: Initial validation of the I-Hand indicates that this new condition-specific PROM for hand nerve disorders is relevant for patients and psychometrically robust. Further research to examine the structural validity using larger samples is needed.

A-0086 The effect of an exercise program in patients with thumb base osteoarthritis: A prospective cohort study with propensity score matching

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Objective: This study compares the effect of a combination of an exercise program and splinting with splinting alone on pain and activities in daily life (ADL) in patients' osteoarthritis (OA) of the thumb base joint (CMC-1). Furthermore, this study investigates predictors for outcomes on pain and ADL in order to optimize health care for individual patients with CMC-1 OA.

Methods: A prospective cohort study was conducted in 11 outpatient clinics for hand surgery and hand therapy in the Netherlands. A combination of an exercise program and splinting was compared with splinting alone using propensity score matching (PSM). Primary outcomes included pain and ADL at 3 months, measured with a Visual Analogue Scale (VAS) and the Michigan Hand outcomes Questionnaire (MHQ). Linear mixed-model analysis was used to study between-group differences, and multiple regression analysis on baseline characteristics for the total exercise program group was used in order to identify predictors for outcome.

Results: In total, 107 participants were included, of which 44 were matched using PSM. A larger decrease

in VAS pain during physical load was found in the exercise program group (35 points) compared to the splint group (19.5 points, $p = 0.012$). Outcomes on the MHQ score showed no clinically relevant differences. Treatment of the dominant side, higher flexion of the first metacarpophalangeal joint, higher age, and type of work with heavy physical labor predicted outcomes on pain or ADL for the total exercise program group ($N = 85$).

Conclusions: Superior results were found for the exercise program group when compared to the splint group, indicating positive effects of an exercise program. Furthermore, several predictors for outcomes on splinting combined with an exercise program were identified. Future research should study exercise programs and predictors of outcome in a larger sample and a more standardized setting.

Clinical Relevance: Applying exercise programs in clinical practice appears to be beneficial for individual patients with CMC-1 OA.

A-0088 Anatomical difference between hand and foot web-space reconstruction

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Objective: Dorsal flap design was widely used in web-space reconstruction. However, difference in anatomy of hand and foot made the design of flap need specific considerations. This study was focused on the difference between web-space anatomy of hand and foot and provided the recommended guideline of flap design for web-space reconstruction in hand and foot region.

Methods: Web-space between 2, 3, 4, and 5 fingers and toes were measured in multiple dimensions and correlated with surgical landmarks that widely used in flap design including metacarpophalangeal (MCP) knuckle, phalangeal length, tip of web-space, and width of web-space. All parameters were analyzed and compared between hand and foot web-space including web-length ratio (defined as distance between tip of web to MCP joint compared with proximal phalangeal distance), web-width ratio (defined as the width of web-space in maximum abduction position compared with the distance between tip of adjacent MCP joint), slope angle (defined as angle between the most dorsal part of web-space and the horizontal line, measured in sagittal plane), and abduction angle of web-space (defined as the angle between the mid-axis of adjacent finger or toe in maximum abduction position, measured in coronal

plane). All parameters were compared between hand and foot and statistically analyzed by paired *t*-test.

Results: Total 108 web-spaces in hand and foot were measured in 18 adults. Average hand and foot web-length ratio were 0.52 and 0.77, respectively. Average web-width ratio in hand and foot were 0.80 and 0.71. Mean slope angle of hand and foot web-space were 25.33° and 31.50°, respectively. And average abduction angle in hand and foot were 19.26° and 5.95°. All these parameters mentioned earlier were compared between hand and foot by paired *t*-test and found statistically difference ($p < 0.05$).

Conclusions: Anatomy of hand and foot web-space were difference and need specific design for web-space reconstruction. Because foot had thicker web-space, more slope angle, and less abduction angle compared to hand web-space, our conclusion was that hand web-space need short and wide flap design. In the contrary, foot web-space need longer and narrower flap for web reconstruction. From data in this study, we recommend flap for hand web-space reconstruction should be at least 50% length of finger proximal phalange and 80% width of distance between tip of adjacent MCP joints. For foot web-space reconstruction, we recommended 80% length of toe proximal phalange and 70% width of distance between tip of adjacent MCP joints for adequate web-space reconstruction.

A-0091 Feasibility of minimally invasive distal radius plate removal (MIPR): About a series of 388 cases

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Objective: The purpose of this study was to evaluate the technical feasibility of a minimally-invasive surgical technique (MIPR) to perform the removal of anterior osteosynthesis plates for fractures of the distal radius.

Methods: We reviewed retrospectively 388 cases of removal of plates on 387 patients, of which 357 were women, with an average age of 50 years old. The incision followed the previous surgical scar. After the removal of the plate, the incision was closed using a subcuticular suture, without drains or immobilization.

Results: The scar was in average 22.2 mm long pre-operatively, 19.8 mm long in average after the incision, and 21.4 mm in average at the end of the surgery, without significant statistical difference. The scar was enlarged 13 times by involuntary skin tear

and 11 times voluntarily with a scalpel. We experienced 29 device-related complications, 1 osseous slot without consequence, and 1 fractured plate. No postoperative complications were encountered.

Conclusions: Our results show that it is possible to perform the removal of an anterior osteosynthesis plate of the distal radius by a 20-mm long surgical approach. A subsequent study comparing the MIPR technique to conventional surgical approaches will be needed to validate it.

A-0092 Detection of penetration of the dorsal cortex by epiphyseal screws of distal radius volar plates: Anatomical study comparing ultrasound and fluoroscopy

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Objective: Osteosynthesis of the distal radius by a volar plate can be complicated by lesions of extensor tendons by screws penetrating the dorsal cortex. The fluoroscopic skyline view enables to confirm the length of the screws. To avoid its risk of irradiation, some authors have recommended to use ultrasound instead. The goal of this study was to demonstrate that the detection rate of screws penetrating the dorsal cortex was at least as good using ultrasound compared to fluoroscopic skyline.

Methods: A volar plate in which one screw penetrated the dorsal cortex was implanted in 10 cadaveric wrists. Three observers had to detect which screw penetrated the dorsal cortex using ultrasound and then a fluoroscopic skyline.

Results: The detection rate of screws penetrating the dorsal cortex was 43.33% with ultrasound and 96.97% using the fluoroscopic skyline. Agreement between the observers was poor with ultrasound and good with fluoroscopy.

Conclusions: Our results show that ultrasound cannot replace the fluoroscopic skyline view to detect screws penetrating the dorsal cortex of the distal radius in clinical practice.

A-0094 Rotatory stability test for diagnosis of radial collateral ligament rupture of the long fingers: Anatomical study

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Objectives: Diagnosing rupture of the radial collateral ligament (RCL) of the metacarpophalangeal joint (MCP) is difficult. The aim of this anatomical study was to validate a rotatory test for the MCP after RCL transection.

Methods: With MCPs and PIPs in flexion, rotation along the axis of the proximal phalanx was applied through an extended DIP to 36 cadaver fingers. Each finger's pulp described an arc of pronation and supination which was noted on the palm. The test was repeated 3 times: before section, after section of the main CL, and after section of both main and accessory CL. Rotatory arcs were measured in pronation and supination.

Results: Mean length of pronation arc after section of the main CL was 17.532 mm while being only 12.413 mm before section for the supination arc. Mean length of pronation arc after section of both CL was 22.833 mm compared to only 11.933 before section.

Conclusions: Our results show a significant difference in pronation stability of the MCP after section of the main CL. We can conclude that rotatory stability test is a valid test for diagnosing RCL rupture in MCPs.

A-0095 Ligament reconstruction suspension arthroplasty using double palmaris longus tendon graft with Mini TightRope for advanced thumb trapeziometacarpal joint arthritis

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Objective: Since 1997, we have performed Thompson's suspensionplasty using abductor pollicis longus (APL) tendon for advanced thumb trapeziometacarpal (TMC) joint arthritis (Soejima O, et al. *J Hand Surg*, 31A: 425-428, 2006). Our long-term results in a 10.2 years' follow-up demonstrated good pain relief and compares favorably with other published reports (Ishiko, T, Soejima, O, et al. *ASSH*, 2016). However, the subsidence of the first metacarpal bone was noted, and thumb metacarpophalangeal joint hyperextension and extensor pollicis longus tendon rupture were observed as postoperative complications. Since 2015, we have developed the new surgical technique of ligament reconstruction suspension arthroplasty (LRSA) using double palmaris longus (PL) tendon graft with Mini TightRope, which is a further modification of Thompson's suspensionplasty, while preserving APL

tendon as an extrinsic stabilizer. The purpose of this study is to evaluate the efficacy of LRSA for treatment of advanced thumb TMC joint arthritis.

Methods: We conducted a retrospective study investigating the use of this technique since 2015 by a single-surgeon. Nine thumbs in nine patients (six males and three females) were identified for this evaluation. The average age at surgery was 65.7 years. According to the Eaton's classification, all patients had advanced stage III osteoarthritis. Visual analogue scale (VAS), grip and pinch strength, thumb range of motion, and complications were reviewed. As an index of the first metacarpal subsidence, the trapezial space ratio which is the height of the trapezial resection space divided by the length of the first metacarpal was measured from the preoperative, postoperative, and follow-up radiographs and CT scans. All patients completed the Disabilities of Arm, Shoulder, and Hand (DASH) survey and HAND-20 evaluation at the latest follow-up.

Results: LRSA technique results in reduced pain levels, increased grip and pinch strength, and preserved range of motion early in the postoperative period. Radiographs demonstrated maintenance of trapezial space height. There were no cases of impingement or fracture of the first and second metacarpal bases. No postoperative complications were noted at this short-term follow-up period.

Conclusions: From our long-term follow-up study in the Thompson's suspensionplasty, loss of the first metacarpal position is seen after complete trapeziectomy. On the other hand, favorable results of suture button suspensionplasty using Mini TightRope have recently been reported; however, the subsidence of the first metacarpal and muscle weakness are matters of concern in case of tearing of the Mini TightRope. Therefore, LRSA using double PL tendon graft with Mini TightRope was devised in reference to ACL reconstruction using TightRope. From this study, LRSA technique preserved APL tendon as an extrinsic stabilizer achieved good pain relief and recreated support of the base of the first metacarpal to resist proximal migration or radial subluxation. This technique also provided an improvement in strength and function early in the postoperative period without any complications. This technique holds promise and merits long term follow-up studies.

A-0096 Corrective osteotomy is an effective method of treating distal radius malunions with good long-term functional results

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Introduction: Malunion occurs in approximately 23% of nonoperatively treated and 11% of operatively treated distal radius fractures. The decision whether to correct a malunion is primarily based on functional impairment and wrist pain. The purpose of this study was to assess the long-term functional outcomes of corrective osteotomies for symptomatic malunited distal radius fractures.

Methods: All consecutive corrective osteotomies of the distal radius performed in one centre between January 2009 and January 2016 were included. The primary outcome was the functional outcome assessed with the Disability of the Arm, Shoulder and Hand (DASH) and the Patient-Rated Wrist Evaluation (PRWE) score. Secondary outcomes were range of motion, grip strength, pain as indicated on the Visual Analogue Scale (VAS) before and after corrective osteotomy, radiological parameters, time to union and complications. Additionally, we aimed to determine if there were any difference in graft versus no graft usage.

Results: A total of 48 patients were included. The median age was 54.5 years (IQR 39–66), and 71% was female. The median time to follow-up was 27 months. The median DASH and PRWE score were, respectively, 10.0 (IQR 5.8–23.3) and 18.5. (6.5–37.0). Except for pronation and supination, range of motion and grip strength of the injured wrist was significantly less compared to the uninjured side. The median time to union was 23 weeks (IQR 12–29.5) and radiographic parameters improved significantly. VAS pain scores decreased significantly from 6.5 preoperative to 1.0 postoperative. Eighteen patients (38%) had a complication for which additional treatment was required. Except for a significant difference in radial inclination and length after the corrective osteotomy in favour of graft usage, there were no significant differences between graft and no graft usage.

Conclusions: Corrective osteotomy is an effective method of treating symptomatic distal radius malunions with good long-term functional results, measured with the DASH and PRWE score, and improvement in radiographic parameters and pain scores. Additionally, no differences in functional outcomes were found between graft and no graft usage.

A-0097 The Amsterdam Wrist Rules safely reduces need for radiography after wrist trauma: An implementation study

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Introduction: While most patients with wrist trauma are routinely referred for radiography, around 50% of these radiographs show no fracture. Currently, guidelines to endorse such decision-making are lacking. To avoid unnecessary radiographs and therefore increased length of stay at the emergency department (ED) and additional health-care costs, we have previously developed and validated a clinical decision rule for adult patients: the Amsterdam Wrist Rules (AWR). The aim of the current study was to evaluate the effect of the implementation of the Amsterdam Wrist Rules at the ED.

Methods: In a before and after comparative prospective cohort study, all consecutive adult patients with acute wrist trauma presenting at the ED of one academic and three teaching hospitals were included. Primary outcome was the number of wrist radiographs before and after implementation of the AWR. Secondary outcomes were the number of clinically relevant missed fractures, the overall length of stay at the ED before and after implementation of the AWR, physician compliance regarding the AWR, and patient satisfaction and experience with the care received at the ED.

Results: In the after group, a total of 402 patients were included between November 2014 and January 2016. The median age was 51 years, and 61% of the patients was female. The before group consisted of a cohort of 854 patients. The patient and fracture characteristics between both groups were comparable. The absolute reduction in wrist radiographs after implementation was 15.9% ($p < 0.001$). One not clinically relevant fracture was missed following the recommendation of the AWR. Compared with nonfracture patients who had a wrist radiograph after implementation of the AWR, those discharged without a wrist radiograph spent 34 min less time in the ED ($p = 0.015$). The physicians adhered to the AWR in 36% of patients. Of all patients who did not receive a radiography of the wrist, 92% was satisfied.

Conclusion: Implementation of the AWR safely reduces the amount of wrist radiographs in selected patients and thereby reducing the length of stay at the ED, without patient dissatisfaction.

A-0098 No benefits of combining proximal row carpectomy with PIN neurectomy for wrist disorders: A comparative study with systematic review of the literature

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Objective: PIN resection in combination with PRC is a preferred method in order to obtain rapid recovery. Review of the literature revealed several studies reporting the benefits of such combination. However, all of studies on this subject were case series or controlled studies comparing PRC and PIN neurectomy with other procedures, such as limited carpal fusions capsule interposition arthroplasty or rehabilitation protocols. From evidence-based point of view, the value of case series is limited, and best evidence comes from controlled trials. So, we performed a controlled trial to evaluate the effects of PIN neurectomy for PRC. Additionally, a systematic review of the literature for the last 10 years for PRC+PIN neurectomy combination was performed.

Methods: Patients with various wrist diseases who underwent PRC were evaluated in two centers retrospectively. In the center 1, PIN was not resected and in the center 2, PRC with PIN neurectomy was performed. Group 1 of 7 patients without PIN neurectomy and group 2 of 8 patients with PIN neurectomy were compared in respect of mean age, follow-up, gender, Q-DASH, VAS, MAYO wrist scores, flexion-extension / radial-ulnar deviation range of motion and presence of arthritis at final follow-up. The second part of the study was a systematic review of PRC combined with PIN neurectomy. With a "proximal row carpectomy" key word, a Medline database search of last 10 years was performed. A total of 155 citations were evaluated with full manuscripts and searched if there was such combination.

Results: Baseline characteristics and the indications for surgery were similar in both groups: There were no statistically significant difference between the groups in regard to age ($p = 0.463$) and follow-up period ($p = 0.728$). At the latest follow-up, the range of flexion-extension and radioulnar deviation was found higher in Group 1, but the difference was not significant statistically ($p = 0.431$ and $p = 0.689$, respectively). Contrary, both Quick DASH and MAYO scores were higher in group 2, but the difference was again insignificant ($p = 0.452$ and $p = 0.728$, respectively). In the second part of the study, a total of 12 citations were included into the study. None of the trials were comparing PRC alone and PRC combined with PIN neurectomy. Mean follow-up of patients was 94.9 (12–240) months. Mean flexion-extension ROM

of patients was 76.9° (53–105) and radial-ulnar deviation ROM was 35.4° (25–45). Mean Q-DASH / DASH score was 26.6 (16–42.5), VAS score was 1.4 (1.2–1.6) and MAYO score was 64.1 (54.6–84)

Conclusion: Our results clearly demonstrate that combining PIN neurectomy with PRC has no advantage. On the other hand, the number of the patients included in the study prevents more strict conclusions, although this is only comparative study in the literature. We advocate not to combine PRC with PIN neurectomy not only for such an approach has no advantage but also has some potential complications.

A-0103 In vivo three-dimensional analysis of malunited forearm diaphyseal fractures with restriction of forearm rotation

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Objective: While malunited forearm diaphyseal fractures are often complicated by restricted forearm rotation, the biomechanical mechanisms involved remain unclear. We assessed in vivo three-dimensional (3D) forearm motion in such fracture cases to evaluate the role of deformity, bone impingement, and interosseous membrane contractures, particularly the central band (CB).

Methods: We evaluated 17 malunited diaphyseal fractures cases (3 females and 14 males) with restricted forearm rotation; 12 cases had both radius and ulna deformities, while 5 had radius deformities alone. Computed tomography (CT) of the bilateral forearm was performed for three rotational positions (maximum pronation, supination, and neutral position), and 3D bone surface models of the radius and ulna were created. The 3D deformity was evaluated by superimposing the proximal affected bone onto the proximal mirror image of the contralateral normal side by a surface-based registration technique using the computer software (Bone Simulator; Orthree, Osaka, Japan). In addition, the distal side was superimposed as same way and the extent of 3D deformity was calculated. Kinematic variables were measured by superimposing the bone in neutral and pronated positions upon the bone in a supinated position using the software. The path of CB was created based upon anatomical locations. As CB is a wide membrane, proximal, middle, and distal longitudinal distance and transverse distance, avoiding bone obstacles, were calculated. The bone impingement between the radius and the ulna during forearm rotation were also analyzed. The relationship of 3D deformity to forearm

motion range, bony impingement, and each CB fiber length was quantitatively analyzed.

Results: The average pronation range of motion was $36.2^\circ \pm 24.9^\circ$, and average supination range of motion was $37.7^\circ \pm 43.5^\circ$. Extension deformity of the radius had significantly negative correlation with pronation range of motion (correlation coefficient, $R = -.60$; $P = .01$), while valgus deformity of the ulna had negative correlation with supination range of motion ($R = -.69$; $P = .01$). Sixteen and 13 cases exhibited limited pronation and supination, respectively. Significance differences were observed in the impingement ratio between pronation (75%: 12 of 16 cases) and supination (8%: 1 of 13 cases, $P < .01$). Extension and internal rotation deformity of the radius and valgus deformity of the ulna increased the risk of impingement during pronation with an odds ratio 1.28 [95% confidence interval [CI]: 1.04–1.93], 1.40 [95% CI: 1.03–2.57], and 1.24 [95% CI: 1.02–2.13], respectively. Although, longitudinal distance of CB did not significantly differ between supination and pronation, the transverse distance of CB significantly elongated in supination ($88.8\% \pm 23.5\%$) compared with that in pronation ($61.5\% \pm 15.2\%$; $P < .01$), whereas transverse distance of normal side was most elongated in neutral. Thus, CB overstretching caused limitation of supination in injured side.

Conclusion: Limited pronation in malunited forearm diaphyseal fracture cases is principally due to bone impingement. Limited supination is predominantly caused by strained transverse distance of CB.

A-0107 Long-term functional results of a wrist exercise program for patients with midcarpal instability

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Introduction: Midcarpal instability is a common cause of pain and impairment for patients with chronic wrist complaints. Surgical interventions have been proposed to augment or shorten the involved ligaments. However, outcome of such surgery is often disappointing and unpredictable, and it is only recommended when conservative treatment fails. Our institution developed a wrist exercise program for patients with chronic wrist pain, aiming at improving positioning, strengthening and functional stabilization of the wrist during activities. The aim of the current study was to determine the effectiveness and durability of our wrist exercise program in patients with the diagnosis midcarpal instability at a minimum of 3 years of follow-up.

Methods: All patients who were diagnosed with midcarpal instability between 2005 and 2011 were included in this study. Midcarpal instability was diagnosed when Lichtman test was found to be positive during wrist cineradiography. All eligible patients received an invitation to participate in the online survey. Key questions were used to select those patients that followed the wrist exercise program. Patients had to scale their perceived pain before and after treatment and indicate the effect of the received treatment (therapeutic effect), using a numerical scale from 0 (no pain/effect) to 10 (worst pain possible/maximum effect). In addition, each participant completed the Dutch language version of the Patient-Rated Wrist and Hand Evaluation (PRWHE) and the Short Form health (SF-36) questionnaires.

Results: A total of 119 patients actually underwent the wrist exercise program based on the specific key exercises. The mean age at the time of wrist cineradiography was 29 years (SD 10.8) with a range of 11 to 64 years. Of all patients 84% was female. In 69% of the patients, the dominant hand was affected, and 43 (36%) patients had bilateral midcarpal instability. The median follow-up time was 6 years (IQR 4.5–7.0) with a range of 2.8–9.2 years. The median perceived pain reduced from 8 (IQR 7–9) before start of the wrist exercise program to four (IQR 2–6) at the time of follow-up. Moreover, the median therapeutic effect of the wrist exercise program was 5 (IQR 2–8). The median PRWHE score after hand therapy was 35.5 (IQR 13–50.5). The median mental component of the SF-36 score was 53.9 (IQR 48–57.4) and the physical component 45.2 (IQR 37.4–52.6).

Conclusion: Although midcarpal instability remains to be a chronic disease, the effectiveness and durability of our wrist exercise program are promising with acceptable long-term functional results and a good quality of life.

A-0108 Trigger finger: What is it that triggers?

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Objective: To determine the exact site of flexor tendon triggering by ultrasound measurement of the tendon diameter in various finger positions and postures to aid selection for different methods of treatment.

Materials and Methods: Twenty trigger fingers and 20 normal controls from the contralateral hand were examined using high-resolution ultrasound. At pre-determined anatomical points and finger flexion angles, the static study investigated the combined flexor tendon diameters, A1 pulley thickness, cross-sectional area of tendons, and hypoechoic area; the dynamic study explored the presence of adherence around and between the tendons. Paired Wilcoxon tests were used to compare the combined flexor tendon diameters, A1 pulley, cross-sectional area of tendons and hypoechoic anterior gap between the normal and trigger fingers. Then, to demonstrate the possible presence of a focal tendon thickening and its proximal movement during finger flexion, the difference in tendon diameter between every finger position (at each finger posture) was calculated using a one-way analysis of variance test. Significance level was set at .05.

Results: The study yielded findings not previously recorded in medical literature. First, measured combined tendon diameters were significantly larger in trigger fingers than normal fingers at all the finger positions. Notably, in both normal and trigger fingers, an anatomical thickening was discovered at the level of $\frac{1}{4}$ of the proximal phalanx length in the extended digit and moved proximally with finger flexion. Trigger fingers also had a larger tendon thickening and a thicker A1 pulley when compared to normal fingers. Finally, trigger fingers had more adherence around and between tendons, when compared to normal fingers.

Conclusion: The larger anatomical thickening gliding through a thickened A1 pulley present in trigger fingers may account for patients' symptoms such as a "locking" sensation during finger flexion. The dynamic study suggested that the number of sites of adherence may be useful in assessing the severity of adherence in patients' fingers. This has potential value in determining the treatment choices of trigger finger.

A-0110 Comparison of treatment outcome after collagenase and needle fasciotomy for Dupuytren contracture: A randomized, single-blinded, clinical trial with a 1-year follow-up

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Purpose: This study compared the efficacy of collagenase treatment and needle fasciotomy for

contracture of the metacarpophalangeal (MCP) joint in Dupuytren's disease.

Methods: This is a prospective, single-blinded, randomized study with a follow-up 1 week and 1 year after treatment. One hundred and forty patients with an MCP contracture of 20° or more in a single finger were enrolled, of whom 69 patients were randomized to collagenase treatment and 71 patients to needle fasciotomy. The patients were followed at 1 week, blinded to follow-up, and were examined by a physiotherapist after 1 year.

Results: Eighty-eight percent of the patients in the collagenase group and 90% of the patients in the needle fasciotomy group had a reduction in their MCP contracture to less than 5° one week after treatment, while the median gain in passive MCP movement was 48° and 46°, respectively.

The median VAS score for procedural pain was 4.9/10 in the collagenase group and 2.7/10 in the needle fasciotomy group. After 1 year, 90% of the patients in both groups had full extension of the treated MCP joint, and the median MCP extension lag was 0° in both the groups. One patient in each group had a recurrence of the contracture. The median improvement in URAM score was 8 units in both groups, and the VAS estimation of treatment efficacy by the patients was 8.7/10 in both groups.

Conclusion: There was no significant difference between the treatment outcomes after collagenase and needle fasciotomy treatment after 1 year.

A-0112 Dynamic MRI as a supplement to conventional MRI for assessing disorders of the wrist

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Objective: Diagnosis of dynamic wrist instability is challenging using the standard imaging techniques. The goal of this research was to optimize magnetic resonance imaging (MRI) for evaluating the wrist during in vivo unassisted motion. We hypothesized that dynamic, in vivo, ionizing-radiation free, assessment of actively moving wrist joints (via rapidly acquired dynamic MRI) will (1) allow more precise assessment of wrist dynamics so that dynamic joint

instability could be evaluated and (2) provide detailed data for study of carpal kinematics in the healthy and unstable joint.

Methods: Images were obtained using Siemens 3.0T MRI systems (Trio Tim or Skyra) with a head radiofrequency (RF) coil. A custom-designed MR-compatible wrist harness facilitated standardized, reproducible motion of the wrist inside the RF coil. First, an MRI protocol using a balanced steady state free precession pulse sequence was designed and optimized for tracking a single, preselected imaging slice through the moving wrist. Fifteen wrists of 10 asymptomatic volunteers were scanned using this protocol during active supination/pronation, radial/ulnar deviation, clenched-fist, and the flexion-extension maneuvers. Motion artifacts were minimized using susceptibility pads. Second, to enable volumetric imaging during the wrist's active motion (3D space +1 D time = 4D imaging), an MRI pulse sequence capable of rapid radial k-space acquisition was optimized. Seven wrists of seven asymptomatic volunteers were scanned during the performance of the aforementioned wrist maneuvers. Measurements derived from images included the distal radioulnar joint (DRUJ) congruity, extensor carpi ulnaris (ECU) tendon translation, the scapholunate (SL) interval, and the SL, radiolunate, and capitulunate angles.

Results: We converged on the following acquisition parameters for the optimized True FISP sequence: TR/TE 3.98/1.99 ms, FA 47 degrees, field-of-view 120 × 120 mm, slice thickness 6 mm, matrix size 128 × 128. The resulting temporal resolution, corresponding to image quality allowing for the assessment of the aforementioned imaging metrics, was 0.47 s per slice (2 frames/s). The optimized radial k-space acquisition parameters converged to TR/TE 2.75/1.59 ms, FA 5°, slice thickness 6 mm, matrix size 96 × 96, spokes 80. The temporal resolution was 0.1–0.2 s per slice (5–10 frames/s) based on the field of view. Four slices through the wrist volume were tracked every 0.5 s. Over a 10-s period (two cycles of active wrist motion), 50–100 images (12–25 volumetric 4D imaging stacks) were acquired. Image quality permitted quantitative measurements of markers associated with wrist instability. Representative images and quantitative measures from dynamic MRI were in agreement with literature-reported values.

Conclusions: Dynamic 4D MRI provides direct visualization of wrist joint kinematics, with rapid image acquisition in the presence of rapid motion. Given the high temporal resolution (Phase I: 0.47 s, Phase II: 0.1–0.2 s), short acquisition time (10 s per scan), and negligible increase in costs, additional work is warranted to assess the use of these methods as

supplements to conventional static MRI for “one stop” comprehensive diagnostic wrist imaging. Such imaging will find utility in the assessment of dynamic joint instability, surgical planning and guidance accounting for joint motion, and for the creation of robust and stable biomechanical models of the wrist joints.

A-0113 Mean 5-Year Follow-Up for Suture Button Suspensionplasty in the Treatment of Thumb Carpometacarpal Joint Osteoarthritis

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Objective: Suture-button suspensionplasty (SBS) has been used to treat thumb carpometacarpal joint osteoarthritis (CMCJ OA). While promising short- and medium-term outcomes have been reported, no outcomes beyond 4 years have been published. The aim of this manuscript is to report the longer term outcomes of SBS and comment on the longevity of the procedure.

Methods: We reviewed the charts of 14 patients who underwent 16 SBS procedures for symptomatic thumb CMCJ OA. We recorded demographic data, preoperative Eaton stage, length of follow-up, Quick Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire scores as well as pinch strength, grip strength, range of motion, and metacarpal subsidence. In addition, operative time and postoperative complications were documented.

Results: The average age of our patients was 64 years. There were 12 females and 2 males. Preoperative Eaton stages were III and IV in eight thumbs each. Mean total operative time was 93 min. Mean follow-up was 64 months with mean improvement in quick DASH score of 58.2. Mean palmar and radial abduction was 105% and 97% of the nonoperated thumb, respectively. Kapandji scores for all of the operated thumbs were either 9 or 10. Pinch strength and grip strength was 107% and 105% of the nonoperated side, respectively. Mean trapezial space height was 71%. One patient underwent removal of a symptomatic implant, and two patients were diagnosed with transient neuropraxia of the dorsal radial sensory nerve.

Conclusions: The favorable outcomes (improvement in range of motion and pain relief) of SBS remain durable over time, and our results show that improvement in strength may also be expected over time when utilizing SBS following trapeziectomy for the treatment of thumb CMCJ OA.

A-0114 Simple assessment of global bone density and osteoporosis screening utilizing standard radiographs of the hand

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Objective: Osteoporosis and resultant fragility fractures have vast consequences at both the individual level and the overall health-care system. While dual-energy x-ray absorptiometry (DXA) is the gold standard for assessing bone mineral density (BMD), other simpler tools may be able to provisionally screen bone quality and signal the need for intervention. We hypothesized that the second metacarpal cortical percentage (2MCP) calculated from standard radiographs of the hand or wrist would correlate with hip BMD derived from DXA and could provide a novel simple screening tool for osteoporosis.

Methods: Two hundred consecutive patients who had hand or wrist radiographs and hip DXA scans within 1 year of another were included in this retrospective diagnostic series. Mid-diaphyseal 2MCP was calculated as a ratio of the cortical diameter to the total diameter. The correlation between 2MCP and total hip BMD was assessed. Subjects were stratified into normal, osteopenic, and osteoporotic cohorts based on hip t-scores, and thresholds were identified to optimize screening sensitivity and specificity.

Results: Second metacarpal cortical percentage (2MCP) correlated significantly with BMD and t-scores from the hip. A 2MCP threshold of <60% optimized sensitivity (88%) and specificity (60%) for discerning osteopenic subjects from normal subjects, whereas a threshold of <50% optimized sensitivity (100%) and specificity (91%) for differentiating osteoporotic from normal subjects.

Conclusions: By demonstrating that global BMD may be assessed from 2MCP, our data suggest that radiographs of the hand and wrist can play a roll in accurately screening for osteopenia and osteoporosis. This simple screening tool that is already ubiquitously utilized for patients with hand or wrist problems may help identify patients at risk of fragility fractures and allow for appropriate referral or treatment. Routine use could be valuable for decreasing morbidity on an individual level and improving financial efficiency on a systems level.

A-0115 A biomechanical analysis of two constructs for metacarpal spiral fracture fixation in a cadaver model: Two Large screws versus three small screws

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Objective: Fixation of diaphyseal metacarpal fractures with lagged cortical screws is a technique employed by many surgeons due to the implants' low profile, biomechanical stability, and no need for removal. Frequently surgeons are confronted with a long spiral fracture that may accommodate either several small screws or fewer larger screws. A biomechanical analysis of a metacarpal spiral fracture model was performed to determine whether three 1.5-mm screws or two 2.0-mm screws provided more stability during bending and torsional loading. Any difference could guide the future application of this technique for hand surgeons in the treatment of this fracture.

Methods: Twelve matched pairs of fresh frozen cadaveric upper limbs were obtained for this study. The second and third metacarpal was harvested from each of the pairs. Spiral fractures were created in all specimens via constant external rotation at a rate of 50°/sec. One specimen from each matched pair was fixed with two 2.0-mm cortical lag screws, while the other was fixed with three 1.5-mm cortical lag screws. Nine pairs underwent combined cyclic cantilever bending and axial compressive loading from 0 to 40 N at 1 Hz for 1,000 cycles, followed by loading to failure at 1 mm/sec. Nine additional pairs were subjected to cyclic external rotation from 0 to 0.5 Nm at 1 Hz for 1,000 cycles while under a constant axial compressive load of 30 N. Specimens were then externally rotated to failure at 5 deg/sec while under a constant axial compressive load of 30 N. Paired *t*-tests were used to compare cyclic creep as well as stiffness, displacement, rotation, and peak load levels during load to failure tests.

Results: No significant differences in spiral fracture characteristics were found between the 18 matched pairs used in the study. The average failure torque for all specimens was 7.2 ± 1.7 Nm with an average time to fracture of 0.23 ± 0.04 s. In cyclic torsional testing, the "2 screws" group exhibited significantly less rotational creep than the "3 screws" group. No other significant differences were found between the test groups during torsional or bending tests.

Conclusions: A reliable metacarpal spiral fracture model was developed for evaluating two different fracture fixation constructs. Both constructs are biomechanically similar except that the "2 screws" construct displayed significantly less loosening during torsional cyclic loading. Therefore, it is more financially sound to use two screws instead of three (33% cost savings), especially due to the decreased operative time needed to place the implants when treating these common fractures. These findings may also be extrapolated to spiral fractures of other long bones.

A-0122 Laser therapy in the management of carpal tunnel syndrome: A systematic review and meta-analysis of randomized controlled trials

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Objective: The role of low-level laser therapy (LLLT) in the management of carpal tunnel syndrome (CTS) is controversial – while some trials have shown distinct advantages of LLLT over placebo and other non-surgical treatments, others have not. The aim of this systematic review and meta-analysis was to assess the benefit and harm of LLLT versus placebo and versus other non-surgical intervention in the management of CTS.

Methods: We searched CENTRAL, MEDLINE, EMBASE and Science Citation Index Expanded (until April 2016) for randomized controlled trials (RCT). Furthermore, clinical trial registries were searched for ongoing studies. Only RCTs (irrespective of blinding, publication status or language) comparing LLLT versus placebo or non-surgical treatment for the management of CTS were considered for the systematic review and meta-analysis. The review was reported in accordance with PRISMA guidelines.

Results: Twenty trials randomizing 977 participants were included; 10 studies compared LLLT with placebo, 3 versus ultrasound (USS) and 7 versus other non-surgical interventions. There is very low-quality evidence that LLLT may result in a greater improvement in visual analogue score (VAS) (MD -1.47; CI -2.36 to -0.58), motor nerve latency (MD -0.09; CI -0.16 to -0.03) and sensory nerve latency (MD -0.10; CI -0.15 to 0.06) when compared with placebo at short term (under 3 months) follow-up. There is low-quality evidence that LLLT may result in a greater improvement in grip strength (MD 2.58; CI 1.22 to 3.95) and finger pinch strength (MD 0.94; CI 0.43 to 1.44) when compared with placebo at short term follow-up. The minimal clinically important difference as previously published was met only in visual analogue score and pinch strength.

There is very low quality evidence that LLLT is less effective than USS at short-term follow-up for improvement in VAS (MD 2.81; CI 1.21 to 4.40) and motor nerve latency (MD 0.61; CI 0.27 to 0.95). There is low-quality evidence that LLLT may result in a poorer improvement in finger pinch strength (MD -7.00; CI -9.23 to -4.77) and motor nerve amplitude (MD -1.9; CI -3.63 to -0.18) when compared with USS at short-term follow-up. The minimal clinically important difference

as previously published was met only in visual analogue score and pinch strength. There is insufficient evidence to show that LLLT is superior or when compared to other non-surgical interventions. No trials reported adverse events as an outcome in any of the comparisons.

Conclusions: There is low- and very low quality evidence to suggest that LLLT may be more effective than placebo in the management of CTS for short-term, clinically significant improvements in pain and finger pinch strength. There is similarly low- and very low quality evidence to suggest that LLLT is less effective than USS in the management of CTS for short-term, clinically significant improvements in pain and finger pinch strength. There is insufficient evidence to support the benefit of LLLT over any other type of non-surgical treatment in the management of CTS. Further randomized trials with low risk of bias are needed.

A-0124 Skin manifestations in territory innervated by median nerve: A new semeiological criterion of carpal tunnel syndrome

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Background: Carpal tunnel syndrome (CTS) is a chronic compression neuropathy with sensory and motor nerve conduction abnormalities. Several studies documented neurophysiologic alterations during CTS but didn't evaluate skin manifestations in territory innervated by median nerve.

Aim: We evaluated skin alterations in patients affected by CTS.

Methods: We examined 273 patients affected by CTS (99 M and 123 F; aged 68.3 years) and observed if neurological symptoms were associated with skin abnormalities.

Results: We found skin damage in 197 patients (72.2%; 74 – 74.7% M, 123 – 70.7% F). Skin changes included anhidrosis, alopecia, nail dystrophy, and Reynould's phenomena/cyanosis. All alterations were localized in territory innervated by median nerve not associated with itch and appeared in particular seasons.

Discussion: These data suggest that chronic compression neuropathy could modify complex systems that control not only nerve sensory conduction but also cutaneous trophism and immune response by causing vasa nervorum's alteration and consequently diseases in synthesis/release of neuropeptides (NP), mediator of different dermatoses, involved

in the transmission of signals between neurons, immune system, and cutaneous cells. Altered NP levels caused by impaired nerve function represent a deficit in skin homeostasis with a drastic reduction in epidermal thickness, shining, and resistance to noxious stimuli.

Conclusions: Cutaneous manifestations, not itching, localized in territory innervated by median nerve and with seasonal course could be considered a new semeiologic criterion of CTS. So many different biologic actions of NP have been demonstrated, but there aren't studies about influence of NP on skin manifestations associated with compression of peripheral nerves. It can be useful to evaluate qualitative-quantitative variations in cutaneous levels of some NP in course of CTS to elucidate interaction mechanisms and for a new prospects for the prevention, and treatment of this type of skin diseases, by using this peptides. Finally, we have noticed an improvement in skin symptoms after decompression of the nerve, the complete disappearance in other cases

A-0126 Transverse and short oblique metacarpal fractures: Outcomes of retrograde cannulated headless screw fixation

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Purpose: Metacarpal fractures are common, accounting for 20–22% of all hand fractures. When displaced, these fractures can be managed with simple cast, K-wires, screws, or plates. No single operative method has been shown to be superior in clinical studies. The aim of this article is to show the results of intramedullary cannulated headless screw (CHS) fixation and to analyze the proportion between the metacarpal height and the screw length that afford better outcomes.

Materials and methods: We did a prospective study between March 2015 and March 2016, with 32 consecutive metacarpal fractures in 30 patients. Transverse (T: 11), short oblique (SHO: 21) fractures were included. Anatomic locations were neck (21) and shaft (11). All fractures were treated with a single 3.5-mm retrograde intramedullary cannulated headless screw. The average age was 37.1 (20–76). Minimum follow-up was 3 months. Clinical assessment consisted on: DASH, VAS, TAM, grip strength, and return to daily activities. Regarding reduction, it was considered excellent (volar angulation $<18^\circ$), good (19–30°), fair (31°–50°), or unsatisfactory ($>50^\circ$). Consolidation time, shortening, secondary displacement, and the measurement of

metacarpal–screw index (MSI), which represents the proportion between the metacarpal height and the screw length, were also recorded.

Results: The average TAM was 255° (210°–270°). Grip strength was 77.8 % compared to the contralateral side. VAS was 1.93. Mean DASH score was 23.5. All patients returned to unlimited leisure activities after an average of 4 weeks. There were no complications. Considering clinical assessment, there were no statistical meaningful differences between location or fracture patterns groups. The average consolidation time of the entire sample was 7.2 weeks (4–12 weeks), with a median of 6. Reduction was excellent 46.88% (T:10 SHO:5), good 18.75% (T:1 SHO:5), and fair 34.37% (T:0 SHO:11) without unsatisfactory results. There were no secondary displacements. Radiological measurements showed an association among a value of $MSI > 1.7$ and fair reduction in 61.54% and an $MSI < 1.7$ associated with excellent or good reduction in 78.95% ($p = 0.02$) (OR IC 95%: 0.16). Significant differences were recorded about the consolidation time, $MSI > 1.7$: 8 weeks, and $MSI < 1.7$: 6 weeks ($p = 0.002$).

Conclusion: The minimally invasive technique with retrograde CHS used in displaced transverse and short oblique metacarpal fractures is technically simple, effective, and with very few drawbacks. We found that the metacarpal–screw index less than 1.7 provides statistically significant advantages regarding consolidation time and reduction. Besides, according to our analysis, the short oblique fracture patterns had worse reduction than the transverse one with this method; nevertheless, this fact was not important regarding final clinical outcome.

A-0129 Distal radius fracture patients over 70 years of age showed declined body balancing ability and osteoporosis

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Objective: Fragility fractures of the distal radius are associated with an increased risk of future hip and spine fracture, so the importance of body balancing ability and bone quality in fall and secondary fracture prevention is well recognized. We assessed body balancing ability, grip strength, and bone quality of women patients with distal radius fractures (DRF)

who underwent surgery and identified the characteristic of the patients aged 70 years and older.

Methods: A prospective multicenter study, approved by IRB, of 146 women with their first fragility fracture of the distal radius who underwent surgery in registered hospitals from January to December in 2015 was conducted. Two weeks after surgery, their body balancing ability was measured by four methods: Functional Reach Test (FRT), Timed Up and Go test (TUG), 2 Step test (2ST), and Timed Unipedal Stance test with eyes open (TUS). 2S is the score obtained by dividing height by the maximum length of the double stride. Grip strength on the nonfracture side (GS) and bone density (T-score) were also measured at the same time point. Statistical analysis was performed using the Student's *t* test to compare the Japanese normative values of same age range, and $p < 0.05$ was considered significant.

Results: FRT was 29.6 cm in women in their 40s ($p = 0.03$), 31.1 cm in women in their 50s ($p = 0.002$), 32.5 cm in women in their 60s ($p < 0.001$), and 28.2 cm in women in their 70s ($p < 0.001$). TUG was 7.7 s in women in their 50s ($p < 0.001$), 7.1 s in women in their 60s ($p = 0.002$), and 8.1 s in women in their 70s ($p = 0.004$). 2ST was 1.40 in women in their 40s, 1.32 in women in their 50s ($p = 0.003$), 1.29 in women in their 60s ($p < 0.001$), 1.21 in women in their 70s ($p < 0.001$), and 1.02 in women in their 80s ($p = 0.01$). TUS was 55 s in women in their 60s ($p < 0.001$). GS was 20.9 kg in women in their 50s, 19.3 kg in women in their 60s, and 18.2 kg in women in their 80s. Only 25% of subjects showed a lower T-score than -2.5.

Conclusion: Patients with DRF showed significantly lower body balancing ability, especially during dynamic motion like FRT, TUG and 2ST. GS was also significantly lower. Most of 40s and 50s did not show osteoporosis, but most of 70s and 80s met the criteria of osteoporosis. This means intervention of osteoporosis treatment is necessary for these ages after DRF. Patients with DRF 70 years of age and older should be identified as those at "high risk" of falls and secondary fractures. Intensive training could be effective for fall prevention.

A-0135 Quantitative measurements of cross-sectional configuration of flexor pollicis longus tendon using ultrasonography in patients with pediatric trigger thumb

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Pediatric trigger thumb is regarded as an acquired condition characterized by flexion deformity of the interphalangeal joint of the thumb. However, the exact etiology or pathoanatomy of this condition remains unknown. The purpose of this study is to evaluate cross-sectional configurations of the flexor pollicis longus (FPL) tendon and the inner space of the A1 pulley quantitatively using ultrasonography. Forty-four patients, 24 boys and 20 girls, with unilateral pediatric trigger thumb were enrolled in this study. We measured the anteroposterior (AP) distance, radioulnar (RU) distance, and cross-sectional area of the FPL tendon 1 cm proximal to the A1 pulley and those of inner space of the A1 pulley using ultrasonography. The measurements were repeated on the contralateral normal side. The average age at the time of the measurements was 34.6 months. The average AP distance of the FPL tendon was 55% longer than that in the inner area of the A1 pulley, and the average RU distance of the FPL tendon was 12% longer than that in the inner area of the A1 pulley. The average cross-sectional area of the FPL tendon 1 cm proximal to the A1 pulley was 76% larger than inner area of the A1 pulley.

In the comparison of the cross-sectional configuration of the FPL tendon and inner area of the A1 pulley, the AP distance of the FPL tendon was more increased than the RU distance of the FPL tendon. Increased AP distance of the FPL tendon seems to be a major cause of the flexion deformity and triggering in the pediatric trigger thumb.

A-0139 Biomechanical comparison of six-strand modified Lim-Tsai vs Tang Flexor tendon repair techniques

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The 6-strand Tang technique of flexor tendon repair has been reported to show superior in vitro results when compared to other core suture techniques. We aim to compare the biomechanical performance of the Tang and 6-strand modified Lim-Tsai repairs. Twenty fresh frozen porcine flexor tendons were randomized into two equal groups for repair with either the modified Lim-Tsai or Tang repair technique with Supramid 4-0 sutures, in addition to an epitendinous running suture with Ethilon 6-0. They were subjected to cyclic tests to record the survival rate and gap formation at the repair site. After 1,000 cycles of distraction at 1Hz,

tendons in the Tang repair group achieved 80% survival rate. None of the modified Lim-Tsai repairs survived beyond 900 cycles. The mean gap formed at the end of 1,000 cycles was 1.09 mm in the Tang group, compared to 4.15 mm in the modified Lim-Tsai group. In conclusion, the Tang repair is biomechanically stronger than the modified Lim-Tsai repair under cyclic loading.

A-0141 Combined remotion TWA and DRUJ hemi-arthroplasty

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Objectives: It is claimed to be an advantage of some latest generation designs for total wrist arthroplasty (TWA) that they can be combined with ulnar head arthroplasty (UHA). So far, no substantial reports are published on this particular combined procedure. The purpose of this study was to present data from the International Remotion Register with focus on the combination of Remotion TWA (R-TWA) and UHA, and, for comparison, other procedures on the DRUJ (ulnar head resection or Sauvé-Kapandji procedure – UHR/SK).

Methods: The Register was screened for the combination of R-TWA and UHA or UHR/SK, performed either in one session or as separate procedures. Demographics were analyzed as far as all entries are concerned. Follow-up data were analyzed for combined procedures performed in one session.

Results: The Register contained data on a total of 383 R-TWA. 39 were combined R-TWA – UHA, performed in 3 of the 14 clinics that made entries in the Register. For comparison, the number of UHR/SK reached 116, performed in 13 of the clinics. Both UHA and UHR/SK were mainly performed in patients with inflammatory arthritis and more frequently in females than in males, but other diagnostic groups were represented as well (post-traumatic, idiopathic osteoarthritis and others). 72% of the UHA's used were Eclipse and 21% SBI. 87% were implanted simultaneously with the TWA. There was a significant tendency towards better ulnar–radial motion in the UHA-group compared to the UHR-group at follow-up, but there were no significant differences in terms of palmar–dorsal motion,

forearm rotation, grip strength, QDASH-score, or VAS-score for wrist pain.

Conclusions: According to the International Remotion Register, combined R-TWA and UHA is performed in a restricted number of cases and only by a restricted number of clinics. By contrast, combined R-TWA and UHR is performed more frequently and by the majority of clinics. Both combined procedures are mostly but not exclusively used in cases with inflammatory arthritis. We could not reveal any clear argument in favour of performing ulnar head replacement rather than ulnar head resection.

A-0142 Effects of humeral shortening on the three-dimensional configuration of the brachial plexus

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Objectives: This study evaluates the gains in length of different brachial plexus segments after three different sizes of humeral shortening osteotomy and the possibilities of brachial plexus direct suture. Finally, a three-dimensional model of the brachial plexus was built in order to better visualize the parts of brachial plexus that are most susceptible to get benefit from the humeral shortening and to better define the indications of this technique for postganglion lesions.

Study Design and Methods: Ten paired brachial plexuses of five fresh frozen cadavers were dissected. The lengths of the different parts of the brachial plexus were measured using a precision three-dimensional mapping system (FARO Arm®), allowing the construction of three-dimensional models of the brachial plexus. The measurements were repeated after humeral shaft shortening of two, four and six centimeters and after a standardized 0.6 Newton tensioning of the plexus. Nerve suturability was then studied, in the various states of humeral shortening, after prior removal of brachial plexus nerve segments. A three-way ANOVA followed by a Bonferroni post hoc test was used for statistical analysis.

Results: Humeral shortening did not allow significant gains in length at superior trunk and posterior cord ($p > 0.05$) because these structures were relative fixed by respectively the suprascapular and axillary nerves. Humeral shortening allowed significant

($p < 0.05$) gains in length at the level of the lateral cord, medial cord, musculocutaneous, median, and ulnar nerves. When the musculocutaneous nerve did not pass proximally through the coracobrachialis muscle, the gains of length increased by 30–50 %. A 2-cm shortening enabled 2-cm length defect direct suture in 70–90 % of cases, regardless of the involved trunk.

Conclusions: Despite the fact that in clinical situations, nerves defects may be larger than the gain observed after humeral shortening when performing even a 6-cm humeral shortening and the potential complications of a humeral osteotomy; this study shows that humeral shortening osteotomy and tensioning of the plexus would enable the direct suture of nerve defects at the level of the lateral cord or medium cord and musculocutaneous, median and/or ulnar nerves avoiding the use of nerve grafts.

A-0143 Elbow flexion reconstruction after traumatic adult brachial pan-plexus injury: Free functioning gracilis muscle transfer versus intercostal nerve transfer to musculocutaneous nerve

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After complete five-level root brachial plexus injury, free functional muscle transfer (FFMT) and intercostal nerve transfer (ICN) to musculocutaneous nerve (MCN) are two potential reconstructive options for elbow flexion. The aim of this study is to determine the role of gracilis FFMT and to determine the outcomes of FFMT versus ICN to MCN transfers with respect to strength. Sixty-two patients who underwent FFMT (neurotized by SAN or ICN) reconstruction or ICN to MCN transfer for elbow flexion following a panplexus injury were included. The two groups were compared with respect to postoperative elbow flexion strength according to the British Medical Research Council grading system, preoperative and

postoperative DASH scores, time from injury to operation, number of donor nerves as well as demographic characteristics. In the FFMT group, 67.7% patients achieved M3 or M4 elbow flexion. In the ICN to MCN group, 41.9% patients achieved M3 or M4 elbow flexion. The difference was statistically significant (p value < 0.05). Changes in DASH scores were not statistically significant. Average time from injury to surgery was significantly different (p value < 0.01) in both the groups. The number of ICN used for the MCN transfer did not correlate with better elbow flexion grade. No differences between ICN and SAN for FFMT neurotization were found. Based on this study, gracilis FFMT reconstruction achieves better elbow flexion strength than ICN to MCN transfer for elbow flexion after pan-plexus injury. The role of gracilis FFMT should be carefully considered in acute reconstruction.

A-0144 Nontraumatic “isolated” anterior interosseous nerve palsy: Reinterpretation of MRIs and electrodiagnostic studies

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Different hypotheses have been proposed for the pathophysiology of anterior interosseous nerve (AIN) palsy: compression, fascicular constriction, or nerve inflammation (Parsonage-Turner Syndrome). We hypothesized that critical reinterpretation of electrodiagnostic studies (EDX) and magnetic resonance imaging (MRI) of patients with a diagnosis of AIN palsy could provide insight into the pathophysiology and treatment. A retrospective review was performed of all patients with a diagnosis of nontraumatic AIN palsy and an upper extremity MRI performed at our institution. The original EDX and MRI reports were reinterpreted by a neuromuscular neurologist and musculoskeletal radiologist, respectively, both blinded to our hypothesis. One hundred and twenty-three patients were identified with nontraumatic AIN palsy. Of these, 16 patients met the inclusion criteria as

having “isolated” AIN palsy. Physical examination revealed weakness in muscles not innervated by the AIN in 5 (31%) cases and EDX abnormalities not related to the AIN were found in 9 (60%) cases. The initial MRI report described atrophy in muscles not innervated by the AIN or nerve enlargement different from the AIN in 8 (50%) cases. In all cases, reinterpretation of the MRIs demonstrated atrophy in at least one muscle not innervated by the AIN and did not reveal any evidence of compression of the AIN. All patients in our series with presumed isolated AIN palsy had MRI evidence of a more diffuse muscle involvement pattern, without any radiologic signs of nerve compression of the AIN branch itself. These data strongly support an inflammatory pathophysiology.

A-0159 The use of prosthesis in carpometacarpal osteoarthritis of the thumb: An international survey about the surgical treatment

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Objective: Advanced carpometacarpal osteoarthritis of the thumb is treated most often with the resection of the trapezoid with or without tendon interposition or ligament reconstruction. The use of a prosthesis is discussed controversially in the literature stating many complications and unreliable long-term results. Systemic reviews couldn't show a significant advantage or disadvantage of any given surgical method regarding the outcome of strength and function. Our goal was the international assessment of actually used surgical techniques and the evaluation of the number of surgeons who do use prosthesis in the treatment and which are their experiences so far.
Methods: We conducted a large international online survey with members of hand surgical societies of the International Federation of Societies for Surgery

of the Hand. The survey was conducted by e-mail, sending a link of the survey (surveymonkey.com) to the respective members. The first part of the survey was about general therapy options depending on the severity of the disease, whereas the second part specifically dealt with the use of prosthesis in carpometacarpal osteoarthritis. It was evaluated which types of prosthesis are used and how many are implanted per year, which complications are common, which is the preferred surgical access, and which is an ideal patient for a prosthesis.

Results: We could include 12 of 56 hand surgical societies (7,200 members) from which 1,180 answered our survey. The most commonly used procedure to treat carpometacarpal osteoarthritis of the thumb is the resection arthroplasty in stage III and IV after Eaton and Littler. On average, 30% of the members of each countries participants use prosthesis of different types as treatment option but state dislocations and loosening of the shafts as the most common complications with a complication rate between 1% and 10% in the majority. Advantages of prosthesis were commented in a faster rehabilitation, a good grip strength as well as in the maintenance of bone length through sparing bone excision. High complication rates and expensive implants were indicated as disadvantages. The ideal patient for a prosthesis is between 30 and 70 years old, doesn't need her or his hands for manually demanding labor or practices high precision work according to the survey results.

Conclusion: Prosthesis are used by about 17% of the participating members but are still associated with many complications and high costs. The resection arthroplasty on the other hand is a safe, reliable, and cheap treatment option used by 99% of the surgeons of this survey. The use of prosthesis can be an advantage for certain patients who would benefit from an early rehabilitation and a good grip strength, certainly requiring a lot of experience of the surgeon. Additionally, a sparing bone excision in the use of a prosthesis can still enable a resection arthroplasty later on if deemed necessary.

A-0162 Outcome of distal radioulnar joint in Galeazzi Lesions: 11-year follow-up

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Objective: To evaluate clinical, radiological, and tomographic long-term evolution of the distal radioulnar joint in Galeazzi lesions treated with open reduction and internal fixation of the radius component and indirect reduction of distal radioulnar joint dislocation.

Material and Methods: We retrospectively evaluated patients with Galeazzi lesions; the inclusion criteria were patients older than 18 years, treated with open reduction and internal fixation of radial fracture, and nonsurgical reduction of distal radioulnar joint dislocation, with postoperative immobilization in slight supination for 3 weeks. All cases with open reduction of the distal radioulnar joint and follow-up of less than 6 years were excluded. We evaluated pain using the Visual Analog Scale and Swanson Scale; function was assessed by DASH score. Wrist range of motion – flexion-extension, lateral deviation and pronosupination – was measured bilaterally with a manual goniometer. Bilateral grip strength was recorded with a Jamar Dynamometer. Distal radioulnar piano key sign was tested bilaterally with the wrist in neutral rotation, maximum pronation and maximum supination to evaluate joint stability. Bilateral true anteroposterior (AP) and lateral X-rays were taken at final follow-up; ulnar dorsal subluxation was measured with respect to the radial axis on lateral X-rays. Radial shortening was measured by taking the ulnar variance on AP X-rays. Distal radioulnar joint arthritis signs were classified following Knirk and Jupiter's scale. Computed tomography (CT) scans of both wrists were taken in three positions – neutral rotation, supination, and pronation. On the axial slices, distal radioulnar joint subluxation was evaluated using the Mino and radioulnar ratio methods. Arthritis signs in the distal radioulnar joint were also recorded.

Results: Fourteen patients met the inclusion criteria; average follow-up was 11.5 years (6–18 years). Twelve were male, and the mean age at the time of lesion was 38 years (18–59). The final evaluation revealed nine patients without pain; three had pain with heavy tasks and two with moderate efforts. Final pain intensity according to the Visual Analog Scale was on average 0.3 (0–3). Average DASH was 3 (0–9).

Wrist flexion-extension was 98%, lateral deviation 95%, and pronosupination 97%; grip strength was 77%, and three patients had piano key sign positive for instability, but none produced pain. All these measurements were recorded comparative to the contralateral wrist. Final lateral X-rays showed one patient with dorsal radioulnar subluxation. However, CT scans showed no cases of distal radioulnar joint subluxation. The average final ulnar variance was 0 mm on the injured side and –0.5 mm on the contralateral wrist. Six patients had radiologic arthritis grade II and two had grade I. The remaining six patients had no signs of arthritis either in X-rays or in CT scans.

Conclusions: Clinical and radiological long-term results showed a stable distal radioulnar joint. Even when almost half of the patients had arthritic changes

in the distal radioulnar joint on the lesion side, they had no significant clinical repercussions, giving a painless joint with an excellent range of motion

A-0172 Dual mobility trapezio-metacarpal implant: Principles and clinical series

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We present the results of a study of the first 65 Touch dual-mobility prostheses with a follow-up of more than 1 year. Articulated prostheses are becoming increasingly popular for the treatment of trapezio-metacarpal osteoarthritis because they provide better results in terms of mobility, strength, and recovery time than trapeziectomies. Early dislocation rate remains high. Dual mobility TM implant with an increased radius of curvature, and an increased range of motion should help to reduce the dislocation rate, the rate of late trapezium loosening, and wear of polyethylen insert. We have conducted prospective follow-up of our patients and present the results of the first 65 cases operated by 3 surgeons with a follow-up of more than 1 year of a total of 450 implants. The prosthesis was implanted in a context of revision of painful trapeziectomy in two cases. Clinical and radiological data were entered into a review database and were analyzed by an independent observer. This series comprised 54 women and 11 men with a mean age 65.2 years. Mean follow-up at the time of review was 18.6 months. The level of work or leisure activities was light in 51% of cases, heavy in 10% of cases, and limited to housework in 39% of cases. The mean duration of resin immobilization was 21 days (2 months after trapeziectomies), followed by self-rehabilitation. The mean preoperative QUICK-DASH score was 37.14, and the mean postoperative QUICK-DASH score was 18.8. The mean pain VAS score decreased from 7.22 to 1.54. Significant gains of mobility were observed, especially for thumb abduction: + 44%, which restored complete opening of the thumb in the majority of cases. Antepulsion was increased by 27%. Kapandji score was increased by 13%. Strength was improved by 46%. 37% of patients presented metacarpophalangeal hyperextension before the operation versus 17.5% after the operation. There were 10 Z-deformity thumbs before the operation, and all were corrected postoperatively, without an associated metacarpophalangeal joint procedure. The Dell stage distribution was: stage 2: 15 cases, stage 3: 20 cases and stage 4: 8 cases. The M1–M2 ratio was 0.68 before the implant and increased to an average of 0.74

(normal value) immediately after the operation. This ratio was maintained at last follow-up.

Restoration of normal length of the thumb accounts for correction of metacarpophalangeal hyperextension in one half of cases as a result of restoration of bone axes and muscle levers.

It also contributes to recovery of strength by restoring normal muscle levers. No case of dislocation was observed in this series of 450 prostheses, partly due to the increased radius of curvature of the metacarpal head and partly due to the large range of joint motion of the prosthesis, which compensates for small errors of orientation of the cup, thereby avoiding a cam effect. Our preliminary results are superior to those of all series of nonconstrained prostheses in terms of dislocation rate, as no implants needed to be removed because of repeated dislocation. A longer follow-up will be necessary to confirm the low rate of loosening and wear of the implant.

A-0173 Approach to the fixation of a scaphoid waist fracture, perpendicular to the fracture: Cadaver model

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Objective: The majority of waist fractures of the scaphoid have been found to be horizontal oblique. In these fractures, screw fixation along the longitudinal axis of the scaphoid is at a great angle to the fracture and may be less efficient. Our hypothesis was that it is possible to place a screw perpendicular to the horizontal oblique fracture from a volar as well as a dorsal approach. This approach may differ from the common approaches used today.

Methods: Computed tomography (CT) of 12 cadaver wrists were performed in three positions – maximum flexion, neutral position, and maximum extension. The scans were evaluated using a three-dimensional model, including simulation of transverse (90°) and horizontal oblique (60°) fractures and depiction of possible screw axes, examining the possible approaches for its insertion. The location of possible entry points for the preferred approaches was measured as well.

Results: The preferred approach for perpendicular screw placement in transverse (90°) fractures was found to be proximal–dorsal or transtrapezial in flexed or neutral positions and distal in the extended position (volar to volar–radial trapezium). For a horizontal oblique (60°) fracture, the best approaches were proximal–dorsal in flexion or transtrapezial in

the extended or neutral positions (through the radiovolar trapezium). In these approaches, the screw could be placed perfectly perpendicular and in the center of the fracture in all specimens. The entry point was either a mean of 7 mm from the volar–radial trapezium edge distally, 2 mm radial to Lister's tubercle axis along the joint line in a neutral position, or 12 mm proximal to the dorsal apex of the scaphoid ridge if performed through an open approach.

Conclusions: It is possible to place a perpendicular screw in the center of the fracture using a proximal–dorsal approach in flexion or a transtrapezial approach in neutral or extension, according to this simulation of a scaphoid waist horizontal oblique fracture.

A-0176 Nonvascularized iliac bone grafting for scaphoid nonunion with avascular necrosis

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Objective: Vascularized bone grafting has been regarded as the standard surgical option for scaphoid nonunion with avascular necrosis (AVN), and the vascularized bone is commonly harvested from the distal radius. However, an adequate amount of bone cannot always be harvested from the distal radius, and the quality and strength of the bone are inferior to those of the iliac bone. In this report, we present the surgical outcomes of nonvascularized bone grafting in patients with scaphoid nonunion combined with AVN.

Methods: From January 2005 to December 2013, 31 consecutive patients with established scaphoid nonunion, proximal pole AVN, and no prior surgery were treated with open reduction, internal fixation with multiple K-wires or headless compression screws, and nonvascularized iliac bone grafting. AVN of the proximal fragment was identified with computed tomography and/or magnetic resonance imaging preoperatively and confirmed intraoperatively. The average interval from injury to surgery was 32.6 months. Fractures occurred at the scaphoid waist in 20 patients and at the proximal pole in 11. The Fisk-Fernandez technique was used in 14 patients who had humpback deformities or severe shortening of the scaphoid, and cancellous bone grafting was used in 17 patients who did not have severe deformities of the scaphoid. The patients were followed up at 2, 4, 8, and 12 weeks after surgery and monthly thereafter until bony union of the scaphoid was confirmed. Differences between

the preoperative and postoperative range of motion, grip strength, scapholunate angle, scaphoid height-to-length ratio, and modified Mayo wrist score were analyzed using the Wilcoxon signed-rank test.

Results: Of the 31 patients, bony union was achieved in 28 (90%). The average time to union was 12.1 weeks. Bony union was achieved in 15 (88%) of 17 patients who had undergone surgery with a nonvascularized cancellous bone graft and in 13 (93%) of 14 patients who underwent surgical management using the Fisk-Fernandez technique. The mean scapholunate angle was improved significantly from 63.0° to 55.5°, and the average scaphoid height-to-length ratio also changed significantly from 0.60 to 0.57. The range of wrist motion and grip strength improved, and the modified Mayo wrist score improved significantly from 51.5 to 70.6 points 2 years after surgery.

Conclusion: Using an appropriate surgical technique, suitable fixation devices, and a careful immobilization protocol, successful outcomes can be achieved using nonvascularized iliac bone grafts in scaphoid nonunion with AVN. Although we did not evaluate revascularization of the proximal fragment after surgery, we did achieve bony union in most cases.

A-0182 Outcome of the different dosages of triamcinolone acetonide injection in the management of trigger finger

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Purpose: This study was designed to compare the efficacy and safety between three different doses of triamcinolone for the treatment of trigger finger.

Methods: Ninety-three patients with a total of 120 trigger digits were included in the study. The involved digits were randomized to three groups. Each group received treatment consisting of injection with 5, 10, or 20 mg triamcinolone acetonide. The natural history of clinical response to the steroid was evaluated during the first 6 weeks after injection. The success rate was determined at 3, 6, 9, and 12 months after injection.

Results: After the injections, pain and triggering improved gradually and nearly resolved completely at 6 weeks in all dosages. But the 5-mg group has significantly more discomfort when compare to the other groups. The dose-related pattern was found at 3 and 6 months after the injection. The 20-mg group has a significant higher success rate when compared to the 5 and 10 mg at 3 and 6 months. The 10-mg group has significant higher success rate when compare to 5 mg

at 3 months. There were no differences of success rate between the groups at 9 and 12 months.

Conclusions: The dose-response characteristic was also demonstrated in the treatment of trigger finger with triamcinolone acetonide. The differences in outcome began to show at 6 weeks and obviously at 3 months after injection and gradually declined overtime.

A-0183 Hand therapy after collagenase *Clostridium histolyticum* injection treatment in Dupuytren's disease

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Objective: Hand therapy is essential after surgical and pharmacological treatment of Dupuytren's disease to achieve adequate function of the affected hand. Its goals are the reduction of edema, prevention of stiffness and the retrieval of a normal range of motion and hand function. Research on the effectiveness of applied hand therapy methods after collagenase *Clostridium histolyticum* (CCH) injection in clinical practice is poor. This study provides a synthesis evaluating the scope of research on use and implementation of different hand therapy methods after CCH injection treatment in clinical practice and their outcomes.

Method: Multiple electronic databases and journals were searched for available information on Dupuytren's disease. The studies were classified using the Oxford Level of Evidence and the Structured Effectiveness Quality Evaluation Scale (SEQES).

RESULTS: Orthosis and hand exercises were the most applied methods in the five analyzed studies (one CCT, two review reports, one expert opinion, and one review article). The sample size of the studies varied from 4 to 144 patients. The Level of Evidence (Oxford) and the SEQES-Scores in the included studies ranged from IIc to V and from 6 to 33, respectively. Treatment included wearing of orthosis and doing hand exercises from 6 weeks to 6 months. In general, no evidence for the effectiveness of hand therapy on range of motion, physical function, and patient satisfaction was found.

Conclusion: The effect of hand therapy after CCH injection treatment is rarely investigated or researched in common with the pharmacological intervention. Thus, it is difficult to determine the individual contribution of hand therapy on treatment outcomes. The heterogeneity of Dupuytren's disease history, small sample sizes, and short follow-ups are also reasons for nonsignificant results. There is a

need for more high-quality research examining the methods of hand therapy after CCH treatment in regard to therapy effectiveness.

A-0184 Immediate mobilization after distal radius fractures stabilized by volar locking plate: A prospective randomized trial

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Objective: Distal radius fractures (DRFs) are very common, and operative treatment by volar locking plate became the standard therapy in the last decade. Furthermore, incidence of DRF will increase of 50% by 2030. So, surgical treatment and aftercare are of great interest. Main reason for open reduction and stabilization with a palmar locking plate is the possibility for early postoperative mobilization. There are only a few studies that compare early postoperative mobilization after DRF with immobilization. Main aim of this study was to compare early postoperative mobilization after DRF with a 5-week cast immobilization. Null hypothesis was that early mobilization leads to equal results in range of motion (ROM) and functional outcome scores than an immobilization of 5 weeks.

Materials and Methods: Thirty patients with an isolated distal radius fracture treated by open reduction and internal fixation with a single volar locking plate without bone graft were prospective randomized in two groups. One group ("early mobilization"; EM) received a removable thermoplastic splint for 1 week and was allowed to move the wrist directly postoperative. The other group ("immobilization group"; IM) received a nonremovable cast for 5 weeks. Both groups underwent physiotherapy 2 times a week. At 6 weeks, 9 weeks, 3 months, 6 months, and 1-year postsurgery, ROM, grip strength, and radiographs had been evaluated. Additionally, Quick Disability of the Arm, Shoulder and Hand (QuickDASH) questionnaire, Patient-rated Wrist Evaluation (PRWE), modified Green O'Brien (Mayo) score, and pain according to the visual analog scale (VAS) score was analyzed.

Results: Patients in the EM group had significant better range of motion in the sagittal plane and grip strength up to 6 months ($p = 0.03$; $p = 0.04$), in the

frontal plane up to 9 weeks ($p = 0.04$), and in forearm rotation up to 6 weeks ($p = 0.03$). As well QuickDASH and PRWE score had been better up to 6 weeks postsurgery ($p = 0.002$; $p = 0.02$). The modified Green O'Brien Score differed significantly up to 1 year ($p = 0.002$). At 1 year, 93% "excellent" and "good" results in the Green and O'Brien Score with a mean QuickDASH of 5.98 ± 10.94 and PRWE score of 4.27 ± 9.23 was observed in the EM group. No differences with respect to loss of reduction, pain, duration of physiotherapy, and sick leave had been detected.

Conclusion: Early wrist mobilization after distal radius fractures, stabilized by a volar locking plate (without bone graft), is a save postsurgery treatment and leads to an improved range of motion and grip strength up to 6 months postsurgery compared to a 5-week immobilization.

A-0187 Autologous fat injection for osteoarthritis of the thumb: Long-term results of 60 patients

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There is preliminary data suggesting that intraarticular autologous fat injection may be beneficial in osteoarthritis of the thumb. We have conducted a prospective pilot study testing this new method regarding its clinical outcome. Here we report 1-year results of 60 patients.

Methods: Up to now, we included 100 patients (m:w = 1:1.7) with CMC joint osteoarthritis in our study. Patients were aged 23–76 years, with a median age of 61 years. Under local anesthesia, a liposuction of about 10 ml abdominal fat tissue was performed. The fat was homogenized using two syringes connected with a Luer Loc. Without any further centrifugation, between 1 and 1.5 ml of fat tissue were injected into the CMC joint under radiologic control. After an immobilization for 7 days in a cast, patients were instructed to regularly use their thumb in daily life. Follow-up controls were done after 2 and 6 weeks and after 3, 6, and 12 months. Preoperative and postoperative outcomes were measured by DASH Score, MHQ, VAS, ROM, and pinch grip strength.

Results: The VAS in rest and in motion showed an improvement that became significant after 6 weeks.

Similarly, the 3-month follow-up results of VAS were significant. The results of quality of life measured by the DASH and the MHQ both showed significant improvements as well. The study's success is substantiated by the patient's willingness to repeat the operation: Roughly 75% have affirmed to undergo the same surgery again. Both the grip and the pinch grip showed no significant change in pre- and postoperative values. Our longest follow-up results were taken 24 months after surgery. Only 2 participating patients required further medical intervention. five patients dropped out of the study.

Conclusion: The 1-year results indicate that intra-articular autologous fat injection is a promising alternative treatment of CMC joint osteoarthritis of the thumb. The introduced method is a relatively simple and safe operation performed in an ambulatory/office setting that reduces pain, improves quality of life, and postpones definite surgery.

A-0189 Arthroscopic-assisted capsuloplasty in scapholunate tears: The role of the dorsal capsulo-scapholunate septum

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Introduction: Our understanding of carpal instabilities – of scapholunate (SL) dissociation in particular – is under rapid evolution. This is due to new findings in biomechanics (Elsaidi et al., 2004) as well as to the identification of a novel structure – the Dorsal Capsulo-Scapholunate Septum – which acts as a major stabilizer of the scapholunate complex (Overstraeten et al., 2013). Also, a new technique of scapholunate ligament suture showed good results. This is surprising, as results of open suture are less good and suture in terms of a soft tissue procedure is often infeasible because of SL ligament avulsion. We therefore redefined the arthroscopic technique: Instead of trying to catch the SL ligament with two converging needles, we used two diverging needles in the attempt to catch the remaining attachments of the dorsal capsulo-scapholunate septum.

Methods: The study was set out as a bicenter study. This included 63 patients in a prospective follow-up, which had an arthroscopically assisted dorsal SL-capsuloplasty between 2009 and 2015. Standard clinical assessment for pain, range of motion (ROM), and grip strength was performed, followed by radiographic assessment of SL gap and SL angle. Patients were stratified according to acute/chronic trauma,

dynamic or static instability on radiographies, and according to Messina-EWAS classification.

Results: After a mean follow-up of almost 2 years, we found significantly decreased SL gaps in both *p*PA and clenched fist views among dynamic instabilities, regardless whether they were acute or chronic. This applied also to instabilities grade EWAS IIIB and IIIC. Postoperative range of motion was not significantly affected by this procedure. Mean postoperative VAS at rest decreased about 90%, mean postoperative VAS under load about 70%. Mean postoperative Mayo Wrist Score was 83, and mean DASH score 12.7.

Conclusion: Arthroscopic capsulodesis is an effective and minimal invasive technique to stabilize scapholunate instabilities. The results are better in dynamic instabilities rather than in static situations, regardless of the fact whether the lesion is fresh or chronic, as healing potential of the DCSS is given regardless of the age of the lesion. Longer follow-up for evaluation will be necessary.

A-0193 Microsurgical reconstruction of the upper extremity after severe trauma

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Objective: The complications of surgical treatment effects of polystructural upper extremity injury with tissue defects caused not only the execution of microsurgical reconstruction but also the planning and conducting of further orthopedic treatment.

Methods: We analyzed treatment results of 137 patients with multistructural trauma of upper extremity, in which we used transplant or transposition of vascularized flaps for soft tissue defects filling (skin flaps, vascularized fibula, and toes). Age of patients ranged from 12 to 68 years, were: men – 109, women – 28, time from injury to specialized care ranged from 2 –3 months to 3–5 years. By injury severity, patients were divided into four groups: the first group– 19 patients, the second group – 23, the third group – 50, and the fourth group – 45 patients. We used vascularized grafts in 69.3% cases of 3°–4° trauma. We used multistage surgery in most patients. Transplantation of vascularized flaps usually performed first. Further reconstructive surgery was performed depending on the type of injuries and their consequences. Treatment results were evaluated after 1 year or more after treatment by quantitative index of integral function of the upper limb.

Results: Functional state of upper extremity in the first group before treatment was estimated as 84.4% ± 0.2%, after treatment – 93.4% ± 0.1%; the second

group function index was $61.9\% \pm 0.3\%$ and $76.0\% \pm 0.2\%$; the third group – $43.4\% \pm 0.3\%$ and $63.9\% \pm 0.3\%$, and the fourth group – $38.9\% \pm 0.2\%$ and $55.6\% \pm 0.2\%$. We defined the dependence between functional results treatment and the severity of the injury – correlation coefficient was 0.82 ($p < 0.001$). So, we observed trend of function growth in patients with more severe trauma.

Conclusions: Use of vascularized flaps transplant in orthopedic treatment of multistructural trauma makes it possible to significantly improve upper extremity function, especially in patients with the most serious injuries. It was proved statistically significant effect on the injury severity of the treatment outcome.

A-0194 Restoration of thumb opposition after brachial plexus injuries

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Objective: Impaired function of a hand after brachial plexus injuries occurs when C8-T1 roots are involved which is characterized by hand intrinsic muscles fast atrophy and loss of thumb opposition. Our aim was to develop a restoration algorithm of hand grips with first finger opposition after brachial plexus injuries, depending on conserving muscles resources and functional needs of patient.

Methods: 168 patients with consequences of traumatic brachial plexus injuries were treated in the department of "Microsurgery and reconstructive surgery of the upper extremity" SI "ITO of NAMS of Ukraine" from 2000 to 2016. 116 (69%) patients needed to restore first finger opposition after neurosurgical treatment phase. ENMG and ultrasonography confirmed extreme degree of denervation, atrophy, and thumb muscle fibrosis. The patients were divided into four groups according to the following principles for the treatment choice. Group A (8 patients) included patients without restoration of any forearm muscle. Patients with up to 6 forearm muscles restored (M3 strength level and above) were included in Group B (35 patients). Groups C and D was divided into two subgroups depending on patient functional needs. In Group C (C1 – 16 patients of intellectual work, C2 – 23 patients of physical work) were patients with 7–11 appropriate muscles to use for transpositions. Other patients with 12 or more forearm muscles restored made up a group D (D1 – 26 patients of intellectual occupation, D2 – 8 patients of physical work). In all patients in Group A, we

performed a series of reconstructions to create a "doll's hand." In Group B, due to the small muscle resources, carpometacarpophalangeal arthrodesis was performed in a way that thumb can create pinch grip with long fingers. In patients of Group C2, due to the prevalence of physical work, despite the average muscle resources, arthrodesis was performed, and "extra" muscles were used for restoration and correction of second to fifth fingers flexion amplitude. In Group C1 – after wrist joint arthrodesis – tendon transpositions were performed to restore flexion of second to fifth fingers and first finger opposition. In all patients of Group D, first finger opposition through tendon transfer was performed. However, while in patients of physical work wrist arthrodesis was desirable, in patients of intellectual work we performed active wrist stabilization.

Results: First of all, surgeon must determine the number of recovered forearm muscles: 0 muscles – arthrodesis and "doll's hand" reconstruction, 1–6 muscles – arthrodesis and restoration of pinch grip, 7–11 muscles – tendon transfers or arthrodesis depends on patients occupation, and 12 and more – tendon transposition.

Conclusions: According to the authors' opinion, the most rational approach to restore thumb opposition should take into account the functional needs of the patient in combination with number and effectiveness "of available drivers." In patients with small muscle resources, and patients of physical work with less than 11 muscles restored, carpometacarpophalangeal arthrodesis of the thumb is preferred (oponenodesis to "working arc" of second or third fingers); in other cases tendon transposition must be performed.

A-0195 Iatrogenic peripheral nerve injuries

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Objective: Iatrogenic nerve injuries can result from direct surgical trauma, compression due to mal positioning during anesthesia, and direct or indirect injuries due to injections. The purpose of this study was to review cases of peripheral nerve injuries caused by direct surgical trauma.

Patients and method: Fifteen patients who were referred to our department complaining of either sensory or motor deficit after surgical interventions were reviewed in this study. The patient consisted of 12 males and 3 females, and the average age was

43.6 years old. We reviewed the type of the surgeon who caused the nerve injury, the affected nerve, treatment of the paralysis, and the pathogenesis of the nerve injury.

Results: Nine patients were initially operated by an orthopedic surgeon, two by a vascular surgeon, and one each by a general surgeon, gynecologist, dermatologist, and an otolaryngologist. The injured nerves were three for the radial and the common peroneal nerve, two for the sural and the accessory nerve, and one for the femoral obturator nerve, femoral nerve, sciatic nerve, and the brachial plexus. Of the 15 patients, 9 required surgical treatment consisting of 3 nerve grafts, 2 tendon transfers, and neurolysis; direct nerve suture; neuroma resection; and removal of the ligature that was placed on the nerve. We directly exposed and visualized seven nerves and identified five cases of nerve transection. Of the 15 cases, there were only 2 cases where the nerve was exposed enough for direct visualization at the time of injury. The remaining 13 paralyzes were created without the adequate exposure to visualize the injured nerve.

Conclusions: Iatrogenic nerve injuries account for around 20% of the traumatic nerve lesions. In our series, 64% of the injuries were created by orthopedic surgeons. With an exception of 2 cases, all the paralyzes were created without the visualization and identification of the nerve. A thorough knowledge of the anatomy is vulnerable to avoid iatrogenic injuries, and surgeons should not hesitate to make a larger incision to identify and retract the nerve.

A-0200 How direct the neuronal growth process in peripheral nerve regeneration? Nanosurfaces scaffold and magnetic nanoparticles future strategies using median nerve rat model

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Peripheral nerves injuries are common lesions that cause loss of function and poor outcome. In case of severe nerve gap (>50 mm), the gold standard remains the autologous graft. The limits are functional damage, double surgical access, and the lack of large amounts of grafts. Researchers focused on two main areas: the role of the interaction between cells with the extracellular membrane (ECM) and the forces acting during regeneration. Regarding the contact between cells and physical stimuli, the tissue engineering builds artificial surfaces than reproducing the topographical signals of the ECM (Micro and Nano size spur). The influence of micro and nanotopography on cells behavior is explored both in vitro and in vivo. SC quit on the anisotropic substrate aligning preferably along the axis of the signal, while cells cultured on flat surfaces show a random orientation. In reference to the forces acting during axonal elongation in 1984, Bray demonstrated in vitro that the application of a mechanical tension helped the axon's elongation. Riggio et al. proposed to use, in

vitro, Rat PC12 cells cultured with magnetizable nanoparticles (MNPs), "assimilated" by cells by endocytosis. Subsequently, an external magnetic field was applied. The association of the nanoparticles and an external magnetic field, generating a pN tension force, able to guide axonal growing and orienting cells along the direction of the magnetic force. In case of severe nerve gap, the gold standard remains the autologous nerve graft; however, the technique could be overcome in the future by alternative solutions. Anisotropic scaffolds could be able to shape the motility, alignment, and speed of cells. On the other hand, the cells after the MNP internalization could be guided under external magnetic field effect to develop a tension forces able to stimulate and direct axon growing. Authors show the histologic and functional results.

A-0201 Effective hand and upper extremity treatments for performing artists and musicians: Identifying evidence-based research

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Objective: Performing artists and musicians are a unique patient population prone to multiple neurologic and musculoskeletal pathologies requiring valid, scientific treatment guidelines and interventions. The purpose of this study was to identify existing science-based "gold standard" randomized controlled trials for preventive therapies and treatments for common hand and upper extremity conditions that this group experiences to establish broadly used evidence based preventive treatment protocols for this patient population.

Methods: The authors investigated availability of high-level randomized controlled trials reporting clinical outcomes of existing preventive therapies and treatment protocols for this group. There were 261 articles meeting 5 established classification criteria. Each article was scored on a set of five questions, which were created by team researchers and clinicians. These questions were based on what team members would find necessary or desired in a high-quality study, which could be considered as a reference for treatment.

These five questions included:

Q1. Had it been published in a peer-reviewed journal?

Q2. Have the medical procedures been described sufficiently with efficacy included?

Q3. Have skilled therapy interventions been described sufficiently with efficacy included?

Q4. Has the study used previously-validated measures or protocols?

Q5. Were timelines for return to work/play included?

Results: A literature search revealed that the first broad search terms returned over 1,500 articles related to musicians. Following a search with the more specific search terms and applying the five established classification criteria, frequency, and fraction of classification, 261 peer-reviewed, scientific articles were identified as most closely matching the final phase of the study. Of these articles, 52 were published before 1990, 41 between 1991 and 1995, 33 between 1996 and 2000, 45 between 2001 and 2005, 56 between 2006 and 2010, and 34 between 2011 and 2013. Based on five established questions, all of the 261 articles selected for the final phase of the study were peer-reviewed articles (Q1); 7 of these articles sufficiently described medical procedures, including efficacy (Q2); 11 sufficiently described therapy interventions, including efficacy (Q3); 25 described previously validated measures or protocols (Q4); and 15 discussed timelines for return to work or play. One study was identified as a peer-reviewed randomized controlled trial on the efficacy of preventive therapy or treatment protocols for hand and upper extremity neurologic and musculoskeletal pathologies most seen in musicians. None of the articles described validated preventive and interventional therapies, including efficacy in reducing the prevalence, cost, and occupational impact of injuries in elite musicians.

Conclusion: Musician injuries related to specific occupational demands necessitate validation of activity-specific modes of treatment distinct from other seemingly similar patient populations. The lack of randomized controlled trials and absence of updated protocols for many of the common overuse injuries reported in this group underscored the need for additional study. Further research should include prospective, randomized controlled clinical trials to establish a "gold standard" scientific reference for the preventive therapies and treatment protocols used to treat hand and upper extremity conditions experienced in this group.

Level of Evidence: Level I

A-0202 Study results after application of a proprioception rehabilitation protocol for the wrist on 15 cases

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Purpose: The rehabilitation after wrist injuries has to protect the ligament during the healing for permitting the function without pain. A lot of studies demonstrate the value of proprioception exercises for ankle, knee, and shoulder but few studies for the wrist. We have tested in our department, since few months, a proprioceptive rehabilitation for wrist. This protocol is applied to patients after injury of the TFCC, after sprain of the scapholunate ligament, after ligament surgery, or also in other cases of pain without explicit injuries. The aim of this rehabilitation is to obtain a muscular stabilization of the wrist for preventing all strains of the ligaments during their healing. It is also the way to teach a wrist management for preventing the arthrosis evolution. We have the same indication than for the rehabilitation of the sprain of ankle, adapted at the wrist function, with physical exercises for strengthening the muscular stabilization.

Method: Fifteen cases has been selected and rehabilitated according to this protocol with only one Hand Therapist. With have used the PRWE, the Quick Dash, and the pain VAS, and we have measured the grip, before and after the treatment.

Results: All the measurements have been improved, less for the grip, except for one patient who has revealed an associated thoracic outlet syndrome.

Conclusion: The results obtained encourage us to continue this rehabilitation. There are many scientific publications about the proprioception; everybody is agreeing with proprioceptive rehabilitation treatment, but it is necessary to explain and to teach a protocol adapted to the wrist.

A-0205 Arthroscopically assessed width of the scapholunate gap in patients with ulnar impaction syndrome

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Objective: Geissler's classification is widely accepted in arthroscopic diagnostics of scapholunate (SL) ligament injury. This review assessed the SL gap width, examined by the probe from midcarpal, in patients with intact SL ligaments who were treated for ulnar impaction syndrome.

Methods: Thirty-two consecutive patients with ulnar-sided wrist pain due to an ulnar impaction with isolated fovea sign with no clinical or radiographic signs of SL lesion were arthroscopically treated by central resection and debridement of the triangular fibrocartilage complex. Eight patients underwent consecutive ulnar shortening and four of them hardware removal, respectively. The patients were clinically examined preoperatively and 3, 6 and 12 months postoperatively as well as at final follow-up a mean of 1.7 years. Clinical outcome and radiographic parameters of the patients with tight SL joint from midcarpal were compared to those patients with lax SL ligament.

Results: In 14 patients, the probe could not be inserted into the tight SL joint from midcarpal. In 18 patients, the SL ligament was so lax that the probe could be inserted into the SL joint from midcarpal. There was no significant difference in the radiographic parameters between the 2 groups: Mean SL width was 1.9mm (SD 0.28) on standard PA radiographs and 2.1 mm (SD 0.35) under stress in the patients with tight SL joint compared to 2.0 mm (SD 0.40), respectively, and 2.2 mm (SD 0.39) in the patients with lax SL ligament ($p = 0.431$ and 0.420). Mean SL and RL angles were 58° (SD 8.5) and 0° (SD 4.6) in the patients with tight SL joint and 60° (SD 8.2) and 0.1° (SD 4.3) in the patients with lax SL ligament ($p = 0.221$ and 0.965). There was no significant difference in improvement of pain, grip strength, Krimmer, or DASH score between the two groups ($p > 0.05$ for each follow-up examination).

Conclusions: Laxity of the SL ligament in more than half of the examined patients allowed the probe to be inserted into the SL gap from midcarpal. This finding was rated as normal and did not influence the outcome in treatment of ulnar impaction syndrome. Probe insertion into the SL joint from midcarpal in the presence of a partial SL ligament rupture from radiocarpal therefore does not necessarily imply necessity of treatment.

Level of evidence: III, case-control study.

A-0206 Rating of central lesions of the triangular fibrocartilage complex with respect to a traumatic or degenerative origin

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Objective: This study examined the reliability of surgeons' estimations of lesions of the triangular fibrocartilage complex (TFCC) and whether they were traumatic or degenerative.

Methods: Fifty consecutive central TFCC lesions were independently rated by 10 experienced wrist surgeons viewing high-quality arthroscopy videos. The videos were reassessed in four further modalities, providing the patients' histories, X-rays, and both, each in a randomized order and after intervals of 3 months. The last modality included patients' histories and X-rays without the videos.

Results: Intrarater reliability showed fair agreement for three surgeons, moderate agreement for two surgeons, and substantial agreement for five surgeons. Fleiss' Kappa multirater statistics revealed fair interrater agreement when the histories were added to the videos with 10 of the 45 Cohen's Kappa coefficients showing slight agreement. The other four modalities demonstrated moderate agreement. No Kappa coefficients were calculated in the range of slight agreement as long as X-rays were added for assessment. Interrater reliability decreased with three coefficients in the range of slight agreement, when only the histories and X-rays and not the videos were assessed.

Conclusions: It appears that rating central TFCC lesions depends on the information provided upon viewing. We present and discuss both clear and ambiguous examples. To obtain higher agreement among different surgeons, a rating system is required as an orientation guide.

Level of evidence: Diagnostic II.

A-0208 Two-layer wound sealing before surgical hand washing for surgeons with a minor cut injury on the hands

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Purpose: Proper hand washing is important to prevent surgical site infection. However, there is a lack of evidence-based recommendation for hand washing when there is a minor cut injury on the hand. We aimed to determine whether two-layer wound sealing on the injured hand can function as a barrier to prevent the

spread of microorganism from the wounded area after surgical hand washing and whether the two-layer wound sealing can protect the wound of the injured hand during surgical hand washing.

Methods: We randomly categorized 20 volunteers (orthopedic residents and fellows) into subjects with a right or left hand injury. Each subject was assumed to have a minor injury on the volar surface of the index distal phalanx of the assigned hand, and the other hand was used as a control. Subjects applied a 1.5 cm diameter, circular, waterproof topical dressing on the index finger (first layer), washed their hands using an alcohol-based solution, then wrapped the index finger with a piece of antimicrobial drape (second layer), and finally performed hand rubbing. Subjects stamped each hand into a hand-shaped agar plate for 10 seconds, and the plates were incubated for 48 hours. If there was any growth of microorganisms, the colonies were counted and the microorganisms were identified using standard laboratory identification procedures. As a positive control, one of the subjects stamped a hand on the agar plate after washing it with tap water. After the hand stamp procedure, the injured hands were checked by an investigator to confirm the wounded area remained properly sealed.

Results: We observed 4 colonies on the 20 injured hands, and all colonies were located on fingers other than the index finger. Mean number of the colonies was 0.2 on the injured hands and 0.25 on the uninjured hands ($p = 0.772$), while the number of colonies was 43 on the hand used as the positive control. The microorganisms cultured from both the injured and the uninjured hands were coagulase-negative *Staphylococcus* species. There was no leak found from two-layer wound sealing after hand washing.

Conclusions: This study using a hypothetical model for a minor cut injury on the hand demonstrates that two-layer wound sealing is an effective barrier not only to prevent the spread of microorganism but also to protect surgeons.

A-0210 Role of 1,2 intercompartmental Supraretinacular artery vascularized bone grafting in scaphoid nonunion and its correlation with arterial duplex scan

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Objectives: Vascularized bone grafts based on 1,2 intercompartmental supraretinacular artery (ICRSA) has solved the short falls of nonvascular bone graft techniques and remained one of the main stay of treatment for stable and unstable scaphoid nonunions. There is always a literature paucity about confirmed

vascularity and the patterns shown by vascularized bone graft at the scaphoid nonunion site. Arterial duplex scan is a noninvasive method of assessing the vascularity, presence of vessels, and the vascularity of the callus tissues can be very valuable for gauging the status of the healing process.

Methods: Twenty patients with scaphoid nonunion were admitted and operated between April 2012 and March 2015. The radiographs, computed tomography (CT) scan, MRI findings, and the postoperative radiographs, arterial duplex scans, and functional outcomes were assessed. An attempt was made to correlate the findings between the diagnostic tools of CT scan in establishing the union across the scaphoid nonunion site and arterial duplex scans in establishing the vascularity pattern of the vascularized bone graft and presence of vessels helping toward the union of the scaphoid which is known for its precarious blood supply and subsequent complications.

Results: The average follow-up in our study was 2.3 years (range 1.9–2.8 years.). All patients were operated under brachial block. Serial monthly radiographs were taken and recorded. Postoperative CT scan in all patients showed bridging trabeculae and good union. Arterial duplex scan confirmed the triphasic flow and vascularity pattern across the vascularized bone graft incorporated into the nonunion site, presence of vessels, and neovascularization, thus making its role very eminent.

Conclusion: 1,2 ICSRA vascularized bone grafting has completely changed the treatment modalities of scaphoid nonunion further by achieving good bony union, symptom free, and excellent functional outcomes. Arterial duplex scan of dorsal wrist is a significant noninvasive tool of investigation in confirming the vascularized bone graft incorporation into the nonunion site.

Level of Evidence: IV

Keywords: scaphoid, nonunion, vascularized, bone grafting, 1,2 ICSRA graft, union, arterial duplex scans

A-0211 Decision of the appropriate length of distal screw with volar locking plate fixation for distal radius fracture

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Objective: The distal screw penetration of dorsal cortex of distal radius (DCDR) is one of the major causes of extensor tendon injuries accompanying volar locking plate (VLP) fixation for distal radius fracture (DRF). Especially, in fractures with comminuted dorsal cortex, determination of appropriate screw length may be difficult. We have utilized the tangent line at dorsal cortex of the lunate that was parallel to the axis of the shaft of radius (L line) obtained from intraoperative lateral fluorography as the reference of screw length. The main purpose of this study is to investigate the relationship between L line and various parts of DCDR and to evaluate whether L line is reliable and valid for the determination of distal screw length.

Methods:

- (1) Subjects included 10 volunteers (5 males and 5 females) without any bony trauma who underwent lateral radiographs and computed tomography (CT) scans. On lateral radiographs, we measured the vertical distances between L line and DCDR at each measuring point in units of 1 mm between 10 mm proximal and 5 mm distal from joint surface of radius. The same measurements were operated on following 3 slices of sagittal CT to confirm the distances from L line to radiographic projection of DCDR and actual DCDR close to tendons: on Lister tubercle (LT) slice, on extensor pollicis longus (EPL) slice, and on extensor digitorum communis (EDC) slice.
- (2) We also evaluated 10 DRF cases (5 males and 5 females) that were operated using VLP according to the reference of L line. The screw length was determined by intraoperative accurate lateral fluorography as the longest distance as the tip of depth gauge was not across L line. We examined postoperative CT in an attempt to confirm the rate of screw penetration and the relationship between L line and the tips of screw.

Results:

- (1) The mean distances (standard deviations) between L line and DCDR on the joint level were 6.0 (1.3) mm on lateral radiography, 6.6 (2.2) mm on Lister tubercle slice, 4.6 (2.2) mm on EPL slice, and 2.5 (1.3) mm on EDC slice. On EPL slices, L lines were located on palmar to DCDR in all cases.
- (2) Postoperative CT revealed one case of dorsal screw penetration just beneath the EDC tendon.

Conclusions:

- (1) L line is useful reference for the determination of distal screw length and prevents screw penetration of DCDR just beneath EPL tendon.

- [2] Anatomical reduction in the fracture and accurate projection of lateral fluorography is essential to use L line as the reference of screw length.

A-0212 Volar locking plate fixation for distal radius fractures using intraoperative computed tomographic navigation

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Objective: Unstable distal radius intra-articular fractures require restoration of alignment. Exact fixation of intra-articular fragments is important for these fractures. Precise insertion of distal screws in the fragments is necessary in volar locking plate fixation. We have used intraoperative computed tomographic (CT) navigation to insert the screws accurately in the dorsal fragments, especially when treating distal radius intra-articular fractures. We report our experience with volar locking plate fixation for distal radius fractures using intraoperative CT navigation.

Methods: This study included 28 distal radius fractures treated with a volar locking plate (HYBRIX, Mizuho, Tokyo, Japan). We used intraoperative CT (SOMATOM Definition AS, Siemens, Erlangen, Germany) navigation (Kolibri, Brainlab, Feldkirchen, Germany) during volar locking plate fixation for 14 intra-articular distal radius fractures. According to the AO comprehensive classification of distal radius fractures, three cases were classified as C1, six as C2, and five as C3. The other 14 distal radius fractures were fixed with a HYBRIX plate without CT navigation (no-CT navigation group). According to the AO classification, three cases were classified as A2, four as A3, two as C1, and five as C2. We evaluated the position of the inserted distal screws in postoperative CT images. We calculated the mean minimum distance between the screw and articular surface and between the tip of the screw and the dorsal cortex in each group. We evaluated three distal ulnar screw positions that influence the stability of the ulnodorsal articular fragment. We compared the results statistically between the two groups. Statistical analysis was performed with the Mann-Whitney *U* test, with $p < 0.05$ considered significant.

Results: The mean distance between the screw and articular surface was 1.6 mm in the CT navigation group and 2.0 mm in the no-CT navigation group. The mean distance between the tip of the screw and the dorsal cortex was 0.7 mm in the CT navigation group and 1.7 mm in the no-CT navigation group. There were statistically significant differences between both findings. In both groups, there were no screw penetrations into the radiocarpal or distal radioulnar

joints. However, there was one case in the CT navigation group and four cases in the no-CT navigation group, wherein the screw under the subchondral bone almost penetrated the articular surface. All screws nearly reached the dorsal cortex in the CT navigation group; however, six screws in five cases were shorter and positioned far from the dorsal cortex in the no-CT navigation group.

Conclusions: We used intraoperative CT navigation in volar locking plate fixation for the treatment of distal radius fractures. We safely inserted the long screw near the articular surface and dorsal cortex. We evaluated three positions of the distal ulnar screw in this study. Our results indicated that the ulnodorsal articular fragment had more stable fixation with precise screw insertion. Precise insertion of screws in intra-articular fragments avoids additional fixations such as dorsal plating or pinning. From our results, we expect not only better radiographic findings but also better clinical outcomes with intraoperative CT navigation.

A-0215 Restoration of pronation and radial deviation in obstetric brachial plexus palsy patients with a new procedure: The Ozkan's switch technique

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Objective: Pronation and supination motion of the forearm is crucial for upper extremity function, since it enables the hand to assume best position for grasping and manipulation. Supination deformity is reported in 6–10% of children with sequela of brachial plexus birth injuries. The purpose of this study is to report the results of a series of patients who underwent surgery using the "Ozkan's Switch Technique," which involves rebalancing of forces leading to supination contracture and ulnar deviation.

Methods: Sixteen children with sequela of obstetric brachial palsy (9 male 7 female patients) with ages ranging between 4 and 16 years (mean age of 9 years) were operated using the "Switch Technique" for the correction of supination deformity and ulnar deviation of the wrist. All patients were available for postoperative clinical evaluation with a mean follow-up time of 17 months (3–39 months).

Results: Mean active forearm pronation was -24° preoperatively. After the surgery, 28 degrees of active forearm pronation was achieved. Preoperative and postoperative mean active radial deviation values were -25° and 11.5° , respectively. Improvement in

wrist position resulted in 25% increase in grip strength postoperatively (from an average of 3.5–4.6 kg). There was an overall increase in hand function after the procedure, and patients reported significant improvement in daily activities.

Conclusions: In classic tendon transfers, an active tendon is usually used to undertake the function of a nonfunctioning tendon. However, all of the tendons used in the “Ozkan’s Switch technique” are functioning tendons, and none of them are paralytic; instead, they are reorganized for the restoration of insufficient function. Our proposed technique involves “switching” of the original muscle bellies and the corresponding tendons. Early results demonstrated that this method can lead to a critical improvement in functional capabilities

A-0217 The skier’s thumb: Patient experiences of current splint provision and reflections on how it would feel if the splint-wearing regime was changed

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Objectives: Different postoperative treatment protocols are used after ulnar collateral ligament (UCL) repair of the metacarpophalangeal (MP) joint of the thumb. A few quantitative research studies showed that modified splint designs, in which early movement of the MP joint is allowed, resulted in less stiffness, less therapy sessions, and earlier return to work. No qualitative research is available in which patients’ perspectives have been chosen as a topic for research related to UCL thumb. The purpose of this study is to explore patients’ experiences, perceptions, and recommendations regarding the design of a splint used after surgical repair of a complete tear of the UCL of the thumb.

Methods: A qualitative approach was chosen. Participants were selected from the database of our hand therapy practice. Twenty patients were selected, based on formulated inclusion and exclusion criteria. Six patients agreed to participate. Semistructured interviews were performed to obtain information into what interviewees saw as relevant and important concerning different aspects of their treatment. All interviews were recorded and subsequently transcribed. Themes were highlighted and identified. Mind-mapping techniques were used for qualitative data analysis. Similarities and differences were recognized. Quotes were used to illustrate data. Psychological factors, like splint adherence and coping mechanisms, were evaluated.

Results: The following recurring themes were identified: pain related to the injury and surgery, tightness of casts, protection ability, safety, pain related to wearing a cast or splint, and freedom of function. Themes were subdivided into three stages of rehabilitation: injury, treatment, and recovery. Only one participant was completely satisfied toward the whole postoperative treatment process. This patient received a removable thermoplastic splint immediately after surgery. Besides recommendations toward prevention of sharp splint edges, this participant mentioned no complaints after 3 months. The other five participants, who were treated with a circular immobilization cast for 6 weeks experienced pain caused by tightness of the cast, stiffness of the thumb, and loss of strength. Personal factors and individual coping styles seem to have influence on expectations, experiences, and perceptions toward a rehabilitation process.

Conclusions: Based on these findings, removable, adjustable thermoplastic splints should be considered immediately after surgery. The findings are similar to findings in quantitative research studies and show that long-term postoperative immobilization should be discouraged due to negative experiences of participants and negative side effects on the healing process. This study contributes to the foundation for changing the postoperative rehabilitation of patients with UCL repair of the thumb.

A-0220 Ten- to 15-year follow-up after distal radius fractures: The relation between anatomical position, radiological osteoarthritis, and functional outcome

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Objective: Last decade, the development of volar plating increased the tendency to perform surgery in case of a dislocated fracture, but it is unclear whether this affects the development of osteoarthritis. This study determines the relation between anatomical position, radiological osteoarthritis, and functional outcome of the wrist in elderly, 10–15 years after a distal radius fracture.

Methods: 189 patients aged between 50 and 70 years at time of trauma were included in this retrospective cohort study with 10- to 15-year follow-up. Based on the reassessed initial X-rays, the patients were placed into four groups (1, anatomical; 2a, acceptable; 2b, operative indication nowadays but treated conservative; and 2c, operative indication and operated). Functional outcome was measured, questionnaires

were answered, and new X-rays of both wrists were obtained. Using a regression analyses, we studied the difference in degree of osteoarthritis within the groups, correcting for age, dominant hand, gender, and osteoarthritis of the contralateral wrist. The difference in osteoarthritis between the fractured and the nonfractured wrist was studied, and factors influencing the outcome were assessed.

Results: Group 2b showed a significant higher degree of osteoarthritis compared with the contralateral wrist. In the other groups, no difference regarding osteoarthritis was observed compared to the contralateral wrist. Furthermore, group 2b was associated with a significant higher degree of radiocarpal osteoarthritis and worse grip strength compared to group 2a. However, this result was not significantly associated with worse range of motion and questionnaire scores. The degree of radiocarpal osteoarthritis of the contralateral wrist appeared to be highly associated with the degree of osteoarthritis of the fractured wrist.

Conclusion: The results of this study showed that degree of radiocarpal osteoarthritis is higher in conservatively treated patients and that actually should have been operated following the current guidelines compared to patients without indication for surgery. This might suggest that our current guidelines can be effective in prevention of posttraumatic osteoarthritis. Since the degree of osteoarthritis of the contralateral, nonfractured, wrist appeared to be highly associated with the degree of osteoarthritis of the fractured wrist, future studies should always assess osteoarthritis of both wrists in order to be able to study the real posttraumatic effect of a distal radius fracture.

A-0221 Digital artery perforator flaps: A versatile reconstructive option for treatment of soft tissue defects and painful scarred or injured digital nerves

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Objective: In 2003, Koshima reported the treatment of meralgia paresthetica using a deep inferior epigastric perforator adiposal flap, and in 2006, this group used a digital artery perforator (DAP) flap to reconstruct the fingertip and finger stump. However, there have been no reports on the use of DAP adiposal flaps to cover digital nerve lesions. Recently, we used DAP flaps and DAP adiposal flaps for the treatment of soft tissue defects and nerve lesions. This study aimed to determine a therapeutic strategy

using DAP flaps for soft tissue defects or DAP adiposal flaps to cover scarred or injured digital nerves.

Methods: Patients ($N = 21$; females, $n = 3$ and males, $n = 18$) were diagnosed with soft tissue defects ($n = 5$), digital nerve adhesion ($n = 6$), and digital nerve rupture ($n = 10$). The average patient age was 42.1 years (range, 20–63 years). The average follow-up period was 7.2 months (range, 2–18 months). We performed preoperative mapping of DAP using colour Doppler ultrasonography. In cases of soft tissue defects, a DAP flap ($n = 3$) or a DAP adiposal flap with skin graft ($n = 2$) were used. The size of the DAP flaps ranged from 5×10 mm to 6.8×20 mm (average = 103.3 mm²). Neurolysis ($n = 6$) was performed in all patients with digital nerve adhesion, and the digital nerves were repaired in those with digital nerve rupture ($n = 15$). Following these procedures, to prevent reentrapment and readhesion, DAP adiposal flaps were elevated and transferred to cover the digital nerve lesion. The size of the DAP adiposal flaps ranged from 5×8 mm to 10×20 mm (average = 79.9 mm²).

Results: For soft tissue defects, all the DAP flaps survived. In two cases of DAP adiposal flaps and skin grafts, the epithelization was delayed. However, additional interventions were not needed. In cases of digital nerve adhesion, all the patients reported symptomatic improvement, and no patient reported symptom worsening. However, in one of the three patients, some subjective paresthesias persisted. The patient complained of residual throbbing pain in her little finger. Her preoperative and final VAS scores were 71/100 mm and 30/100 mm, respectively. At the final follow-up, all the patients reported no obvious numbness or pain, which indicated readhesion or reentrapment around nerves. In patients treated with digital nerve repair, Tinel's sign-like symptoms were considerably reduced at the repaired sites. The average VAS scores for pain at rest were 27/100 mm at 2 weeks after the operation and 28/100 mm at the final follow-up. In addition, the average VAS scores for tenderness at the repaired sites were 5/100 mm and 0/100 mm, respectively, at these time points.

Conclusions: The DAP flap or DAP adiposal flap with skin graft provides soft tissue coverage without sacrificing the digital artery. And the DAP adiposal flap is expected to be useful for covering scarred or injured digital nerves to prevent reentrapment and readhesion after digital nerve neurolysis or repair.

A-0222 Autonomous patient-controlled mobilization protocol after flexor tendon repair: A case series

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Objectives: Despite many publications on rehabilitation methods after surgery repair of flexor tendon injuries of the hand, there is no consensus as to which method is superior. However, it is clear that nonadherence to post-operative therapy protocols adversely affects the outcome after flexor tendon surgery. In a developing country context, the most important factor associated with a poorer outcome is the late onset of physical therapy. We have hypothesized that an autonomous rehabilitation program with the use of a no cost splint and based on an online illustrative video will improve adherence and patient compliance ensuring a better outcome.

Methods: Twenty-one digits of 14 patients after flexor tendon repair in zone II were included. Autonomous early passive mobilization physical therapy and splinting started the fifth day after surgery, with support through an online available video depicting prescribed exercises; follow-up was continued until postoperative week 20. Patients were evaluated with regard to range of motion, grip strength, and the QuickDASH disability scale. The assessments were performed at 3, 6, 12, and 20 weeks.

Results: Two patients (2 fingers) were excluded due to inability to comply with follow-up visits. Range of motion after 20 weeks according to the scoring system of the American Society of Surgery of Hand (ASSH) was excellent in 4 fingers, good in 11 fingers, and fair in 4 fingers. There were no poor results. Mean grip strength at final follow-up was 86% of contralateral hand. Mean QuickDASH score was 12.4.

Conclusion: Results of this study show that a rehabilitation program based on an autonomous passive rehabilitation protocol achieves good results in range of motion, muscle force, and early return of function of the hand. These results are comparable to other published series. We propose this simple, nonexpensive method for developing countries with less than optimal availability of health care.

Level of Evidence: IV

A-0225 Carpal tunnel release: Comparison of the classic open with a minimally invasive one small incision technique

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Objectives: Open carpal tunnel release is probably the most common procedure in surgery of the hand. The purpose of this prospective randomized study was to examine whether the extent of the incision is

related to an increased rate of complications, has an impact to early or late recovery, and return of the patients to their previous activities.

Methods: Two hundred patients with clinical and neurophysiologic findings of carpal tunnel syndrome underwent carpal tunnel release. All patients were manual workers and were randomized in two groups. One hundred patients in the first group (with a mean age of 58 years) were operated with the classic open method and 100 patients in the second group (with a mean age of 56 years) underwent a minimally invasive release with the Knifelight device. For the method using the Knifelight, a skin incision of less than 1 cm was done at the distal edge of the flexor retinaculum, and the release of the flexor retinaculum was performed by placing and advancing the device from distally to proximally. Illumination during transection of the ligament confirmed the release. Patients in both groups were instructed to use their hand immediately for light tasks but they did not perform weight bearing activities for two weeks.

Results: Follow-up ranged from 18 months to 5 years. In all patients, pain and paresthesias improved significantly after surgery. Two-point discrimination improved gradually in both group and reached the final value (mean 5 mm in both groups) at 2 months postoperatively. Three weeks after the procedure grip strength was 70% of the preoperative value in the first group and 85% in the second group. At 3 months after the procedure, grip strength was the same in both groups. It was measured 33 kg 3 months postoperatively compared to 29 kg preoperatively. Patients of the second group with the Knifelight used their hand more freely at 3 weeks postoperatively. They returned to their manual work 2 weeks earlier (4 weeks vs. 6 weeks) than the patients in the first group probably thanks to the smaller incision which caused less discomfort. Two patients in the first group and one patient in the second group presented symptoms of recurrent carpal tunnel syndrome and needed to undergo a revision carpal tunnel release with a hypothenar fat pad flap procedure. Other complications included two algodystrophies and one superficial infection both in the first group.

Conclusion: Patients of the second group recovered function and grip strength earlier than the first group. The smaller incision seems to have influenced the preliminary results. After 3 months, patients in both groups presented equal function and grip strength.

A-0226 Trapeziectomy with and without ligament reconstruction and tendon interposition: A randomized controlled trial

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Objective: To compare the functional and activity outcomes after two different methods of surgery for osteoarthritis in the first carpometacarpal joint: trapeziectomy, with and without ligament reconstruction and tendon interposition (LRTI) using the abductor pollicis longus tendon, at 3 months and 1 year postoperation.

Methods: A randomized controlled, double-blinded trial, with two parallel intervention groups was conducted in a pretest–posttest design. Inclusion criteria were clinically and radiographically diagnosed osteoarthritis in the first carpometacarpal joint, without osteoarthritis in the first metacarpophalangeal joint or other joints in the carpus, and no earlier operation in the exact thumb or wrist. Pain was the main outcome; physical tests and activity measures were secondary outcomes.

Results: Twenty-nine hands received trapeziectomy with LRTI, and 32 received Trapeziectomy alone. One dropped out from the study in the LRTI group and three in the trapeziectomy group, all before the assessment at 3 months. No statistically significant difference in change was found between the 2 groups at any test time, on any of the outcome measures, except for an increase in activity satisfaction in the LRTI group. A clinically important reduction in pain was found for 68% in the LRTI group and for 76% in the Trapeziectomy group at 1 year. Painlessness was reached for 25% and 24% of the patients in the 2 groups respectively.

Conclusion: Neither the Trapeziectomy alone nor with the LRTI could be preferred before the other with regard to the outcome of pain, physical function, or activity performance.

Keywords: osteoarthritis, osteoarthrosis, trapeziometacarpal joint, carpometacarpal joint, trapeziectomy, ligament reconstruction and tendon interposition, abductor pollicis longus.

A-0227 Comparison of the regeneration of nerve allograft with or without chondroitinase

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Purpose: Chondroitin sulfate has been known to inhibit the growth-promoting activity of endoneurial laminin. Chondroitinase has been used in Axogen-processed nerve allograft in expectation of better

nerve regeneration. The authors aimed to compare the regeneration of nerve allograft with or without chondroitinase in a rat model.

Methods: Thirty Lewis rats were randomly divided into 3 groups in a sciatic nerve defect model: Group A received reversed autograft, group B received detergent-processed nerve allograft without Chondroitinase, and group C received processed nerve allograft with chondroitinase. At 12 weeks, histomorphometric and functional evaluation such as isometric tetanic force, wet muscle weight, and ankle contracture angle were performed.

Results: Group A showed significantly better nerve regeneration in terms of isometric tetanic force, wet muscle weight, and ankle contracture angles compared to other groups ($p < 0.001$). The average isometric tetanic force, wet muscle weight in group B and C were not statistically different ($p = 0.278$ and $p = 0.78$, respectively). Group B showed better recovery in terms of ankle contracture angle compared to group C ($p < 0.001$).

Conclusion: Additional chondroitinase treatment during nerve allograft processing has no beneficial effect on nerve regeneration with detergent-processed nerve allograft.

A-0234 Outcome analysis of nail bed injuries

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Objective: The fingertip and nail bed injuries are the most commonly injured part of the hand and is an important aesthetic and functional part of the hand. Without proper treatment, injury to the nail complex has the potential to cause considerable dysfunction and/or deformity. Despite a high incidence, controversy remains around the appropriate management of nail bed injuries. This study is a compilation of data derived from 549 nail bed injuries treated over a 6-year period and be to suggest an appropriate treatment.

Methods: In the retrospective study, we analyzed data from 549 nail bed injuries in 536 patients operated for 6 years. At least 6 months follow-up patients were included and other combined injuries inside the same hand were excluded. Age, type of injury, bony injury (fractures), nail substitute (treatment methods), and outcomes were reviewed. Results were determined for 549 nails after follow-up examination by the authors, and these were divided into identical to opposite group, major and minor abnormalities based on Zook's criteris. The sum of the minor and major nail abnormalities for each finger was used to determine a grade of excellent (no abnormalities), very good (1 minor), good (2 minor), fair (3 minors and

1 major), or poor (more than 3 minors or 1 major). Statistical analysis was done between the injury category (type, site, nail substitute, and fracture) and the overall final grade.

Results: The patients age range from 7 months to 83 years, with an average of 34 years. The long finger was the most common injured fingers followed by ring, index, thumb, and small finger. Lacerations were the most common type of injury, followed by crushes, and avulsions. The most frequent area of nail injury was distal third with the middle third, nail fold, and proximal third following closely. Fractures accompanied in 182 cases. The nail fold and nail repairs were most often covered with avulsed nail and with silicone sheet for 16 cases. Over 50% were excellent (293 cases), 22.6% very good (124 cases), 11.3% good (62 cases), 6.2% fair (34 cases), and 6.6% (36 cases) graded as poor. There were no statistically significant differences identified between nail deformities and age, digit, and nail substitutes. Crush and avulsive injuries were found to have significantly worse results ($p < 0.05$) compared to lacerations. Poorer results were obtained in fold injuries than other parts ($p < 0.05$). The presence of fracture was associated with poor results ($p < 0.05$).

Conclusions: It seemed that the poorer results were related to site of injuries (nail fold), presence of fracture, and type of injury and concluded that the cause were multifactorial. Overall outcomes were good. However, nail splitting, nail roughness, and nail adherence cause dirtiness, catching, bending, and various cosmetic problems. Careful suture and replacement of nail to nail fold were important to reach good results.

A-0237 Spinal accessory nerve repair using a direct intraplexal fascicular transfer: A retrospective case series with 2-year follow-up

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Objective: Spinal accessory nerve lesions are primary iatrogenic, consecutive to lymph node biopsies. Since diagnosis is often delayed, performing a direct suture is rarely possible, leading to secondary nerve surgery such as grafts or nerve transfers. We propose a new direct transfer using a fascicle from the posterior division of the upper trunk to reinnervate the spinal accessory nerve, and we present its preliminary outcomes in a case series.

Methods: We retrospectively reviewed a series of 11 patients with trapezius palsy due to iatrogenic injuries of the spinal accessory nerve. The mean age was 38 years old (range 21–59). Preoperatively, the major complain was shoulder weakness and fatigability, associated with a trapezius atrophy and a limited range of motion (averaged shoulder abduction at 95°). In all cases, electromyography confirmed the clinical deficit. Through a V-shaped supraclavicular approach, the spinal accessory nerve was identified at the upper edge of the trapezius muscle, before its entry into the muscle belly. After identification of the upper trunk's posterior division, intraneural dissection under microscope magnification and selective neurostimulation allowed to select a deltoid fascicle, with the same diameter as the spinal accessory nerve stump; a direct tensionless suture was then performed. Postoperatively, the patient was immobilized 3 weeks in a Gilchrist bandage. Patient follow-up was conducted at 3 and 6 months and then every 6 months. A video-assisted assessment of shoulder active abduction was performed as well as strength evaluation using the Medical Research Council grading system. Moreover, deltoid strength and scapula dynamic stability during abduction of shoulder were evaluated.

Results: Postoperative active shoulder abduction averaged 155° (94% of the contralateral side), with a mean follow-up of 23 months (range 12–53 months). Trapezius muscle strength graded M5 in 3 cases, M4 in 7 cases, and M3 in one case. No deltoid impairment was reported. Scapula was considered stable in eight cases and instable in two cases. One of those required secondary scapulopexy.

Conclusions: Spinal accessory nerve graft is a difficult surgical procedure, requiring a good anatomical knowledge of the cervical area, a laborious dissection to identify both nerve stumps into the scar tissue, and the harvesting of a graft from the lower limb. The new technique described here seems to be reproducible without major technical difficulty, giving satisfactory functional results for the management of iatrogenic trapezius palsies. It allows a direct tensionless suture close to the trapezius muscle, using an intraplexal motor nerve as a donor without postoperative deficit.

A-0238 Collateral ligament injuries of the metacarpophalangeal joint in long fingers: Results of a series of 20 patients Presentation of a new clinical test

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Objective: Collateral ligament injuries of the metacarpophalangeal (MP) joint in long fingers are rare conditions and mostly treated conservatively in comparison to the thumb. Clinical examination is essential to diagnose the gravity of the ligamentous injury. The aim of our study was to report results of surgical management of a series of 20 patients and to focus on a new clinical test.

Methods: Twenty patients, mean age 48 years (22–70), were managed surgically for grade 3 injuries of the radial collateral ligament (RCL) of the middle finger (9), ring (4), and small finger (7). The mean delay between accident and surgery was 59 days (0–180). Preoperatively, the new laxity test (Meyer's test) and the Bellemere test were positive in all cases. Surgical intervention found two Stener lesions. The RCL was injured at his distal part in nine cases, middle part injuries were found in five cases, and proximal lesions in seven cases. Bone anchors were used in 16 cases. There was one proximal osseous detachment treated by direct screwing. Postoperatively, the MP joint was protected by an extension orthoses for 1 month, following by a syndactyly for 2 months. Patients were reviewed by an independent examiner with a mean follow of 20 months (6–34). Total active motion (TAM) was measured, comparative MP laxity tests were performed at 0°, 30° and 90° of flexion, the Meyer and Bellemere tests were compared to the normal hand, and strength measurements were realized.

Results: Fifteen patients were reviewed for clinical examination. One complication was noted (CRPS type 1). Mean Quick Dash was 16.2 (0–61) and mean Dreiser index was 3 (0–13). Mean TAM was 251° (218°–308°) with mean active MP flexion–extension of 86°–11° (72°–99°/0°–29°). The mean radial MP laxity at 0°, 30°, and 90° of the injured digit was, respectively, 22°, 15°, and 13° compared to the normal side 18°, 17°, and 14°. The mean ulnar MP laxity at 0°, 30°, and 90° of the injured digit was, respectively, 30°, 25° and 12° compared to the normal side, 31°, 22°, and 12°. Meyer's test shows a mean MP laxity of 17° (7°–34°) of the injured digit and 13° (9°–16°) on the normal side. Bellemere's test to radial and ulnar side on the injured digit shows a mean MP laxity of 12° and 11° compared to 24° and 10° on the normal hand. The mean global strength (Jamar) of the operated hand was 29 kg and 35 kg on the opposite side. Distal and lateral pinch measurements on the injured digit revealed a mean strength of 7 kg and 3 kg compared to 9 kg and 3 kg on the normal side.

Conclusions: Clinical results after RCL repair on the MP joint of long fingers are good, despite some residual ligament distension demonstrated by our laxity tests measurements. Our new laxity test (Meyer's test) is a simple and painless clinical test

allowing to diagnose grade 3 RCL injuries necessitating surgical repair.

A-0240 Percutaneous screw fixation in scaphoid fractures: A rational approach

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Objective: To analyze the indications, results, complications, a possible real benefits of the percutaneous technique revising three series of patients operated with 3 different types of screws.

Methods: A total of 134 patients operated with percutaneous screw fixation for scaphoid fracture were assessed. Group 1 (43 patients including 39 males and 4 females) was treated with Twin-fix screw. The average age was 32.2 years. Group 2 (58 patients including 47 males and 11 females) was treated with AO screw and washer. The average age was 32.8 years. Group 3 (33 patients including 29 males and 4 females) was treated with HCS screw. The average age was 33.0 years. 88 patients have been rehabilitated in our center, 33 patients have disregarded our instructions and have not been rehabilitated, and 13 patients were lost to follow-up. Results were evaluated according to a scheme including Mayo Wrist Score, radiographic consolidation of fracture fragments, return to work, or sport activities.

Results: Our results were optimal and good in 69.8% (twin fix), 89.6% (AO), and 86% (HCS). Radiographic consolidation occurred in almost all cases within 7 weeks except 4 cases (within 10 weeks). About to return to work activities, we found no significant differences between 3 the groups. We did not observe any cases of nonunion or infection in three groups. However, we observed several common technical drawbacks at 3 procedures. Regarding drawbacks, we had in twin fix group two cases of screw removing, one case of screw breaking, one case of change in open procedure; in AO group one case of screw removing; and in HCS group one case of change in open procedure and two cases of screw removing. Other technical drawbacks observed in all groups were cutter or screwdriver breaking, bending or breaking of guidewire, and measurement errors or incorrect position of the screw. We observed CRPS only in one case (twin fix group).

Conclusions: Percutaneous screw fixation of selected scaphoid fractures is a less invasive procedure, requires short surgical times in expert surgeons, is a good alternative to a long immobilization and to open

procedure, and has a high rate of union, minimal complications and rapid return to full function and activity, including sports. Moreover, we believe that a large learning curve is necessary, and we think that a rate of technical drawbacks can be reduced by careful attention to detail during surgery. We suggest the use of percutaneous screw fixation not only in unstable reducible scaphoid fractures but also in stable acute fractures in selected high demand patients. Percutaneous screw fixation can be also used in selected cases of delayed union and in scaphoid fractures (stable or unstable and reducible) associated with other fractures with surgical option in the same side (e.g. distal radius or metacarpal fractures)

A-0243 Why minimalistic approach is the future of orthotic management in the upper extremity: An evidence-based experience

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Introduction: Orthotic management has been a common use among hand therapists in the last 50 years. Prior to the advent of modern low-temperature thermoplastic (LTP), orthoses were nonetheless made for many pathologies using less versatile materials such as organic (wood and leaves), metals, leather, and others. (1) During this time, many orthotic models were proposed for different upper extremity problems, from static to dynamic to static progressive orthoses and many more. Today, however, fast-paced lifestyles, exceedingly high levels of functional demands of patients and limited health-care resources have pushed the boundaries of orthotic fabrication to become extensively functional but yet remain simple. The objective of my presentation is to present the minimalistic approach (MA), initially introduced by Paul van Lede (Belgian OT) in 1998 (2) and repropounded in 2002 (3) and demonstrate its applicability and value in today's hand rehabilitation reality.

Methods: After illustrating the theoretical concepts of the MA, numerous orthoses models will be presented for different districts of the distal upper quadrant and in relation to a multitude of clinical applications. The minimalistic orthoses models will also be compared to other devices used with similar goals but with critical pitfalls.

Results: The MA can and should be used to preserve or enhance function of the patient, without further impeding normal daily activities that the pathology or trauma already has affected. Simplistic orthoses must be (1) easy to make and (2) to on/off autonomously by the patient, (3) socially desirable and light

in weight, and (4) quickly adjustable if necessary. The orthotic maker must not only possess sound physics concepts but also understand how each fabricated orthosis influences the patient's function. This approach can be used for orthotic management of any district of the body. It can be realized with different brands of LTP or other material such as polymer tapes, neoprene, leather, spring wire or coils, and so on. However, there is a common decisional algorithm to follow each time an orthosis is custom made according to the MA. From the orthotic prescription, anatomic boundaries must be established, and the therapeutic goals must first be discussed with the patient. Only then mechanical and technical considerations, dictated by physical laws and by the orthotic material properties, respectively, have to be considered before creating the individualized orthosis.

Conclusion: Orthotic fabrication is used by many hand therapists throughout the globe and for nearly all upper extremity problems. In order to maximize orthotic management success, the MA is preferable to encourage patient compliance. This approach can be adopted by either the novel or the expert therapist and requires no additional splinting equipment. If anything, costs related to materials and human resources will be reduced.

Level of Evidence: 5

A-0247 Position of the flexor pollicis longus tendon in relation to the Aptus FPL-Plate (Medartis) and to the distal volar radius width

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Objective: The flexor pollicis longus tendon (FPLT) rupture is a well-documented complication related to the use of distal radius volar locking plates. To avoid FPLT rupture a new plate was designed particularly for intraarticular fractures demanding a distal plate position, leaving a gap within the distal material edge. This study investigates the FPLT-position in relation to this plate and distal radius width in different wrist and finger positions used for daily activities.

Methods: Twelve patients undergoing osteosynthesis for distal radius fracture (AO/ASIF-Classification category C) in 2015 with the Aptus FPL-Plate at the AUVA Lorenz Böhler Trauma Hospital in Vienna were included. Their mean age was 54.18. A high-frequency ultrasound was performed 32.14 weeks postoperatively by an experienced radiology specialist to locate

FPLT position in two separate wrist positions: (1) wrist neutral and fingers fully extended position and (2) wrist in 45° extension and clenched fist position. For analysis, we used the axial ultrasound videos. Postoperative X-rays and CT scan were included for the analysis, especially the soft tissue CT-scan window for the exact localization of the FPLT. To analyze the position of the FPLT and plate in the ultrasound and CT scan, the distance to the radial border of the distal radioulnar articulation in the CT scan was measured (point 1) and put into relation (in percentage) to the distal radius width.

Results: In all cases, the FPLT is positioned closer to the volar distal edge of the FPL-Plate in position 2 than in position 1. In four cases, the FPLT didn't touch the plate at all and is moving independently from the plate position. In those cases, the center of FPLT in position 2 is laying the most ulnar, within less than 50% of the distance to point 1. In the other two-third of the cases, the FPLT is gliding into the material gap even if the ulnar edge of this material gap is laying more radial than the middle of the distal radius up to 62% to point 1. No signs of tendinopathy of the FPLT was found in any of the cases. Different parameters to avoid tendon and FPL-Plate interference in a distal plate position are: (A) position of the center of the FPL-Plate between 40% and 50% to point 1, (B) dorsovolar inclination angle of the distal radius of about 10° in the lateral X-ray projection, and (C) the FPL-Plate position at least 1.5mm proximal to the watershed line in the ulnar half of the distal radius.

Conclusions: The FPLT slips into the material gap of the FPL-Plate reducing the contact pressure to the distal edge of the plate in its distal position.

A-0250 Minimal endoscopic surgery for treatment the cubital tunnel syndrome

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Background: Compression of the ulnar nerve in the cubital tunnel is the second most frequent entrapment neuropathy of the upper extremity after carpal tunnel syndrome. None of the described techniques for ulnar nerve decompression, however, have proved to be superior in randomized prospective trials. The ideal operative treatment for cubital tunnel syndrome remains controversial. We therefore presented our series of endoscopically decompression of the ulnar nerve at the elbow to determine the effectiveness of this procedure.

METHODS: It was prospective, nonrandomized clinical study. In 25 patients: 15 men and 10 women (age's

range 29–76 years) with clinical McGowan grade I (3 patients), II (16 patients), and III (6 patients), and electrophysiologic signs of cubital tunnel syndrome, 21-cm of the ulnar nerve was released through a 2-cm-long skin incision. Diagnosis was based on history, clinical examination (i.e. pain over medial epicondyle, sensory loss, positive Tinel's sign, weakness or atrophy of the muscles innervated by the ulnar nerve, and positive elbow flexion test), and confirmed by neurophysiological studies (nerve conduction velocity and electromyography). A 4-mm, 30° standard endoscope and Storz retractor were used during the procedure, and the mean postoperative follow-up examination was 12 months.

Results: There were no visible nerves and vessels injured during the procedure. The main postoperative complication was hematoma in two patients which resolved after conservative management. There was no elbow extension deficit after surgery and surgical wounds, all healed within a week. At final follow-up evaluation, according to the Bishop Rating system, excellent outcomes were obtained in 20 (80%) patients and good outcomes in 3 (12%) patients. Grip strength showed a highly significant increase after surgery compared to the nonoperated hand ($p < 0.005$). The mean DASH score was decreased significantly about 72% (from 76.4 before operation to 21.3 after procedure) ($p < 0.005$); 88% patients were satisfied with the procedure.

Conclusions: Endoscopic technique for treating cubital tunnel syndrome is a safe and reliable procedure, characterized by a short incision, minimal soft tissue manipulation, less scar sensitivity, and early postoperative mobilization. It demonstrates promising benefits against conventional approaches (complete release and good visualization) and reduced complication profile (painful scarring and elbow contracture). Endoscopy is a widely imaging study for assessing nerves providing useful information on the severity and stage of nerves pathology.

A-0253 The natural history of elbow flexion strength following obstetric brachial plexus injury

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Objective: There is little published literature regarding recovery of elbow flexion after obstetric brachial plexus injury (OBPI) managed without nerve reconstruction. A study was undertaken to establish the outcome for elbow flexion in children with OBPI who

have not had brachial plexus repair and to look at the influence of injury severity on elbow flexion strength.

Methods: Before 2008, our Brachial Plexus Unit did not routinely offer nerve exploration and reconstruction for OBPI. Children born before 2008 (starting 1985) were identified from the service database, together with the Narakas grade, the age of recovery of elbow flexion, and record of any surgery. While children who have full recovery are discharged, the service aims to follow-up those with any persisting deficit until skeletal maturity. The range of active elbow flexion against gravity was measured in those who have attended for follow-up since 2014. During a 2-year period (2011–2012), elbow flexion strength was measured in children aged 5 years and older. Maximum isometric force of elbow flexion for both arms was measured with a hand-held dynamometer, with the elbow flexed at 90° and the forearm in neutral rotation. Shoulder function, including the Mallet score, was routinely assessed.

Results: 232 children born before 2008 had been assessed for OBPI. Eighty had had full recovery within 1–2 months, leaving 152 with a persisting deficit. The Narakas group was known for 149, 58 group 1 injuries, 55 group 2 injuries, 24 group 3 injuries, and 12 group 4 injuries. Five children had undergone nerve exploration and repair, three for Narakas group 4 lesions, with nerve grafting of the upper trunk in two. Only 1 (Group 4) of the 147 patients, managed without nerve exploration, had been noted to have insufficient flexion to reach the mouth. None required consideration for secondary reconstructive procedures for elbow flexion. The age of recovery of elbow flexion was recorded in 130 children, mean 4 months for group 1 injuries, 6 months for group 2 injuries, 8 months for group 3 injuries, and 12 months for group 4 injuries. The range of active elbow flexion was available for 42 cases, with a mean of 137° (range 110°–160°).

Elbow flexion strength was measured in 39 children, mean age of 12.6 years (range 5–22) who had not had nerve reconstruction. All had a full range of active flexion. The mean power of elbow flexion was 8.7 kg, 63% (range 23–100%) of the normal side, 68% for group 1 injuries, 61% group 2 injuries, 64% group 3 injuries, and 62% group 4 injuries. The mean total Mallet score for the shoulder was 17 (Maximum = 25). Twenty-two cases had surgery for internal rotation contracture of the shoulder.

Conclusions: After OBPI, it is very unlikely that elbow flexion will not recover spontaneously to a satisfactory functional level. Although recovery occurs later in those with more severe brachial plexus injuries, a similar strength is eventually achieved. It is therefore doubtful if it is necessary to reconstruct nerves to restore elbow flexion.

A-0257 In situ decompression of the ulnar nerve under local anesthesia

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Objectives: Ulnar nerve entrapment at the elbow is the second most common peripheral nerve compression syndrome. When surgical decompression is indicated general anesthesia, brachial plexus block, or local anesthesia can be performed. We evaluated the use of local anesthesia while performing in situ decompression at the cubital tunnel.

Methods: All operations were performed by four senior surgeons of our department. Indication criteria for the operation were failure of conservative treatment in the presence of clinical signs of ulnar tunnel syndrome and an electroneuromyography (EMG) examination confirming the diagnosis. A standard posterolateral longitudinal incision was used. Local anesthesia was performed, under tourniquet, by injecting 15 ml of 2% lidocaine with epinephrine 20% µg/ml supplemented with 1.5 mg of 8.4% sodium bicarbonate. A further 5ml of the same mixture was used in cases of intraoperative discomfort of the patient. Metal staples were used for wound closure and a bulky dressing for coverage of the operated elbow. Patients were discharged immediately after the operation and were evaluated for pain and satisfaction at the outpatient clinic of the department.

Results: From 2011 to 2015, 129 patients were operated for in situ decompression of the ulnar nerve in the cubital tunnel. 72 women (mean age: 59.1 years) and 49 men (mean age: 6.1 years) were evaluated using Visual Analogue Scale (VAS) intraoperatively, on day 1, day 15, 1 month, and 1 year after surgery. Satisfaction rates were evaluated using the Likert-type scale. VAS score in female patients was improved from 6.3 intraoperatively to 1.6 at 1 month postoperatively, while in male patients, pain was decreased from 4.7 to 1.1 considering the same postoperative period. Satisfaction rates according to Likert-type scale was 3.4 for women and 3.8 for men, at 1-year follow-up.

Conclusions: The use of local anesthesia for decompression of the ulnar nerve was first described by Lankester and Giddins in 2001, and its gaining major popularity among hand surgeons at the early years. The results of the technique are comparable to the use of general anesthesia, regarding pain control and satisfaction of the patients. The combination of its effectiveness with its low cost favors the use of local anesthesia in treating ulnar neuropathy, especially in public health systems facing a national economic crisis.

A-0259 Understanding carpal instability nondissociative: The deceptive use of 2D data sets in addressing lunate morphology

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Objectives: Diagnosis of carpal instability nondissociative (CIND) requires an accurate clinical, biomechanical and radiological evaluation. Different imaging techniques have been presented over the years with varying predictive values, even the shape of the lunate on lateral radiographs. We investigated the value of the morphology of a lunate as seen on a conventional lateral radiograph and compared to the 3D data set of a multidetector helical CT of the wrist. Variable angulation of the wrists in lateral radiograph projections is suspected to have a great influence on the assessment of the shape of the lunate. Therefore, it is thought to have lost its predictive value in imaging of CIND

Methods: Ninety conventional lateral wrist radiographs gathered from 56 randomly selected patients were evaluated and classified into one of three lunate shapes (dorsal, volar, and neutral) by three authors (reference group) and a panel of medical professionals. Interrater and intrarater variability were calculated between the panel and reference group. Then, a set of Digitally Reconstructed Radiographs (DRR) was computed from the CT images of three selected lunates with each one of the distinctive shapes of lunate as agreed on by the observers on lateral radiograph. These three lunates were first segmented and projected in a XYZ system and then rotated in steps from -20 degrees to +20 degrees, so each lunate could be projected as a 2D image in 81 different positions.

Results: Interrater agreement was poor to moderate, mean 0.305 (range 0.05–0.305), intrarater agreement was poor to good, mean 0.326 (range 0.180–0.667), and when the classifications made by the panel were compared to the reference group, agreement was poor to moderate, mean 0.326 (range 0.091–0.462). All three DRR series showed, when rotated, apart from the original type of lunate also both other types of lunate shape: When rotated -20 degrees, the dorsal type lunate imposed as a volar type, and when rotated -15 degrees it appeared to be a neutral type. The neutral type of lunate appeared to be a volar type when rotated -15 degrees and dorsal when rotated to +5 degrees. When rotated -10 degrees, the volar type imposed as neutral and dorsal when rotated to +5 degrees.

Conclusions: Reproducibility of the evaluation of the shape of the lunate through conventional lateral

radiography is limited. Appreciation of the morphology of the lunate, as seen on a lateral radiograph, is also very dependent on the angle in which the radiograph has been projected. Therefore, it has no predictive value in imaging of CIND contrary to earlier beliefs.

A-0260 Clinical outcomes of reconstruction of distal biceps tendon rupture with the use of two anchors and mini open surgical approach

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Objective: Distal biceps tendon rupture is a rare injury. Surgical reinsertion to the radial tuberosity is the treatment of choice for excellent functional results. In this study, we present the functional outcomes after surgical reconstruction of distal biceps tendon with mini single incision technique and the use of two anchors.

Methods: Eighty-six male patients were operated for acute traumatic rupture of the distal biceps tendon at the Microsurgery, Hand and Upper limb Department at the General Hospital KAT and followed up prospectively during the last 5 years. Mean age was 46.1 years. The injury involved the right biceps in 71% of cases (61 patients, 85% dominant hand) and the left in the rest 29% (25 patients, 12% dominant hand). Labor workers were affected in 86% of cases. Mean interval to surgery to surgery was 10.3 days. All patients were operated with a mini single incision approach, and the tendon was reattached to the radial tuberosity with the use of 2 Panalok 3.5 mm Mitek bone anchors. An elbow splint at 90° for rest and protection was used for 4 weeks, and all patients followed the same rehabilitation program. All measurements were made with the use of a hand dynamometer (Jamar dynamometer) and a hand goniometer (Baselin goniometer), while pain and functionality were assessed according to VAS score, ASES score, and DASH score.

Results: VAS score decreased from 5.5 at the day of injury (mean value) to 0.3 at 2 months postoperatively. Hand grip was restored completely at 2.6 months postoperatively, complete elbow flexion at 1.9 months,

and elbow extension at 2.2 months. Pronation and supination was fully restored at 2.8 months for 92% of the patients. DASH score was reset to 0 at 3.9 months and ASES score was maximized at 3.6 months. Complications were recorded at four patients. One patient suffered from posterior intraosseous nerve palsy, which resolved in 3 months postoperatively. Two patients reported lateral antebrachial cutaneous nerve palsy, and one patient was diagnosed with heterotopic ossification.

Conclusions: Reconstruction of the distal biceps tendon rupture with a mini single incision technique and two bone anchors offers quick return of the patient to its previous activities, high rate of satisfaction, and minimal postoperative complications.

A-0263 Investigation of 145 dorsal metacarpal artery perforators using color Doppler ultrasound

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Introduction: Some investigators have reported the feasibility of investigating the location of perforators using preoperative color Doppler ultrasound (US). The use of a dorsal metacarpal artery perforator (DMAP) flap is well known for treating skin defects of the dorsal hand and finger. Here we aimed to investigate the location and number of DMAPs using color Doppler US.

Methods: We investigated DMAPs arising from the second, third, and fourth dorsal metacarpal arteries (DMAs) in 28 hands of healthy volunteers (14 women and 14 men) using color Doppler US (GE healthcare, Venue40). We evaluated the number and direction of perforators and their distance from the distal end of the metacarpal.

Results: In total, 145 DMAPs (73 in men and 72 in women) were observed. The number of perforators arising from the second, third, and fourth DMAs was 60, 52, and 33, respectively. In these hands, four fourth DMAs and two third DMAs were defective. The percentage of perforators directed to the dorsal, radial and ulnar side was 73%, 20%, and 7%, respectively. Of all the perforators, 73% were located within 25 mm proximal to the distal end of the metacarpal.

Discussion: Preoperative assessment of the location of DMAPs is very useful for designing a DMAP flap. Our results revealed that the number of perforators arising from the second DMA was the highest, although a substantial number of DMAPs was observed to arise from the third and fourth DMAs. Thus, it was possible to design flaps involving DMAPs from the third and fourth DMAs. Moreover, investigating DMAPs using

color Doppler US could be easy, safe for patients and useful for preoperative planning.

A-0264 Biomechanical property of three-dimensional printed volar locking distal radius plate: Comparison with conventional volar locking plate

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Objectives: This study evaluated the biomechanical properties of a new volar locking plate made by three-dimensional (3D) printing using titanium alloy powder and two conventional volar locking plates made by cutting of metal block under static and dynamic loading conditions that were designed to replicate those seen during fracture healing and early postoperative rehabilitation.

Methods: For all plate designs, 12 fourth-generation synthetic composite radii were fitted with volar locking plates according to the manufactures' technique after segmental osteotomy. Each specimen was first preloaded 10 N and then was loaded to 100N, 200N, and 300N in phases 1, 2, and 3, respectively, at a rate of 2N/s. Each construct was then dynamically loaded for 2,000 cycles of fatigue loading in each phase for a total 10,000 cycles. Finally, the constructs were loaded to a failure at a rate of 5 mm/min. Differences between the experimental groups were statistically evaluated with a one-way analysis of variance and a Tukey post hoc test with the level of significance set at $\alpha = 0.05$.

Results: All three plates showed increasing stiffness at higher loads. The 3D printed volar locking plate showed significantly higher stiffness at all dynamic loading tests compared to the 2 conventional volar locking plates ($p < 0.05$). The 3D printed volar locking plate had the highest yield strength which was significantly higher than those of 2 conventional volar locking plates.

Conclusions: It seems clear that 3D printed volar locking plate may offer adequate stability for the experimental model of the distal radius fracture in which the anterior and posterior metaphyseal cortex is comminuted severely. The results of the presented study provide evidence of clinical use of 3D printed

volar locking plate whose design can be modified following the fracture configuration and the anatomy of the radius.

A-0267 Minimal clinically important difference of patient-rated outcome instruments in distal radial fracture

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Objectives: The purpose of this study is to determine the minimal clinically important difference (MCID) of Disability of shoulder, arm, and hand (DASH) and Patient-rated wrist evaluation (PRWE) in the patients with the fracture of distal radius.

Methods: A total of 161 patients treated with volar locking plate for the fracture of distal radius were evaluated between August 2014 and August 2016 in our clinic. Among these patients, one who completed the two patient-rated outcome instrument (DASH and PRWE) and anchor questionnaire at consecutive outpatient visits were enrolled. Anchor questionnaire indicates the degree of clinical change that patient was perceived since the previous visit. The patients with the fracture of distal radius were asked to visit the outpatient department 1 month, 2 months, 3 months, and 6 months after the operation. The patients were categorized into three groups according to the anchor questionnaire: (1) no change or (2) minimally improved or (3) markedly improved. Difference in the two patient-rated outcome instrument were used for calculating an anchor-based receiver-operator characteristic curve. Minimum detectable change was also calculated as distribution-based approach. We determined the MCID of DASH and PRWE in reference to the cutoff value from ROC curve and minimum detectable change.

Results: The MCID of the DASH was 9.3 points. The area under the curve was 0.78 [95% confidence interval (CI), 0.6–0.95]. The MCID of the PRWE was 17.75 points. The area under the curve was 0.82 [95% CI, 0.68–0.96]. Using the cut-off value, the sensitivity of the MCID is 91.3% for DASH and 70% for PRWE. The specificity of these MCID is 61.5% for DASH and 92.3% for PRWE, respectively.

Conclusion: We determined the MCID of the DASH and PRWE for the patients with distal radius fractures using anchor-based approach and distribution-based approach. These values can be used when evaluating the effects of treatment or calculating sample size on studies of distal radial fractures.

A-0269 Can MRI and bone scan predict the result of ulnar shortening osteotomy?

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Introduction: To evaluate the predictive role of MRI and bone scan for clinical result of ulnar shortening osteotomy.

Materials and Methods: We retrospectively reviewed 47 patients clinically diagnosed with ulnar impaction syndrome and treated with ulnar shortening osteotomy from February 2010 to October 2015. Preoperative MRI and bone scan were obtained in all patients. We assessed anatomical location of bone marrow edema, subchondral sclerosis, and cystic change in MRI and of hot uptake in bone scan at the radius, ulnar, lunate, and triquetrum. We evaluated pain VAS score and DASH score preoperatively and at 6 months after surgery for each patient. There were 18 males and 28 females ranging in age from 19 to 60 years (mean, 42 years). Mean period of conservative treatment after the onset of symptoms ranged from 0.5 to 180 months (mean, 21.1 months). The minimum follow-up was 6 months (mean, 13 months; range, 6.2–48 months).

Results: Preoperative pain VAS score of overall patients ranged from 6 to 9 (mean, 7.85). Preoperative DASH score ranged from 14.2 to 68.3 (mean, 33.3). At the time of 6 months after surgery, mean pain VAS score is 19.5 [range, 0–5] and mean DASH score is 17.6 [range, 0–47.5]. The most common site of abnormal signal change in preoperative MRI was lunate (39 cases, 83%) followed by triquetrum (16 cases, 34%), ulnar (4 cases, 29.8%), and radius (3 cases, 6.4%). In bone scan, 29 cases (61.7%) of lunate showed hot uptake followed by triquetrum (22 cases, 46.8%), ulnar (17 cases, 36.2%), and radius (8 cases, 17%). There was no meaningful correlation between the site of signal change in MRI and hot uptake in bone scan ($p = 0.057$). We categorized MRI findings into three groups, and there was no difference between groups concerning clinical scores (pain VAS and DASH score) of preoperative and 6 months after surgery. Bone scan analysis between group of hot uptake and no change also resulted in

no significant difference in clinical scores preoperatively and 6 months after surgery.

Conclusions: Ulnar shortening osteotomy is a good treatment option for refractory ulnar impaction syndrome. MRI and bone scan finding has a limited role in predicting the result of ulnar shortening osteotomy

A-0272 Successful closure of persistent small-sized posterior elbow soft tissue defects with rotation flap under local anesthesia

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Purpose: Treatment of soft tissue defects over the posterior elbow is challenging. The clinical application of a local rotation flap or its indication with respect to defect size has not been well reported. Therefore, we evaluated the outcomes associated with rotation flap surgery for soft tissue defects over the posterior elbow and determined the optimal defect size for its indication.

Methods: Thirty patients with wound dehiscence associated with the posterior surgical approach for elbow trauma and treated with rotation flap surgery under local anesthesia were retrospectively reviewed. The size of the defect, operative time, wound healing time, pre-/postoperative Mayo Elbow Performance Scores (MEPS), and range of motion (ROM) for the elbow joint were assessed. The optimal defect size threshold for predicting survival of the rotation flap was determined using receiver-operating characteristic curve analysis.

Results: At an average of 29.4 months, all patients had achieved soft tissue healing without recurrence. No reoperations or conversions to other flap techniques were noted; however, complications related to the procedure occurred in six patients. The mean size of skin defect was 7.4 cm². Average operative time and wound healing time were 25.6 min and 21.9 days, respectively. There was a significant improvement in the MEPS (preoperative mean, 56.4; final follow-up, 90.2; $p < 0.001$). However, there was no difference in preoperative and postoperative ROM of the elbow joint. The optimal defect size predicting survival of the rotation flap without complication was 10 cm², with a sensitivity of 83.3% and a specificity of 83.3%.

Conclusions: For wound dehiscence associated with elbow trauma, the presented rotation flap procedure provided good coverage without failure for defects less than 7.4 cm². This procedure provides an attractive

alternative (without any complications) to more complicated techniques for defects less than 10 cm².

A-0274 Follow-up 11 years after wrist arthrodesis in nonrheumatoid patients

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Objective: Plate and screw fixation has been the standard treatment for painful wrist disease in non-rheumatoid patients for the last decades. Reoperations and residual pain are reported by some authors, and others find higher satisfaction and function in their patients. We present long-term results after wrist arthrodesis in nonrheumatoid patients.

Methods: Seventy-four patients (50 men), 50 (21-79) years of age, had their wrist fused due to SLAC/SNAC (44), sequele distal radius fracture (16), lunate malacia (8), or other nonrheumatoid arthrosis (8). The right side was operated in 40 patients (39 dominant wrists), and 35 patients had altogether 75 prior wrist surgeries. Fourteen of 74 had bilateral wrist arthrosis. A Synthes titanium (67) or Synthes angular stable (7) arthrodesis plate was used for fixation, and bone was transplanted from the iliac crest (52), distal radius (20), or ulna (2). A postoperative cast was used for 8 weeks after which the patients were allowed unrestricted use. Complications and reoperations during the follow-up period were registered. At final follow-up, the patients completed the QDASH and PRWHE questionnaires and rated their pain at rest and under activity. Forearm rotation, grip-, and key-pinch were measured and radiographs taken.

Results: All arthrodeses healed in three after re-fixation with a new plate and bone grafting. Thirteen patients had early (excessive pain, tendon rupture/tendinitis, CTS, hematoma, 3 metacarpal fx, long metacarpal screw) and 43 late (plate/screw/CMC3 problems, non-union, pain, DRUJ problems) complications, and 38 patients were operated altogether 62 times during the follow-up period. Thirteen patients did not attend the final follow-up after 11(4) years (8 patients died, 1 patient emigrated, and 4 did not want to attend). Sixty-one patients reported their mean QDASH, PRWHE, and VAS pain scores at rest and activity to 35 (24), 39 (28), 2.0 (2.6), 3.3 (3.1), respectively. Clinical examination in 54 patients revealed reduced grip strength (24 vs. 32, CI 2-13 kg), key pinch (7 vs. 9 CI 1-3 kg), supination (77 vs 87 CI 4°-16°) and pronation (80 vs. 85 CI 7°-10°) compared to the opposite wrist. Patients who experienced complications and/or reoperations (34/61) during the

follow-up period reported worse function and higher pain; QDASH 45 vs. 23 CI 6–21, PRWHE 51 vs. 25 CI 6–21, VASrest 2.9 vs 0.9 CI 0.8–3.3, and VASact 4.1 vs 2.4 CI 0.6–3.6) compared to the others. Plates or screws were broken in 10 of 30 patients with remaining osteosynthesis material. Nine of 61 have been scheduled for reoperations after the follow-up (plate removal and/or Darrach's procedure (4), rearticulation (4) and CMC2-5 arthrodesis (1)).

Conclusion: Wrist arthrodesis reduces hand function, and the patients report residual pain both at rest and under activity. Since complications and reoperations occurred through the follow-up period, we report a higher complication and reoperation rate than prior studies with shorter follow-up. For the majority of our patients, wrist arthrodesis was not final surgery, and a more systematic follow-up could have reduced the complication rate.

A-0275 New classification on the configuration of the distal radioulnar joint in patients with ulnar impaction syndrome

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The development of arthritis in the distal radioulnar joint (DRUJ) is one of the major concerns after ulnar shortening osteotomy. One of the important factors affecting on the development of DRUJ arthritis is the configuration of the DRUJ. Although tolait classified the types of DRUJ based on the shape of ulnar notch of the distal radius, they did not consider the shape of ulnar head in the DRUJ. The purposes of this study are to evaluate the configuration of DRUJ and to suggest new classification of the joint in patients with ulnar impaction syndrome.

We retrospectively reviewed 26 wrists of 26 patients (7 males and 19 females) with ulnar impaction syndrome who checked preoperative 3D computed tomography (CT) and underwent ulnar shortening osteotomy. On the 3D CT, we measured the slope of the ulnar articular side of distal radius and radial articular side of distal ulna in the DRUJ using Materialise Mimics®. The slope was defined as positive if the longitudinal articular line is directed from distal ulnar side to proximal radial side. We classified configurations of distal radius and ulna into three

groups; vertical ($-5^\circ < \text{slope} < 5^\circ$), oblique (slope $> 5^\circ$), and reverse oblique (slope $< 5^\circ$). We also simulated the changes of the joint in the DRUJ between initial state and 2 mm shortening of ulna. The average ulnar variance was 3.4 mm. Of the 26 wrists, 7 wrists were vertical type, 5 wrists were oblique type, and 14 wrists were reverse oblique type in the slope of distal radius in DRUJ. Among the seven wrists with vertical type in the slope of ulnar side of distal radius, there was one wrist with vertical type, four wrists with oblique type, and two wrists with reverse oblique type in the type of ulnar slope. Among the five wrists with oblique type in the slope of the ulnar side of distal radius, there were three wrists with oblique type and two wrists with reverse oblique type in the type of ulnar slope. Among the 14 wrists with reverse oblique type in the slope of the ulnar side of distal radius, there were 1 wrist with vertical type, 5 wrists with oblique type, and 8 wrists with reverse oblique type in the type of ulnar slope. There was significant correlation between the slope of distal ulna and the changes of the joint space between initial state and 2 mm ulnar shortening. When we simulate the changes of the joint space in the DRUJ after ulnar shortening, the slope of distal ulna was more important than that of distal radius. New classification based on both the slopes of distal radius and the ulna seems to be more reasonable compared to the previous classification. Further studies seem to be needed to verify if distal ulna with reverse oblique type can be a risk factor for the progression of DRUJ arthritis.

A-0277 Radiographic measurements in the macrodactyly of the fingers

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Objective: Macrodactyly is a rare congenital anomaly characterised by enlargement of the digits in the hand or foot. The degree to which tissue types overgrow within affected digits varies. To our knowledge, radiologic parameters have not yet been studied in macrodactylic hands. The objectives of this study are to measure the increase in length, anteroposterior diameter, and width in macrodactylic fingers, compare them with normal fingers, and to suggest useful surgical options.

Methods: A retrospective audit of all patients diagnosed with macrodactyly of the hand who visited our clinic from January 2001 to December 2014 was carried out. We routinely obtained standard PA and lateral

radiographs of fingers at initial visit. Radiographic measurements were performed independently by two orthopaedic surgeons. Intraclass correlation coefficients (ICCs) were used to determine the interobserver reliability of measurements. We measured the length, width, and anteroposterior (AP) diameter on the finger posteroanterior (PA) and lateral radiographs and compared these values to that of the contralateral normal hand.

Results: In total, 28 patients diagnosed with macrodactyly of the hand were found between 2001 and 2014. The mean age was 66 (range, 6 to 218) months at the time of first visit. Although all elements were enlarged in macrodactylic fingers, the AP diameter and width were enlarged more than length. The contribution of each phalanx to the total length difference was similar among proximal, middle and distal phalanges. We found that the anterior soft tissue was more enlarged than the bone or posterior soft tissue on the lateral radiograph. Interobserver agreement regarding measurement of the length, AP diameter, and width was moderate to strong.

Conclusions: In this study, the AP diameters and widths of macrodactylic fingers were more enlarged than the length of fingers. Although operation methods for macrodactyly are improving, our results show that efforts should be directed towards reducing the AP diameter and width of macrodactylic fingers. The contribution rate to AP width was largest for the anterior soft tissue, which indicates that debulking soft tissue at the volar side should be important to ensure the best outcome. We believe our study offers insight into which structures are involved the most in macrodactyly, thus helping surgeons to achieve major goals in treatment, such as reducing the disparity in length and difference between affected and healthy digits, and maintaining motion at the joints.

A-0281 Splinting after surgery for Dupuytren's Disease: A systematic review and meta-analysis of the available evidence

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Objective: This systematic review identifies and appraises available evidence regarding the effectiveness of postsurgical splinting in combination with hand therapy following Dupuytren's disease (DD).

Methods: A systematic literature search for randomized clinical trials was conducted. Methodological quality of included studies was assessed using the

Risk of Bias Tool. A meta-analysis was conducted for Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) and active range of motion (AROM). For rating the quality of evidence the Grades of Recommendation Assessment, Development and Evaluation (GRADE) was used.

Results: Three articles with 264 patients with surgical release of DD were included. All patients had standard hand therapy postsurgery, and patients in the splint groups wore a night extension splint.

Conclusions: The studies provide moderate quality, and no statistical significant outcomes were found. In conclusion, the suggestion is against using the night extension splint as a routine intervention.

A-0282 Controversies in Poland syndrome: A systematic review on the presentation and definition of Poland syndrome in literature

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Objective: Poland syndrome was first described as a deficiency of pectoral muscles with ipsilateral symbrachydactyly. Currently, many case reports describe variations in Poland syndrome, in which often only pectoral muscle deficiency is used as a defining criterion. However, more syndromes contain pectoral deficiency. The aim of this review is to study the diversity of the phenotypic spectrum of Poland syndrome to create more awareness for alternative diagnoses in pectoral muscle deficiency.

Methods: A systematic literature search was performed in seven databases. Articles containing phenotypical descriptions of Poland syndrome were included. Included studies were scored on number of patients, gender, familiar existence, and definition of Poland syndrome. In addition, hand deformities, thoracic deformities, and other deformities were registered per patient. Alternative syndrome diagnoses were identified in patients with a combination of hand, thorax, and other deformities.

Results: Hundred and thirty six articles were included, describing 627 patients. Ten different definitions of Poland syndrome were practiced. In 58% of the cases, an upper extremity deformity was found. In 43% of the cases, an associated deformity was found. Classical Poland syndrome was seen in 29%. Fifty-nine percent of the patients with a pectoral malformation, a hand malformation, and another deformity had at least one feature that matched one of the alternative syndromes with pectoral muscle deficiency. To illustrate this, the

combination of pectoral malformation, thumb hypoplasia, and cardiac defects (ASD) could be suggestive for Holt-Oram syndrome. Duane-radial ray syndrome ($n = 22$) matched the presented phenotypes most often.

Conclusion: Pectoral muscle hypoplasia is not distinctive for Poland syndrome alone but also present in syndromes with other associated anomalies and an entirely different pattern of inheritance. Therefore, we advocate the use of the classical definition of Poland syndrome limited to hypoplasia of the pectoral muscle and symbrachydactyly. This prevents diagnostic and prognostic errors.

A-0283 Nerve transfers for restoring elbow flexion in brachial plexus palsy

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Objective: Nerve transfers (NT) consist in sectioning a donor nerve and connecting it to the distal stump of a recipient unreparable nerve. For elbow flexion restoration in brachial plexus palsy (BPP), we used different NT: the phrenic nerve (PhN), the intercostal nerves (ICN), and Oberlin's technique. The aim of this retrospective study is to evaluate the results of this procedure in BPP.

Methods: From 78 BPP, ICN was used in 21 (17 biceps and 4 triceps), Oberlin technique was used in 7, and PhNT was used in 3. In six cases we used different association of NT and combined neurotizations: neuro-neuronal-neurotization (NNN) and direct neuromuscular neurotization (DNMN). Combined neurotization in two cases: medial pectoral (MPN) to musculocutaneous nerve (MCN) + DNMN with intercostal nerves (ICN) to biceps. In three cases, we used double NT: PhN associated with spinal nerve (SN) to MCN and ulnar nerve in two cases; in one case we used a long sural nerve graft – SNG – (bypass) PhN to MCN. In one case, we used NNN + DNMN: NNN by SNG using C3+C4 + SN to MCN and DNMN to biceps. Patients were reviewed at 6, 12, and 36 months postoperatively. The mean age of the patients was 29 years. The average posttraumatic interval prior to surgery was 6–9 months. Muscular reinnervation was evaluated according to BMRC scale.

Results: The average time required for biceps reinnervation was 12–14 months after ICNT and 8–9 months after PhNT; for triceps was 9 months after ICNT; and in Oberlin technique was 4–6 months. After Oberlin technique was no motor or sensory deficit related to the ulnar nerve. After ICNT to biceps, 12 patients achieved M3–M4 elbow flexion, 3 patients with M1–M2, and 2 patients with M0. For triceps, two patients achieved M3–M4 elbow extension – to which we performed Carroll transposition for elbow flexion recovery – one M1–M2, and one M0. Of the seven patients with Oberlin technique, five achieved M4, one M3, and one M1–M2. After PhNT associated with SN recovered biceps function at M2–M3 in 2 cases and a poor result (M1) with singular NT (PhN to MCN) by SNG.

Conclusions: NT is an important goal in BPP. ICNT into the nerve of biceps for elbow flexion recovery is a reliable procedure in BPP. ICNT for triceps offers a positive alternative (Carroll transposition). Combined neurotization NNN + DNMN and double NT association improved results. Oberlin technique is simple and offers better results in short time and is an effective and safe option.

A-0284 Ulnar polydactyly: A comparison of long-term outcomes of vascular clip application versus surgery in the newborn

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Objective: Currently, there are three options to treat ulnar or postaxial polydactyly type B (PAPD-B): surgery, suture ligation, or vascular clip application. The aim of this study is to compare vascular clip application with surgery based on complication rate, pain, and appearance of the scar.

Methods: Patients with PAPD-B were identified in our patient registry. Treatment age and number and type of complications were extracted. Caregivers were asked to complete a questionnaire containing VAS scores for pain and aesthetical outcome regarding appearance of the scar. To compare nominal variables, we used Fisher's exact test. A *t*-test was used to compare continuous variables. Considering that the VAS scores would not be normally distributed, we used nonparametric tests to compare them.

Results: Fifty-six patients with 82 fingers with PAPD-B were included. Mean treatment age in the vascular clip group was significantly lower [1.1 months (SD: 3.41)] compared to the surgical group [11.7 months (SD: 5.85); $p = 0.000$]. More complications in the surgery group ($n = 8$) were reported than in the vascular

clip group ($n = 4$), but this was not significantly different ($p = 0.536$). Nevertheless, complications in the surgery group were more severe (early shed of the extra finger, thrombosis in the extra finger, extravasation, burn as result of the tourniquet) than complications in the clip group (accidental removal of vascular clips). Twenty-three patients completed the questionnaires. Fifteen PAPD-B fingers were treated with vascular clip application and 19 PAPD-B fingers received surgical treatment. Median VAS-score on pain of the scar in the vascular clip group was 0.90 (IQR: 0.05-1.75) (with a score of 10 equal excruciating pain) compared to 0.00 (IQR: 0.00-0.10) in the surgery group ($p = 0.009$). Median VAS score on aesthetical outcome of the scar in the vascular clip group was 2.50 (IQR: 0.30-4.70) (with a score of 10 equal to completely satisfied) compared to 8.90 (IQR: 7.55-10.25) in the surgery group ($p = 0.000$).

Conclusions: This study shows that vascular clip application for PAPD-B can be easily implemented in an outpatient setting with minor complications and without the risk of general anesthesia in a young child. Nevertheless, VAS-scores on aesthetical outcome showed significantly lower scores in vascular clip application compared to surgery. This difference may be due to the shorter follow-up time in the vascular clip group resulting in a less matured scar at the time of this study. In order to increase patient satisfaction, surgical correction of the scar can be considered under local anaesthesia at an older age when desired.

A-0285 Jabaley epineurial splint technique versus conventional fascicular group neurography in distal median and ulnar nerves reconstruction

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Objective. The Jabaley's technique derives from the Richter technique of epineurial suture. The Jabaley's technique is a FG suture technique in which the stress is taken up by the epineurial splint sutured at a different level than the FG suture following the Saint-Venant principle. The technique is more time consuming than a normal FG suture but more rapid than nerve grafting.

Methods Between 1989 and 2015, we performed 265 median and 337 ulnar nerves direct coaptation reconstruction in the forearm. In the median nerve, FG

neurography was performed in 48 cases of which we chose the Jabaley technique in 20 cases. In the ulnar nerve, we performed FG neurography in 113 cases of which 44 were repaired by the Jabaley technique. The epineurial splint is created on the profound side of the nerve connected to the mezo nerve, restoring the epineurial vascular support. The two flaps (proximal and distal) of the epineurial splint are tailored to be unequal. Thus, the FG's suture line will be performed at a different level than the epineurial one. After precisely cutting the FG's the suture may be performed without any tension from profoundness towards superficial with 10-0 stitches. The technique maintains all the indications of the FG suture of the upper and lower limb.

Results: The results were good and excellent in 77.08% for the median nerve repaired by usual FG suture and using Jabaley repair were good and excellent in 80 %; for the ulnar nerve, usual FG suture yielded good and excellent results in 80.5% and Jabaley repair yielded good and excellent results 81.81%.

Conclusions: The advantages of this technique consists mainly of rendering possible a stress less fascicular group neurography in border-line situations that normally impose nerve grafting, offer mechanical protection, resistance to elongation, internal, and external gliding possibilities, and vascular support by the epineurial vascularization.

A-0286 Pollicization: Whether this operation is useful in case of two-finger hand?

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Objective: Pollicization is one of the effective methods of grasp restoration in congenital and acquired hand deformations. But still there is a question: Whether this surgical treatment expedient in children with only two-finger hands?

Methods: We have an experience of 410 pollicizations in children with congenital and acquired hand deformities. Fifteen patients had one or both hands with only two fingers. In all cases, the patients had complex malformations – the ulnar deficiency variant (congenital humeroradial synostosis) or atypical cleft hands and feet. As for deformities, we estimated

syndactyly, contractures, clinodactyly, and other deformations, condition of carpal and metacarpal bones and the ratio of radiocarpal joint surfaces.

Results: In seven cases, there was total syndactyly of triphalangeal fingers, in 3 cases – incomplete union at the distal interphalangeal joint level, in 2 cases – basal union of fingers. 3 patients had no fingers union. In all cases, there were finger deformations: flexion contractures (9 hands), contractures with clinodactyly (5 hands), and isolated clinodactyly (1 hand). In 2 cases, both fingers had common MCP joint on common metacarpal bone. Two patients had hand deviation. Fifteen pollicizations of radially located finger were performed. First, we eliminated syndactyly using the magnifying lens, careful identification, and palmar neurovascular bunches preservation from fingertips to basis. Further, we determined the arteries on a palmar surface. In 4 cases, there was the only vessel divided into 2 branches at the finger base level. In the remaining patients, it was possible to identify the main artery to every ray. We didn't have any problems with shifted finger veins. In cases of clinodactyly or contractures, we eliminated them in the same stage mobilizing the neurovascular bunches of a transferring finger to the proximal interphalanx joint level and carrying out a capsulotomy or a corrective osteotomy. In two cases of common MCP-joint and common metacarpal bone, we performed the radial finger rotation and its slight transposition to the palmar side. In both cases, fingers had the common flexors and extensors tendons, which were divided at MCP-joint level. In other patients, we carried out the epiphysis separation from a transferring metacarpal bone diaphysis, the diaphysis distal part resection, moving the remained proximal part of metacarpal bone to the palmar, and radial direction and fixing the mobilizing finger at the end face of metacarpal bone. Finally, we closed the wounds on fingers side surfaces with skin grafts in 12 patients with primary fingers union. No one of patients had problems in the postoperative period.

Conclusions: The pollicization of radially located finger is feasible and expedient technique in cases of hand with only two fingers. Even in severe deficit, it is possible to get bilateral grasp function, which is very important at self-service, especially for children with bilateral affection.

A-0287 Intrafamilial variability in triphalangeal thumb phenotype: Evidence for phenotypic progression over generations

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Objective: Phenotypic variability is known to be present in triphalangeal thumb (TPT) families. Both isolated TPT and TPT accompanied with preaxial polydactyly can be present within the same family. However, recent observations in our clinic suggest structural increased prevalence of severe phenotypes in a large TPT-population, as newborns demonstrate phenotypes like triplications of the thumb accompanied with postaxial deformities. Therefore, the aim of this study is to investigate the progression of the TPT-phenotype through generations in this population.

Methods: Index patients from a Dutch TPT-population were identified. Questionnaires regarding family occurrence and phenotypes were distributed. Subsequently, families were visited to validate the phenotype. Both prevalence of different phenotypes and inheritance pattern of the TPT-phenotype between multiple generations were analyzed. Furthermore, TPT-families that have been published in literature were reviewed to validate our results in other populations.

Results: In all, 170 patients with TPT were identified from 11 Dutch families. An identical 105C>G mutation in the ZRS-region has previously been confirmed in these families. When analyzing the prevalence of phenotypes, the majority (54%) of patients born in the last 25 years demonstrated a severe TPT-phenotype. Severe TPT-phenotypes have increased dramatically through multiple generations, from 16% to 54%. Additionally, the transition of phenotypes is analyzed in 132 segregations between two subsequent family members. In 54% of these segregations, the phenotype remained stable. Furthermore, 38% of the segregations produced a more severe phenotype while in only 8% the phenotype was less severe compared to affected parents. Overall, 71% of the index patients had a more severe phenotype compared to their great-grandparent. Similar observations have been analyzed in 14 reviewed families that previously have been published in literature.

Conclusion and Discussion: Our results are not in accordance with the notion that phenotypic variability is present in TPT-families. We observe a pattern that resembles phenotypic anticipation through multiple generations. Although all family members share an identical mutation in the ZRS-region (105C>G), it does not explain the wide phenotypic range of anomalies. The structural progression of the phenotype will have significant functional impact on the affected

children, who are required to undergo additional operations and may experience reduced thumb and hand function compared to their parents and grandparents. Furthermore, our observational study provides better estimations for counseling by the Plastic Surgeon and Clinical Geneticist and provides new insights into the regulation of the SHH gene by the ZRS-enhancer.

A-0293 Clinical utility of conventional bedside monitoring combined with high-resolution ultrasonography for monitoring vascular compromise after free tissue transfer

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Introduction: The purpose of this study was to report the clinical utility of conventional bedside monitoring combined with high-resolution ultrasonography (US) for monitoring vascular compromise after free tissue transfers.

Methods: Thirty-six patients with tissue defects in extremities, reconstructed by 20 free fasciocutaneous, 14 free osteocutaneous, and 2 free musculocutaneous flaps, were included in this study. Blood flow around anastomosis pedicle and in subcutaneous tissue of grafted skin flap was investigated by power Doppler US at the end of reconstructive surgery. We marked blood flow which was typically observed in each area on the skin for repetitive postoperative examination. This ultrasonographic examination was performed whenever conventional bedside monitoring showed abnormality. Emergent surgical exploration was only performed whenever ultrasonographic examination revealed loss of blood flow in anastomosis pedicle. The utility of our monitoring technique was investigated by the success rate and salvage rate of free tissue transfers and false positive rate of vascular compromise of anastomosis pedicle.

Results: Thirty-three of 36 patients were performed ultrasonographic examination. Twenty-nine of 33 patients showed blood flow in each marked position although conventional monitoring showed abnormality. Twenty-six of 29 patients showed no flap failure, but remaining three patients resulted in partial necrosis, which revealed that anastomosis vascular system did not cover whole part of flap, and we could not salvage this partial necrosis. On the other hand, 4 of 33 patients revealed ultrasonographic abnormality. One patient had arterial and venous flow loss around anastomosis pedicle with complete loss of

subcutaneous blood flow in flap. The other three patients showed obstruction of venous flow of anastomosis pedicle although arterial flow was present with decreased subcutaneous blood flow in flap. Emergent surgical reexploration showed same findings as US, and we could not find any false-positive cases. We were able to salvage these three of four failing flaps by thrombectomy with vein graft; however, one case resulted in partial necrosis which needed plastic surgery. In summary, the success rate of free tissue transfer was 87.9% (29 of 33 cases) and partial necrosis which needed plastic surgery was 12.1% (4 of 33 cases). In three of four cases which showed vascular compromise of anastomosis pedicle were salvaged.

Conclusion: Early recognition and rapid reexploration of free flaps with signs of vascular compromise are associated with better outcomes; however, the best method for monitoring tissue perfusion has yet to be established. Our monitoring technique revealed not only higher salvage rate which contributed to higher success rate but also lower false-positive rate which contributed to avoid unnecessary reexploration.

A-0294 Spontaneous healing of fingertip amputations under IV 3000 semiocclusive dressing

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Objective: Fingertip trauma is a burden on the health-care system due to increased frequency. Spontaneous healing of tissue loss at this level (amputation zones I and II) is an increasingly used treatment option. There is a noninferiority of the conservative treatment versus surgery (flaps) in terms of hand mobility and finger morphology; it is superior in two-point discrimination, regeneration of dactylogram, and absence of additional scars. The principle of the method is to protect the wound with an occlusive dressing (film), allowing tissue regeneration in a controlled environment. There is a wide range of commercially available products and also a need for teaching and spreading the method. The purpose of this study was to (1) evaluate our treatment protocol and (2) analyze educational issues (medical staff and patients).

Methods: Surgeon–patient discussion to decide if the method is suitable for the individual case (inclusion/exclusion criteria, patient’s wishes and requirements, cooperation and comprehension of advantages and disadvantages). Classical treatment protocol was applied as described in the literature using IV 3000 film (Smith & Nephew Medical Limited, London, United Kingdom) and supplemental Aquacel Ag+ Hydrofiber technology (ConvaTec Inc, Flintshire, United Kingdom) on the wound. Training of residents and nurses was insured to understand and apply the principles of spontaneous healing (case selection, initial wound care, and technique of dressing changes). Questionnaire was completed to evaluate patients’ satisfaction.

Results: Twenty-five patients completed the study, with good morphologic and functional results, without complications. Time to healing was 2–8 weeks. IV3000 prevented excessive moisture and caused very little skin maceration by allowing vapor transfer. It remained well in place but removal was not painful, acted as a barrier, and permitted patients to shower. Aquacel Ag+ reduced bacterial contamination in selected cases and diminished the foul odor. All patients rated the result as excellent or good, with main advantage in avoiding OR surgery \pm hospital stay and principal inconvenient the number of dressing changes. Residents and nurses appreciated the versatility and reproducibility of the method.

Conclusions: Conservative treatment reduces pressure on the OR, providing excellent results. Patient informed consent and compliance depend on surgeon–patient communication and on patient’s understanding level. Medical staff requires training for the successful application of treatment principles. Further research is necessary to choose the most suitable protocol and products but keeping in mind the stringent need for cost-efficiency.

A-0297 Flexor mechanism in radial polydactyly

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Background: Radial polydactyly (RP) comprises a diverse group of anomalies. The complexity of anatomy may be underestimated resulting in poor primary surgical results and late deformities. There is a paucity of literature regarding flexor mechanisms in RP. This study focuses on flexor anatomy and procedures to address anomalies of flexor tendons and pulleys.

Method: This is a prospective study of flexor tendon (FPL) and pulley anatomy, anomalies and associated surgical procedures recorded in operation records of patients undergoing primary correction of RP.

Results: Of 54 thumbs undergoing primary surgery, FPL inserted into both duplicates in 40 (74%) of 54, ulnar duplicate only 10 (19%) of 54, and radial duplicate only 3 (5%) of 54. FPL was absent in 1 (2%) of 54. FPL hypoplasia, poor excursion, and deficient pulley systems were observed. Procedures undertaken included FPL transfer to dominant duplicate, centralization of FPL, and release of abnormal insertions / connections (27 procedures). Seventeen (26%) of 54 thumbs required pulley reconstruction, the majority in Wassel groups III and IV.

Discussion: Flexor anatomy in RP is complex. We advocate systematic exploration of the flexor mechanism at primary surgery and an anatomical approach to reconstruction. This optimizes results from primary surgery, provides valuable prognostic information, and guides management of late deformity.

A-0298 Modified distal radius dorsal skyline view for the evaluation of distal radio ulnar joint

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Objectives: Congruency of distal radioulnar joint (DRUJ) after treatment of distal radius fractures is necessary for preservation of pronosupination of the forearm, and it is accepted that a 1 mm step off rises the risk of degenerative arthritis. The purpose of this study is to describe a modification of the original dorsal skyline view (DSV) used for the evaluation of the dorsal radius cortex for screw protrusion, proposed by Jacob and Clay, to assess DRUJ, simultaneously.

Methods: This study involves 30 healthy volunteers over the age of 18. Fluoroscopic images were made, establishing the position of each joint in the upper extremity in which the dorsal cortex of the distal metaphysis of the radius could be properly assessed as well as the DRUJ. Starting at the DSV original position, modifications in the arm rotation, elbow flexion, and supination, and flexion of the wrist were made until the best image was obtained.

Results: The position where the DRUJ and dorsal radius cortex were seen clearly was a mean Shoulder External Rotation of 17° (\pm 3°SD) [IC99: 13°–21°], Elbow Flexion of 67° (\pm 5°SD.) [IC99: 64°–69°], forearm

supination of $88^\circ(\pm 3^\circ\text{D.E.})$ [IC99: $87^\circ\text{--}90^\circ$], and wrist flexion of $88^\circ(\pm 8^\circ\text{D.E.})$ [IC99: $85^\circ\text{--}92^\circ$].

Conclusions: It is very important to evaluate intraoperatively the presence of articular step offs and gaps, articular congruency, and invasion of screws at the DRUJ, in the context of a distal radius fracture. The DSV is of great value in this matter when modified, with more degrees of shoulder external rotation and less elbow flexion, allowing for the visualization of both the dorsal radius cortex and the DRUJ. We propose the modified DSV as a useful asset in distal radius plating.

A-0300 Decision-making in treatment of patient with thumb CMC-joint osteoarthritis: A pilot study

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Objective: From the literature, it is known that the radiological classification of Eaton Littler is not highly correlated with clinical symptoms. However, surgery is often decided upon by a higher Eaton Littler score. Outcomes of surgery procedures and conservative treatment show improvement over time. Although some guidelines recommend to start with conservative treatment first, it is still unknown which clinical symptoms might be favorable for conservative hand therapy or surgery in thumb CMC-joint osteoarthritis. Purpose of this pilot study is to find clinical symptoms that indicate surgery to be the first choice of treatment in patients with thumb CMC-joint osteoarthritis.

Methods: Conservative treatment was standardized and consisted of individual training, splinting, and advise concerning thumb stability and its use in functional exercises, and group counseling and health education about knowledge of arthritis, causes, symptoms of thumb osteoarthritis, and the way to deal with this in activities of daily life by ergonomic advises. Functional outcomes in this study were: pain (NRS 0-10), pinchforce (lateral grip using the Preston pinch gauge), and the DASH questionnaire for disability. Assessments were done at intake, and after 3, 6, and 12 months. Patients who underwent surgery for their thumb CMC-joint osteoarthritis after initially having started the conservative hand therapy were registered. Differences over time of the functional outcomes were calculated by using the Wilcoxon signed-rank test. To examine the differences in initial outcome for the conservative group and the group that had an operation within 12 months postconservative therapy, student *t*-test was used. Considering the study to be a pilot, the statistical significance was set at $p < 0.10$, in order to determine trends in the data.

Results: Twelve (12 %) of 97 subjects who initially started with conservative hand therapy had surgery within a year. Comparing the data at intake of the surgery group with the nonsurgery group revealed that

both perceived pain (NRS: $t = 1.78$; $p = 0.10$) and disability (DASH: $t = 3.10$; $p = 0.01$) were higher in the surgery group, that is, pain NRS = 7.4 ± 1.8 versus 8.4 ± 1.6 and disability DASH: 42.9 ± 18.2 versus 66.9 ± 18.7 . The initial value of perceived pain and perceived disability showed a moderate correlation (Spearman $\rho = 0.39$, $p = 0.03$). The mean time on hand therapy for the whole group was 8.0 ± 2.0 hours.

Conclusions: Data of present study indicate that high perceived pain intensity and a high level of perceived disability might indicate that a surgery procedure might be the first choice for treatment of thumb CMC-joint osteoarthritis. Due to the small numbers, some of the found differences were not statistical significant. A larger data set will enable us to calculate risks estimates with which a clinical decision rule for surgery on thumb CMC-joint osteoarthritis can be established.

A-0301 Functional outcomes of a standardized hand therapy program in patients with thumb CMC-joint osteoarthritis: A cohort study with 12 months follow-up

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Objective: From the literature, it is known that multimodal interventions are more effective in patients with thumb CMC-joint osteoarthritis than single interventions. Purpose of this study is to monitor functional outcomes of a new standardized multimodal hand therapy program in patients with thumb CMC-joint osteoarthritis during a follow-up of 12 months.

Methods: Conservative treatment was standardized and consisted of individual training, splinting, and advice concerning thumb stability and its use in functional exercises. Subsequently, group counselling and health education were applied considering knowledge of arthritis, causes, symptoms of thumb osteoarthritis and the way to deal with this in activities of daily life by ergonomic advice. The four group sessions involved three to five patients and lasted 1.0 h each. The mean total treatment time in the program was 8.0 ± 2.0 h for the whole group. Functional outcomes in this study were: pain (NRS 0-10), grip strength (JAMAR), pinch force (lateral grip using the Preston pinch gauge) and the DASH questionnaire for disability. Assessments were done at intake, and after 3, 6 and 12 months. Patient satisfaction was assessed on a 11-point Likert-type scale at the closure of the hand therapy program. Differences over time of the functional outcomes were calculated using the Wilcoxon signed-rank test. An improvement of more than 10%

improvement is considered to be clinically relevant. The significance level was set at $p \leq 0.05$.

Results: Ninety-seven patients participated in the standardized hand therapy program for thumb CMC-joint osteoarthritis of which 12 patients had surgery for their complaints within 1 year. Perceived pain intensity showed significant and clinically relevant improvement after 12 months (from 7.6 to 6.5 points). Pain and grip strength improved significantly after 3 months (respectively from 7.6 to 5.5 points and from 18.8 to 21.5 kg). However, the improvement in grip strength is not considered to be clinically relevant. Although disability shows a clinically relevant difference after 6 months compared to intake (respectively DASH score 32 and DASH score 47), this was not statistical significant due to high variability in the data. Instead of the improvements seen after finishing the standardized hand therapy program after 3 months, all functional outcomes showed a tendency toward deterioration between 6 and 12 months follow-up, that is, pain (7.7%), grip strength (8.2%), pinch force (3.3%), and disability (29.4%). Patient satisfaction with the standardized conservative hand therapy program was good (8.2 ± 0.9).

Conclusions: The most significant and clinically important improvement was seen in perceived pain especially after 3 months. After initial improvement in pain and disability, there is a tendency of worsening of complaints in the second half of the 12 months follow-up. It is hypothesized that better results might be obtained when at start those subjects who will benefit the most of a multimodal hand therapy program could be identified by their representation of clinical symptoms.

A-0302 Anatomical study of the first dorsal interosseous tendon for its use in the repair of chronic rupture of the radial collateral ligament of the index metacarpophalangeal joint

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Introduction: Injuries to the radial collateral ligament (RCL) of the index finger are scarcely reported in the literature. The most commonly proposed treatment for these chronic injuries at the metacarpophalangeal joints is by means of a free tendon graft.

Materials and methods: We present an anatomical study suggesting the use of the distal tendon of the first dorsal interosseous muscle (FDIM) for repair of a posttraumatic radial chronic instability of the metacarpophalangeal joint of the index finger. For the study, we selected 10 hands from 10 cryopreserved specimens thawed at room temperature for dissection.

Results: The results indicate that the length of the dorsal tendinous insertion of the first dorsal interosseous muscle is always longer than the length of the radial collateral ligament. All tendons of the FDIM were longer, at least 2 mm, than the full length of the RCL. Ranges were between 2 and 10 mm.

CONCLUSIONS: From this study, we can conclude that the distal tendon of the deep part of the first dorsal interosseous muscle is suitable for its use as a graft for repair of chronic ruptures of the radial collateral ligament of the metacarpophalangeal joint of the index finger.

A-0303 Acceleration of peripheral nerve regeneration using nerve conduits in combination with induced pluripotent stem cell technology in aged mice

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Introduction: Aging deeply influences peripheral nerve regeneration. The elderly people suffer from a decline in neural function and the delay in recovery from motor and sensory impairment. However, there are very few studies evaluating the peripheral nerve regenerative capacity of nerve conduits in aged animals. We previously reported peripheral nerve regeneration using nerve conduits with induced pluripotent stem cell (iPSc)-derived neurospheres in young mice. In the present study, we repaired peripheral nerve gaps both in young and in aged mice using the nerve conduits coated with iPSc-derived neurospheres and evaluated nerve regenerative capacity in aged mice compared to young mice.

Methods: The sciatic nerve 5-mm defects in young mice (6 weeks old, n = 25) and aged mice (94 weeks old, n = 32) were reconstructed by the nerve conduits coated with and without iPSc-derived neurospheres. The bioabsorbable nerve conduit (external diameter 2 mm, internal diameter 1 mm, and length 7 mm) was composed of an outer layer of a poly lactide mesh and

an inner layer of a porous sponge composed of 50% L-lactide and 50% ε-caprolactone. Mouse iPSc cells were neurally induced in vitro using a published protocol. The secondary neurospheres derived from mouse iPSc cells were suspended in each conduit (1,500,000 cells per conduit) and cultured in the conduit in vitro for 14 days. Motor function recovery both in young and aged mice was assessed by walking rack analysis and electrophysiological studies at 12 weeks. Nerve regeneration and the grafted iPSc cell-derived neurospheres were evaluated by histological analysis.

Results: Both in the nerve conduits coated with and without iPSc-derived neurospheres, the motor functional recovery and the number of regenerative axons in the aged mice were significantly lower than those in the young mice at 12 weeks after the implantation. Even in the aged mice, axonal regeneration in the nerve conduits with iPSc-derived neurospheres were significantly greater than those in the nerve conduit alone.

Conclusion: Aging influenced peripheral nerve regeneration with nerve conduits in mice. Peripheral nerve regeneration using nerve conduits was accelerated by supportive cells such as iPSc-derived neurospheres in aged mice. This is the first study reporting the use of nerve conduits in combination with iPSc technology in aged mice.

A-0305 Early outcomes of tendon repair and reconstruction in the hand using barbed sutures

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Introduction: Advancements in suture material and techniques have led to a vast improvement in the tensile strengths as well as outcomes of tendon repair and reconstruction. However, the challenges with using conventional sutures has been the added volume of suture material from knot tying for the various techniques used, and its problem with glide. Using barbed sutures allow for a knotless suturing technique and can therefore be a potential solution to these problems.

Methods and materials: This is a retrospective study conducted in a single tertiary hospital over a period of 1 year. Between July 2015 and July 2016, 16 patients underwent barbed suture repair or reconstruction of 19 tendons in the hand. One patient was lost to follow-up, and the remaining 15 patients were included in the study. The average follow-up period was 6 months. Patient's case notes were reviewed to ascertain the type of tendon repair

performed, repair technique, and the type of suture used. Records from the Hand Occupational Therapist as well as the Hand specialist outpatient clinic were reviewed to determine if there were any postoperative complications.

Results: Five patients underwent tendon repair of traumatic lacerations of eight flexor tendons, as three patients had concomitant injuries to two tendons on the same finger. Three patients underwent extensor tendon repair while the remaining seven underwent tendon transfers. All 18 tendons were repaired with V-LOC 3-0 barbed sutures using the Modified Kessler's four-strand double core technique. During follow-up, there were no complications of tendon rupture or repair failure requiring revision surgery. Range of motion was satisfactory, with no evidence of excessive tendon adhesions.

Conclusion: The early outcomes of using barbed sutures in tendon repair and reconstruction are favorable. With knotless repair, surgical time is also decreased. Further studies are needed to ascertain the long-term results of the use of such sutures.

A-0315 Restoration of muscle function with novel chimeric cells therapy of myoblast and mesenchymal stem cell origin

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Objectives: Clinical strategies to prevent denervation atrophy and maintain muscle function following hand trauma and muscle tissue loss include surgery, pharmacotherapy, physical therapy, and electrical and magnetic stimulation. However, none of these approaches have shown significant efficacy in restoration of muscle mass and function. Allogeneic stem cell therapies and vascularized composite allotransplants (VCA) aiming to restore affected muscles are challenged by limited engraftment and allogeneic rejection. Muscle-derived chimeric cells (MDCCs), created via ex vivo fusion of donor and recipient cells represent a novel and promising therapeutic option in the field of muscle regeneration and VCA, eliminating the need for life-long immunosuppression. The aim of this study was to characterize phenotype of MDCC of the myoblast and mesenchymal stem cell (MSC) origin and evaluate the efficacy of engraftment and restoration of

muscle function following delivery of the MDCC therapy to the Duchenne Muscular Dystrophy (DMD) MDX/SCID mice model.

Methods: Ten ex vivo fusions of the human myoblast-MSD and myoblasts-myoblast stem cells were performed, using the polyethylene glycol technique. MDCCs phenotype and genotype were characterized by flow cytometry, confocal microscopy, HLA-typing, and STR-PCR. MDCCs were cultured for 21 days to test cell proliferation, dystrophin expression, and myogenic differentiation. To test the efficacy of human MDCCs in vivo, MDX/SCID mice ($n = 4/\text{group}$) received intramuscular injections to the gastrocnemius muscle of: Group 1 – vehicle (60mcl PBS), Group 2 – 0.25×10^6 of nonfused MSC and 0.25×10^6 myoblasts, Group 3 – 0.5×10^6 of nonfused myoblasts, Group 4 – 0.5×10^6 of human myoblast/MSD MDCC, or Group 5 – 0.5×10^6 of human myoblast/myoblast MDCC. The pattern of injection sites was standardized for all experimental groups. The therapeutic effect was monitored by muscle function tests (grip strength, wire hanging, and muscle weight in vivo and ex vivo muscle force measurements). Assessment of muscle inflammation, fibrosis, and dystrophin expression was evaluated by histology and immunofluorescence at day 7 and 90 after human MDCCs therapy delivery into the MDX/SCID mice.

Results: Following fusion, chimeric state of human MDCCs was confirmed by presence of cell markers, HLA antigens, and gene allele characteristic for both parent cells. MDCC maintained proliferative capacity in long-term cultures and differentiated toward mature skeletal myocytes. MDCCs survival and engraftment to the gastrocnemius muscles was confirmed by dystrophin expression of 12% at day 7 and 17.5% at 90 days after intramuscular injection. MDCC recipients showed a 2.5-time increase in muscle force ($p = 0.04$) and improved tolerance to fatigue at 90 days after MDCCs delivery compared to the vehicle treated MDX/SCID mice.

Conclusions: This study confirmed feasibility and efficacy of MDCCs therapy in restoration of gastrocnemius muscle function. MDCCs therapy represents a novel, universal approach for restoration of muscle function in cases of muscular dystrophy, traumatic muscle tissue loss, and regeneration of muscle components of the VCA.

A-0316 The ability of URAM and MHQ to measure Dupuytren disease progression

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Objective: This study aimed (1) to determine whether the Unité Rhumatologique des Affections de la Main (URAM) scale and Michigan Hand outcomes Questionnaire (MHQ) are able to detect change in hand function due to Dupuytren disease (DD) progression and to compare their abilities and (2) to determine the clinimetric properties of the Dutch URAM.

Methods: Data of 233 DD patients participating in a cohort study were used. Concurrent validity (Spearman's ρ), reliability (Cronbach's alpha, ICC, SEM, SDC, Bland-Altman plot), responsiveness (Mann-Whitney U test, floor-, or ceiling effects) and the interpretability (MIC) were calculated for both questionnaires, except for the reliability measures (ICC, SEM, SDC, and Bland-Altman plot) that were not determined for the MHQ.

Results: The URAM and MHQ were both able to distinguish those who did show disease progression from those who did not (resp. $U = 1252.5$, $p = 0.008$, and $U = 1086.0$, $p < 0.001$). Boundary effects were present in 13.9% for the URAM and in 4.7% for the MHQ. For the URAM, the ICC agreement was 0.76 [95%CI: [0.64–0.87]] and the SEM was 2.1 [1.7–2.5], and the SDC was 5.7 [4.8–7.1]. The internal consistency was high (Cronbach's α [95% CI] = 0.91 [0.89–0.93] and 0.90 [0.87–0.92]).

Conclusions: The URAM and MHQ are suitable to measure change in functional restrains due to Dupuytren disease progression on a group level. The MHQ suffers less from boundary effects than the URAM but is less clinically applicable due to the length. The Dutch URAM has good clinimetric properties.

A-0318 A comparison of outcomes of K-wire versus plate fixation for distal radial fractures with regard to patients' quality of life

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Introduction: There are several options of operative treatment for distal radial fractures, but two methods are most commonly used: palmar plate and percutaneous K-wire fixation. A direct comparison of these

techniques shows no significant differences in mid-term clinical outcomes, with K-wire fixation being simpler and cheaper. Multiple outcome measures have been described to assess the treatment outcomes, but only single studies have evaluated the impact of the fracture and its treatment on the general health and quality of life of patients.

Objective: The objective of the study was a comparison of outcomes of K-wire versus plate fixation for distal radial fractures with regard to patients' quality of life.

Materials and Methods: One hundred and two patients, 79 women and 23 men with displaced distal radial fractures, were nonrandomly allocated for either K-wire ($n = 72$) or palmar plate ($n = 30$) fixation. In general, simpler fractures were fixed by pins, while plates were used for those that were more severe.

Results: No statistically significant differences were seen at 3- and 6-month follow-up assessment in any of the analyzed variables: wrist range of motion, total grip and key-pinch strength, and the DASH and SF-36 scores.

Conclusion: We conclude that being guided by the postulated algorithm in treatment choice of distal radial fractures is a reasonable balance between clinical- and cost-effectiveness. We also failed to find any advantage in health-related quality of life as an outcome measure in distal radial fractures compared to standard measures.

A-0329 Friction neuropathy of the ulnar nerve in the elbow area

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Friction neuropathy of the ulnar nerve is caused by repetitive and long-term irritation of the ulnar nerve, and its displacement and compression against the medial epicondyle of the humerus during elbow flexion. This causes morphological changes, which could result in permanent damage to the nerve. The requirement of the diagnosis is displacement of the nerve in the sulcus during elbow flexion due to habitual, posttraumatic, or iatrogenic causes. This neuropathy need not to be obvious during nerve conduction studies (NCS).

Material and method: During the period of 2008–2015, there were 544 patients surgically treated for various problems of the ulnar nerve in the area of the sulcus. Presented group contains 47 patients who underwent surgery due to symptomatic form of

friction neuropathy. There were 22 women and 25 men; average age was 42 years. Classical therapy of this condition includes various types of nerve transposition. Our surgical method is however based on "in situ" decompression and partial subperiosteal medial epicondylectomy.

Results: Results are evaluated according to clinical regression of the finding and follow-up NCS, in case there was a finding before the surgery. After 3 months, there were 28 of 47 patients completely without any complaints. This ratio increased in time; after 6 months, it was 44 of 47 and within a year there were 46 of 47 satisfied patients. Complications were very mild and included wound problems, such as hematoma and wound dehiscence. There was one case of limited range of motion in the elbow, which subsided after physiotherapy. Persisting paresthesia and pain was present in one case, in which surgical revision had no effect.

Conclusion: The advantage of surgical therapy of friction neuropathy of the ulnar nerve in the sulcus nervi ulnaris is simplicity of the method and none to minimal manipulation with the nerve. There is a low risk to cause injury to the nerve. The results are great and the patients are able to rapidly return to full exertion.

A-0331 Composite fingertip grafts in children: The Newcastle experience

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Introduction: Composite grafting of fingertip amputations refers to nonmicrosurgical replantation and is anecdotally only recommended for children less than 6 years old with a noncrush injury. Whilst composite grafting maximizes fingertip volume and provides better functional and aesthetic results; it is compounded by variable success rates. However, assessment of graft "take" is highly subjective, and in our experience, a proportion of those initially thought to have failed go on to regenerate and restore tip volume. We aimed to review our pediatric composite graft cohort and assess success/failure rates and identify those grafts initially labeled as "failed" which subsequently regenerated.

Methods: A 5-year retrospective review was conducted for all composite graft procedures performed assessing demographics, aetiology, level of injury, warm/cold ischaemia times, time to reattachment and partial/complete failure/success rates. Furthermore, regeneration and healing time in failed composite grafts was assessed.

Results: Twenty-three cases (14 male, 9 female; age 1–12 years), all secondary to crush aetiology were identified. Injury time to theatre varied from 2 h to 22 h, with 18 (78%) children undergoing surgery within 10 h of amputation. Delay to theatre was encountered in 8 (35%) cases, principally due to caseload. Overall, 11 (52%) composite grafts were successful, while 10 (48%) failed; 54% of cases reattached after 5 h were successful; 43% of those reattached within 5 h were successful. We found no correlation between warm/cold ischaemia time for those grafts which were successful (307/137 min) versus those that failed (73/296 min). Seventeen grafts were subjectively assessed to be necrotic at first review; of these, 10 (59%) failed completely and 7 (41%) subsequently regenerated and healed within a mean of 3 months (range 10 weeks–5 months).

Conclusions: Herein, we demonstrate a 52% composite graft success rate, despite crush aetiology for all cases, prolonged warm ischaemia time and significant delay to reattachment of up to 22 hours. Thus, we suggest that the '5-h reattachment concept' for composite graft reattachment is outdated and should be attempted even with prolonged ischaemia if surgical expertise is available. Furthermore, we propose that grafts initially deemed to be necrotic at first dressing change should be given the opportunity to heal, as up to 40% may regenerate to restore fingertip volume.

A-0332 Ten-year experience with total wrist prosthesis: Is it an option for total wrist fusion

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On bigger joints like hip and knee, the arthroplasty is established. Long-term results in wrist arthroplasty are controversial discussed by hand surgeons. Failures in wrist arthroplasty show us a learning curve and a changing of the design of wrist prosthesis in the last years. For long time, the total wrist arthrodesis was the standard procedure in cases where salvage procedures are unsuccessful. The satisfaction of total wrist arthrodesis is poor. And people more and more ask for keeping functional preservation.

In 2005, we start to implant wrist prosthesis (Universal 2©; KMI) in suitable cases without contraindications for this procedure. The indication for wrist prosthesis in our hand is very stringent and will discuss for every case. Since 2015, we implant the new generation of wrist implant – Freedom© (KMI; Integra). From 2005 to 2016, we implanted 27 total wrist prosthesis and did 8 total wrist fusion. In one case, we implant a

custom-made prosthesis after resection of the distal radius in case of giant cell tumor.

The resulting mean range of motion was 30-0-30 degrees for extension/flexion and 15-0-10 degrees for ulnar-/radial deviation. The grip strength was good compared with the opposite side. In one case, a changing in the distal component was necessary after 5 years. In one case, we must remove the prosthesis after 7 years because of loosening of the carpal implant, but after 1 year we do a new total wrist prosthesis (Prosthelast) because the patient don't want to have a wrist fusion. The third patient where we have to remove the implant was in case of dislocation after a tumble. Twenty-six patients are still happy with the surgery and would do this treatment again.

The total wrist prosthesis still is in progress, and we have to look for complications and long-term results to find the best solution for our patients. In our opinion, the total wrist prosthesis is an option for a wrist reconstruction, and an alternative surgery for total wrist fusion when the indication is given. We have to respect the request of our patients to keep function of the wrist. But we also have to inform them about problems and risks.

A-0333 Results of the KinematX wrist hemiarthroplasty

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Objective: To present updated results of the initial cohort of wrist semiarthroplasty patients using the KinematX prosthesis and to present initial results with the modular KinematX prosthesis

Methods: In a consecutive single surgeon series 20 patients have undergone wrist replacement using the KinematX hemiarthroplasty. All patients were assessed pre and postoperatively by an independent observer by means of DASH, MAYO, and PRWE; range of movement; grip strength, and return to work. In addition, two patients have now undergone replacement using a modular KinematX replacement

Results: The average follow-up for the mono-block KinematX is now 4 years. Seventeen of 20 patients remain implanted, 2 patients have been converted to total wrist replacement, 1 for loosening and 1 for persisting pain, and 1 patient was converted to a total wrist fusion. One patient required excision of the radial styloid and removal of ectopic bone. Patient

satisfaction remains high; all parameters measured were improved and reached statistical significance. There has been no evidence of loosening with the exception of one patient who was converted to a total wrist. Conversion of a monoblock to total wrist has been achieved in two patients. Two patients have now undergone modular KinematX replacement

Conclusions: At an average of 4 years, results of the KinematX remain satisfactory; the long-term results remain unknown. Two patients required conversion to total wrist replacement or fusion for persisting pain, emphasizing the need for careful selection for wrist semiarthroplasty. The Modular KinematX should offer advantages if conversion to total wrist replacement is required

A-0335 Neurovascular injuries after supracondylar humerus fractures in children

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Objective: Nerve- and arterial injury are said to occur in respectively 6–10% and 7–12 % of cases after dislocated supracondylar humeral fractures in children. There is still no consensus in the literature regarding the management of these complications (wait and see vs early exploration). At our unit, we explore these injuries, and we now present a consecutive cohort of patients treated at our hospital.

Methods: Twenty-one supracondylar (Garden 3, 20 with extension pattern) humeral fractures (15 boys, mean age 7,2 (3,3) years) with nerve and/or vascular injury have been referred to the National hospital (Rikshospitalet) since January 2014. Twenty fractures had been reduced and fixed with K-wires at nearby (except one patient treated abroad) hospitals, 18 with 2 crossing wires, 1 with 4 wires, and 1 with additional screw fixation. The elbows were explored 14 (24.2) days after injury. Seven were pulseless on arrival, and one of these was pale with slow capillary refill, the remainder were «pink and pulseless». All patients had nerve deficits from one (14) or several (7) nerves, and exploration was carried out via an anteromedial (18) or anterolateral (3) approach.

Results: Arterial status: In the seven pulseless arms, five vessels were tethered down and occluded in the fracture, one vessel was thrombosed and one vessel ran through the fracture. Circulation was restored after arteriotomy and washout with heparinized saline

in one; in the remainder, circulation was reestablished after release of the vessel from the fracture.

Nerve status: We found 13 median nerves injured (6 epineural hematomas, 6 nerves tethered in fracture, and 1 nerve running through fracture from posterior), 11 ulnar nerves injured (8 epineural hematomas, 2 nerves tethered, and 1 nerve 90 % severed by multiple passes with a large caliber pin) and 3 radial nerves injured (1 epineural hematoma and 2 nerves tethered). All nerves were released, one nerve (ulnar nerve) required nerve grafting and this patient later had an AIN–ulnar nerve transfer performed. No complications were seen related to the surgery apart from some hypertrophic scars in the cubital fossa (most elbows were very swollen at exploration). All patients had recovered good nerve function (motor and sensory and clinical testing) and circulation (palpable pulses, doppler examination in some of the children) at last follow-up, mean 22.7 (19.6) weeks. Slight loss of extension was seen in some cases.

Conclusion: We continue to find serious neurovascular injuries in this patient group and advocate early surgical exploration. Consensus may be difficult to reach due to the small number of cases at most centers. A thorough clinical examination of the nerve and vascular status before and after fracture treatment is important. We attempt to perform the exploration the next day, pale, pulseless arms are explored on an emergent basis.

A-0336 Ulnar head hypoplasia and DRUJ dislocation in children suffering from obstetric brachial plexus palsy

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Objective: Some children with late sequelae from obstetric brachial plexus palsy (OBPP) present with an ulnar deviated wrist, regularly attributed to tendon imbalance. The plain radiographs show various degrees of ulnar head hypoplasia and dislocation of the distal radioulnar joint (DRUJ). So far, no corrective treatment has been described. We present the variations in these lesions, an hypothesis about the pathophysiology and treatment strategies.

Methods: Among approximately 1,500 children suffering from OBPP treated between 2000 and 2016, those with an obviously ulnar deviated wrist were retrospectively analyzed. Twenty-nine (2%) patients with

apparent wrist ulnar deviation could be identified. Their records and radiographs were analyzed, scrutinized, and classified.

Results: In 18 of 29 cases, plain radiographs showed an neutral ($n = 7$), hypoplastic ($n = 7$), or even overgrown, ulna plus like ($n = 4$) shape of the bony ulnar head. True DRUJ dislocation was observed in six cases. Active and passive pronosupination was impaired in all children. We propose a classification according to the shape of the ulnar head and the degree of DRUJ dislocation. The severity of the initial OBPP related to ulnar nerve lesion seems to be a common and determining pathophysiologic factor, in terms of the severity of the clinical findings of ulnar hypoplasia and the radiological changes.

Conclusion: Ulnar wrist deviation as sequelae from OBPP is a complex and rather unknown impairment. The diagnosis is easy, but the pathophysiology and a proper reconstructive treatment strategy are so far unknown. This proposed classification can be helpful in deciding the proper treatment. In a growing child, there are no good bone stabilization procedures for this condition. However, reestablishment of DRUJ congruency should be the primary goal – to improve active and passive pronosupination, combined with tendon transfers to enhance the active muscle strength. Relocation of the DRUJ is the main goal, but it is difficult to achieve in a growing child with complex muscular weakness due to the initial OBPP.

A-0340 Direct nerve sutures in upper obstetric brachial plexus repair

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Aim: In selected cases of severe [extended] upper obstetric brachial plexus lesions, after proper exposure and mobilization of the traumatized roots and trunks and neuroma excision, direct nerve coaptation with tolerable tension and arm positioning are technically feasible and provide good quality functional outcome. We present our surgical technique and preliminary results in a prospective open patient series.

Materials and methods: Between 2013 and 2015, this technique has been applied in 12 OBPP cases with the following distribution: 4 cases of upper and middle trunk suture, 3 cases of isolated upper trunk suture; 3 cases with direct coaptation of the root stump C5 or C7 unto the distal C8 contribution to the lower trunk; 2 cases with partial upper trunk reconstruction: root C6 onto the medial part of upper trunk [and a graft from C5 onto the lateral upper trunk], root C5 onto the distal C5 contribution to the upper

trunk and to the motor part of the avulsed C6 root. In 2016, six more repair have been performed. All children were examined every 3 months postoperatively and aROM and muscle strength (modified BMRC) were recorded together with motion videos.

Results: All children showed a surprisingly good functional recovery with active shoulder abduction above 90° and strong biceps activity.

Conclusion: Direct suture is a good option in selected OBPP cases. Rotational imbalance of the shoulder must be prevented by a simultaneous nerve transfer onto the suprascapular nerve.

A-0346 Is opponensplasty recommended for octogenarians with severe carpal tunnel syndrome?

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Objective: As the population ages, the number of elderly people who undergo surgery for carpal tunnel syndrome is increasing. Many elderly patients with carpal tunnel syndrome have advanced disease and difficulty with finger grasp. To restore finger grasp, surgeons sometimes perform opponensplasty with carpal tunnel release, but the efficacy of opponensplasty in elderly patients with severe carpal tunnel syndrome is unclear. In this study, we retrospectively evaluated the outcome of opponensplasty in elderly patients compared to that for carpal tunnel release alone.

Methods: We reviewed all patients older than 80 years who underwent surgery for carpal tunnel syndrome in the past 5 years in our institution. We surveyed patients with Bland classification grade 5 or 6, based on a nerve conduction study. All patients received preoperative information on opponensplasty (Burkhalter procedure), and could decide whether or not to have the procedure. The patients were divided into 2 groups: patients who underwent carpal tunnel release alone (group O) and patients who had opponensplasty with carpal tunnel release (group T). We evaluated subjective symptoms, sensory thresholds with the Semmes-Weinstein test, and fingertip and lateral pinch strength pre- and postoperatively. We also administered the Hand20 questionnaire for patient-based outcomes. Patients were followed for at least 1 year. The Mann-Whitney *U* test was used to detect pre- to postoperative differences.

Results: We reviewed 34 wrists of 26 patients. The mean age was 83 years old. Twenty-eight wrists were assigned to group O and 6 to group T. Ten wrists were

in Bland grade 5 and 24 were in grade 6. Preoperatively, 7 wrists had nocturnal pain that was relieved postoperatively; however, all but 3 patients had residual numbness. Pulp pinch strength improved more in group O than in group T; the average change in pinch strength was 2.2 kg in group O and 3.1 kg in group T ($p < 0.05$). The pre- to postoperative difference in the Hand20 score was 27 points in group O and 24 points in group T, which was not significant. The pre- to postoperative difference in the score for item 18 on the Hand 20 questionnaire about inconvenience in daily life was not significantly different: 2.1 in group O and 1.0 in group T. Moreover, no patients in group O were willing to undergo opponensplasty after the initial operation.

Conclusions: Elderly patients who underwent surgery tended to have residual wrist numbness and inability to oppose the thumb postoperatively, even after 1 year. Although patients who underwent opponensplasty regained more pinch strength than patients with carpal tunnel release alone, the scores for patient-based outcomes did not differ between the 2 groups. We conclude that octogenarians with severe carpal tunnel syndrome can gain pain relief with carpal tunnel release alone and that opponensplasty is not a required procedure.

A-0350 Ligamentous reconstruction of the interosseous membrane of the forearm in the treatment of instability of the DRUJ

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Objectives: To measure the quality of life and clinical and functional outcomes of patients treated with ligament reconstruction interosseous membrane (MIO) of the forearm, using tendon brachioradialis muscle (BR), and describe a new surgical technique for the treatment of joint instability of the distal radio ulnar joint (DRUJ)

Methods: From January 2013 to September 2016, 24 patients with longitudinal injury DRUJ, who were submitted surgical treatment with reconstruction procedure of the distal portion of the interosseous membrane (DOB) with the new technique proposed in this study. All patients were assessed by occupational therapy sector at regular intervals postoperatively and underwent the same rehabilitation sequence.

The parameters analyzed were ROM (Range of motion), DASH (Disability Arm, Shoulder and Hand), VAS (Visual Analogue Scale), radiographic analysis to visualize the instability of DRUJ pre- and postoperatively. Description of the complications and the time to work return.

Results: The follow-up time was 19 months (3–25). The ROM averaged 167.92° (93.29% of the normal side). The value of the subjective assessment of pain (VAS) was 2/10 (1–6). The measurement of quality of life by DASH was 5.63 / 100 (1–18). The time to return to work was 7.37 months (3–12). As for complications, one patient with unstable DRUJ, and submitted reconstruction of the TFCC by Brian Adams-technique 6 months after the first reconstruction. Currently, he developed pain relief and is with the ROM of the functional handle, and returned to his professional activities. Three other patients developed problems around the K transverse wire and were treated with the removal of this, all doing well.

Conclusion: The new approach (reconstruction of oblique distal portion of the interosseous membrane) presented in this study is safe and effective in the treatment of longitudinal instability DRUJ, since it has low rate of complications, radiographic results, clinical, and functional satisfactory. Allows return to their social and professional activities and increases the quality of life of these patients.

A-0351 Item reduction in the patient-reported wrist evaluation using decision tree modelling

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Objective: Patient-reported outcome measures are widely used to record efficiency and effectiveness of treatments and are increasingly used as primary outcome in studies. The Patient Reported Wrist Evaluation (PRWE) was developed to quantify pain and disability of the wrist. The aim of this study was to determine whether a shorter, decision tree-based version of the PRWE could be developed that is reliable and valid.

Methods: Patient characteristics, PRWE scores and VAS scores were collected from a cohort of 10,394 patients who completed the patient-reported wrist

evaluation between November 2011 and May 2016 at 11 hand surgery practice sites as part of routine outcome measurement. Optimization of the CHAID algorithm was performed to find the best parameters for the development of the decision tree. The standard error of measurement (SEM) and the 90% minimal detectable change (MDC) were calculated for the difference between the original PRWE and the decision tree PRWE (DT-PRWE) and compared to the original SEM and MDC. In addition, the ICC was calculated. The VAS score for pain and disability measured in the same patients was used to validate the DT-PRWE with a different patient reported outcome measure.

Results: Included patients were split into a development ($n = 7,795$) and validation ($n = 2,599$) group. Using the development group, an optimal decision tree was found for both the pain and the disability subscore, where the pain decision tree used only 3 instead of 5 questions and the disability decision tree used only 3 instead of 10 questions. In the validation group, the difference between the original PRWE and DT-PRWE total scores had an SEM of 5.0 and an MDC of 11.7. The ICC was 0.97. Correlation coefficients of the PRWE and the PRWE-DT on the one hand and the VAS scores on the other hand were highly similar; .90 versus .89 for pain and .69 versus .66 for function.

Conclusion: We found that a decision tree-based PRWE, using only 6 instead of 15 questions, is a reliable and valid alternative for the PRWE. The decision tree PRWE will reduce patient burden and answering time and therefore may increase the response rate and increase the feasibility of using the PRWE in routine outcome measurement during regular patient care.

A-0365 Long-term follow-up after single digit replantation and analysis of the relationship between outcomes

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Objective: Previous studies did not focus on the role of psychological factors. And some inconsistencies can be observed among subjective satisfaction and objective functional results. Therefore, the aim of this study was to follow-up the long-term comprehensive results of successful single digit replantation and to analyze the relevance among subjective satisfaction, objective functional results, and psychological sequelae.

Methods: Twenty-six cases in 26 patients with successful digit replantation were reexamined after 36.9 months (range, 25–49 months postinjury). All patients did not undergo secondary corrective operations, such

as tenolysis and secondary nerve repair. The range of active motion of joints, grip and pinch strength, and cutaneous sensibility of patients were measured. DASH questionnaire was used to evaluate the upper-extremity function and subjective satisfaction. The assessed psychological sequelae included depression, anxiety, and posttraumatic stress disorder (PTSD) using Self-Rating Anxiety Scale, Beck Depression Inventory, and Screen for Posttraumatic Stress Symptoms, respectively. Pearson's correlation coefficient was applied to compare the relationships among the objective data. Spearman's correlation coefficients were adopted to analyze the relations among subjective, objective, and psychological outcomes.

Results: The average total grip and pinch grip strength of the injured hands were 39.2 and 7.8 kg, respectively. The average active range of motion for replanted thumbs and fingers were 74.6° and 138.5°, respectively. These objective results all accounted for greater than 50% of that measured in the contralateral hands. The average static two-point discrimination (s2PD) of the injured digits was 10.8 mm (2–20 mm). The mean score for the DASH questionnaire was 6.6 (range: 0–39.2). The symptom of cold intolerance occurred in 50% of the patients. Two patients were diagnosed with depression, and only one patient exhibited PTSD. The DASH score exhibited good statistical correlation with total grip strength, pinch grip strength, and s2PD.

Conclusions: After digit replantation, total grip strength, pinch grip strength, and s2PD are important factors positively related to subjective satisfaction of patients. The psychological symptoms tend to disappear during long-term follow-up.

A-0367 Delivery of VEGF gene through adeno-associated virus 2 vectors to enhance digital tendon healing in a chicken model

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Objective: A major challenge in repairing injured digital flexor tendon is the weak intrinsic healing capacity of tendon, which is responsible for rerupture of repaired tendon after primary repair. In an experimental model of transection and surgical repair of the digital flexor tendon in chicken toes, we aim to test the effectiveness of introducing the vascular endothelial growth factor (VEGF) gene through an adeno-associated virus (AAV) vector to enhance tendon healing strength.

Methods: One hundred and eighteen flexor digitorum profundus (FDP) tendons in the long chicken toes were completely transected in zone 2 and surgically repair using 2-strand modified Kessler method. These toes were divided into two groups: 58 FDP tendons (group 1) were injected with 2×10^9 particles of AAV2-VEGF per tendon, and 62 tendons (group 2) after injection with saline. The toes were immobilized in semiflexed position for the first 3 weeks and then released for free toe motion. At postoperative 1, 2, 3, 4, 6, and 8 weeks, the ultimate strengths of the healing tendons were tested in an Instron tensile testing machine. At week 4, 6, and 8, the work of digital flexion (WOF) was also recorded and adhesions around the repair site scored. We also supplemented a group (20 toes) in which only empty AAV2 vector was injected to the tendon, and tendon strength and adhesions were recorded at week 2 and 4.

Results: Delivery of AAV2-VEGF significantly increased ultimate strength of the healing tendons at postoperative weeks 3, 4, 6, and 8 ($p < 0.05$ or $p < 0.01$). At week 4, the tendon strength was 12.4 ± 8.6 N after AAV2-VEGF injection, but 5.7 ± 1.1 N after saline injection. At week 6, the strength was 46.4 ± 19.2 N after AAV2-VEGF injection, but 27.1 ± 8.9 N after saline injection. At week 6 and 8, the adhesion scores and WOF of the toes after AAV2-VEGF injected were not increased. We found no significant increases in the strength of the tendon after injection of sham vector compared to that in saline control group.

Conclusions: The results of this study show the therapeutic efficacy of AAV2-VEGF for improvement in tendon healing strength without aggravating adhesion formation after surgical tendon repair. AAV2-VEGF therapy appears to be a promising method of biological modulation of healing of the digital flexor tendons.

A-0368 Current methods, survival rates, and influencing factors of distal replantation in 31 fingers

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Objective: The numerous factors may affect the survival rate of digit replantation. There are inconsistent viewpoints about the important influencing factors to the digit replantation. The aim of this study was to present the current methods and survival rates of distal finger replantation performed in our department in recent 2 years and to determining the influencing factors for survival.

Methods: From January 2013 to December 2015, the distal replantation were performed (distal to the insertion of flexor digitorum superficialis tendon) in 31 fingers in 29 patients (23 men and 6 women) in this retrospective study. The average age of the patients at the time of surgery was 38 years (range 18–74 years). During operation, all structures were repaired primarily, unless flexor/extensor tendons avulsion injury or nerve gap were present. One or two K-wires were used to fix the fractures of middle or distal phalanx and dislocation of distal interphalangeal (DIP) joint. If the comminuted fracture involved the articular surface of DIP, we performed the arthrodesis of DIP joint. We routinely repair one side of the digital artery by direct anastomosis or vein graft, and then one or two veins were anastomosed. In some cases, veins are usually not easily recovered, and the method of continuous bleeding is adopted. We investigated many individual factors, which possibly affect the survival rate of replantation, such as gender, age, smoking, number of veins repaired, and use of vein grafts, warm ischemia time, the time of operation, and so on.

Results: All patients were manual workers, and the mechanisms were crush or avulsion. A single finger replantation was performed in 93% ($n = 27$) of patients. Eleven fingers were incompletely amputated, while the remaining was completely amputated. The overall survival rate of finger replantation was 78% ($n = 24$). The average warm ischemia time was 4 hours (range 2–7 hours). Vein grafts were required in 6 (19%) fingers for arterial anastomosis. Using Pearson's chi-squared test, the influencing factor for survival rate include the type of amputation, smoking, and the time of replantation (day or night).

Conclusions: If it is possible, the operation of replantation should be performed in the day time; otherwise, two surgeons fully rested may be needed.

A-0369 Hand rehabilitation with robotic orthoses

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Objectives: To demonstrate that the robotic orthoses are a new alternative in support of the processes of passive rehabilitation and the assistance of object manipulation, besides, to evaluate if the robotic orthoses improve the functionality in the basic activities and allow the patients to continue participating in their family and social environment.

Methods: This is a descriptive case study carried out in Colombia. Two patients were selected: The first patient with traumatic cervical spinal cord lesion at the C6 level in which the EMMRA-1 prototype was used, consisting of a hand and wrist exoskeleton with rehabilitation applications and assistance of object manipulation, and the second patient with posttraumatic rigidity secondary to a complex intra-articular fracture of the head of the second left-hand metacarpal in which the PRO-Dix Prototype was used, consisting of a robotic orthoses for passive rehabilitation. The instruments used were clinical history, DASH scale, visual analogue pain scale (VAS), and goniometer. The data were taken from the medical records and analyzed by epidemiologist.

Results: In the patient with cervical spinal cord injury, a DASH score of 83.33 and an EVA scale of 3 were initially found. After 2 months of use, EMMRA-1 exoskeleton improved the functionality to 63.33 according to the DASH scale and decreased pain to 0 according to EVA scale. In addition, the patient reported improved self-esteem and quality of life. In the patient with hand fracture, a DASH score of 17.5 and an EVA score of 8 were initially found, after using the PRO-Dix II improved the functionality to 2.5 according to DASH scale and decreased pain to 1 according to EVA scale. In addition, it improved the arches of mobility of the metacarpophalangeal joint (MF) from 20° to 50° and of the proximal interphalangeal joint (PIF) from 72° to 90°.

Conclusions: The EMMRA-1 exoskeleton used in the patient with traumatic cervical spinal cord injury allows the rehabilitation in the home, the voice recognition module allows him to control his hand again to open and close at will, facilitating the grasping of objects, improving functionality, and decreasing chronic pain. The robotic orthoses for the second finger PRO-Dix II used in the patient with joint rigidity after postsurgical hand fracture, allowing benefits such as an increase in the arches of mobility in the MF and in the PIF, improving the functionality and decreasing pain.

Level of evidence: The purpose of the study is to generate clinical evidence (level III) of the usefulness of robotic orthoses in solving global public health problems related to hand disability.

A-0371 The necrotic diabetic hand might be one of the terminal complications of diabetes mellitus

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Objective: The manifestations of diabetes were already well reported, such as limited joint mobility, Dupuytren's contracture, and trigger finger. However, the necrosis of hand in patients with diabetes mellitus (DM), which might be similar that of foot, was not known yet. We wanted to know that the necrosis of hand in diabetes might be one of the terminal complications of DM.

Methods: From January 2014 to August 2015, we recruited patients with DM who showed necrosis of their hands. Patients with history of using vasopressors were excluded. Finally, five patients were enrolled. Four patients were male, and mean age was 64 years. Mean duration of DM was 21 years, and mean HbA1C was 8.4. The blood glucose level of all patients was not successfully controlled by medications. Therefore, all patients were treated with insulin injection.

Results: Clinical manifestations and extent of necrosis of hand were diverse, such as necrosis of dorsal skin of hand, necrosis of single digit, and necrosis of whole hand. Only two patients had history of trauma, such as prick by needle or wood branch. The other three patients showed very poor glucose control (HbA1C > 9.0), and they had other complications, such as DM nephropathy, DM retinopathy, and DM foot. They already had hemodialysis and amputations of both the legs. Only one patient with skin defect of dorsal hand was successfully treated with flap surgery and skin graft. Other four patients were treated by amputation. All three patients with poor glucose control died within a year from hand amputation.

Discussion: DM foot was already well known as the vascular and neuropathic complications of DM, and the prevention and treatment protocols were already reported. We found that clinical manifestations of necrotic DM hand were a little similar to those of DM foot. This condition might be one of the terminal vascular and neuropathic complications of DM. In accordance with the longer survival of DM patients by the development of DM medications and management of other complications, hand surgeons should know about this condition and make the prevention and treatment protocols.

A-0373 Wide awake approach for tendon transfer

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Background: There are many surgery with short operation time on hand and wrist surgical field. So many hand surgeons have applied local anesthesia

to hand surgery having short operation time with tourniquet. But recently many hand surgeons take advantage of vasoconstrictive effect of the epinephrine and apply it to hand surgery without tourniquet. Epinephrine was thought not to be injected into the finger traditionally. But this idea has been refuted in many basic scientific studies and clinical studies also. Wide-awake approach on hand surgery has significant merits in a preoperative preparation and an intraoperative field especially in flexor tendon repairs, tenolysis, and setting the tension on tendon transfer. Also, it has cost-efficiency. So, we think wide-awake approach would be anesthetic trend shifting on hand and wrist surgery field.

Methods: From December 2013 to December 2015, 10 patients with chronic extensor pollicis longus rupture underwent EIP transfer surgery with wide awake local anesthesia no tourniquet (WALANT). All patients do not need admission. We evaluated pain with postoperative VAS score and also evaluated the result with functional score (DASH) and final ROM on affected hand. And we compared total cost between WALANT operation and ordinary regional anesthesia.

Result: There were in total 10 patients, 7 females and 3 males; mean age was 57.1 (range from 21~77). Mean postoperative VAS score was 1.3 (range from 1~2). Mean functional score (DASH) was 29.1 (range from 10~42). Mean Pinch power was 91% (range from 80%~98%) of unaffected side. Mean grip strength was 90.5% (range from 82%~97%) of unaffected side. Mean final MP ROM was 56.3 (range from 53~60) and IP flexion was 79.7 (range from 70~90). Mean IP extension was 7.2 (range from 0~12). The WALANT operation costs approximately \$300 for day surgery in the outpatient department. It has cost efficiency compared to using conventional regional anesthesia which costs approximately \$600 for 3 days of hospital stay after surgery.

Conclusion: The wide-awake approach has allowed the surgeon to know how much tendon tension on tendon repair site and tendon transfer site. Need not wait for NPO time and not to use tourniquet. Anesthetic time can be longer with bupivacaine if we need long surgical procedure time. The wide-awake approach makes surgeon do tendon surgery much easier and more reliable. And that would change the trend of anesthesia on hand and wrist surgery.

A-0377 Serial stab incision venous drainage technique in fingertip replantation

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Purpose: Fingertip replantation is a challenging and technically demanding procedure. Various venous drainage techniques have been introduced because venous drainage is important for success. We present a new venous drainage technique using serial multifocal incision in Tamai zone I fingertip replantation.

Methods: Between 2013 and 2015, we performed 94 fingertip replantations without vein anastomosis. Eighty were men and 14 were women with a mean age of 42 years (range: 8–42). All patients suffered amputations above the distal phalanx joint (Ishikawa subzone I, II, and III). We performed only artery anastomosis. To relieve venous congestion, we incised the fingertip 2–3 mm using a number 11 scalpel blade and allowed the vein to drain naturally. We made small serial incisions every 2–3 days for a week.

Results: The overall success rate for this procedure was 90%, and 85 digits survived. Two patients with partial necrosis and 9 patients with complete loss needed a second operation. Two patients received blood transfusions with an average transfusion of 3 units, but all had accompanying injury on another site. No one complained of nail deformity or wound infection.

Conclusions: The serial stab incision venous drainage technique was simple and allowed easy control of venous drainage amount and duration. Compared to other external bleeding techniques, this allowed easy handling of the replantation site and reduced the chance for infection. It also avoided damage to an anastomosed vessel, scarring, and nail deformity. Thus, this technique allowed adequate venous drainage and also reduced the need for blood transfusions. We propose this simple technique with high survival rate for artery-only fingertip replantation

A-0380 Measurement properties of the Unité Rhumatologique des Affections de la Main (URAM) scale in patients with Dupuytren's disease

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Objective: The Unité Rhumatologique des Affections de la Main (URAM) scale is a 9-item questionnaire to

specifically assess functional outcomes in patients with Dupuytren's disease. However, the measurement properties have been rarely studied. The aim of our study was to investigate the reliability, validity, responsiveness, and interpretability of the German URAM in patients with Dupuytren's disease.

Methods: All patients with Dupuytren's disease, who were treated either with collagenase clostridium histolyticum or underwent surgery, were prospectively documented in our clinical register. They completed the URAM, the brief Michigan Hand Questionnaire (briefMHQ), and the EuroQol EQ-5D-5L (EQ-5D-5L) before (i.e. baseline) and 1 year after intervention. At the same time points, extension deficit was measured with a goniometer. The measurement properties of the URAM were analyzed by calculating internal consistency (Cronbach's α) and construct validity (Pearson's correlation coefficient [r]) using 1-year follow-up data. The responsiveness (effect sizes [ES]) and interpretability (minimal important change [MIC]) were evaluated for patients who had baseline and 1-year follow-up data.

Results: We included 112 patients (91 males and 21 females) with Dupuytren's disease affecting a total of 160 fingers. Forty-six fingers were operated, and 114 received a collagenase injection. The URAM demonstrated high internal consistency with $\alpha = 0.93$. We found a strong correlation of the URAM with the briefMHQ ($r = -.78; p \leq .001$), a moderate correlation with extension deficit ($r = .51; p \leq .001$), and a small correlation with the EQ-5D-5L ($r = -.37; p \leq .001$), as expected. For the evaluation of responsiveness and interpretability, the data of 56 patients were available. The responsiveness for the URAM was large (ES = 1.34) and higher than for the briefMHQ (ES = 1.08) and extension deficit (ES = 1.22). The MIC was –6 points.

Conclusions: The German version of the URAM shows good reliability, validity, and responsiveness, which is higher than the responsiveness of the briefMHQ. Therefore, we recommend using the URAM as the preferred measure to assess the functional outcomes of German-speaking patients treated for Dupuytren's disease.

A-0382 Evidence-based hand therapy rehabilitation protocol for the treatment of proximal phalangeal fractures

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Introduction: The function of the fingers is vital for daily tasks as well as for the capability to work. Due

to this fact, it is important that patients with fractures of the phalangeal receive appropriate treatment to restore normal function. The discussion regarding the appropriate surgical and nonsurgical treatment of phalangeal fractures is an ongoing topic in the literature. There is knowledge about possible complications in both treatments. Conservative treatment has shown to cause a possible permanent loss of function and in surgical intervention, oedema, scarring and adhesion must be considered. Regardless of the initial intervention, the immediate treatment through the hand therapy with early motion is evident.

Objective: The aim of this study was to review the current literature and evidence in the treatment of fractures of the proximal phalanges, to develop an evidence-based rehabilitation protocol and to examine the implementation of the protocol into daily practice.

Methods: The current literature was reviewed, and of the emerged knowledge rehabilitation protocol was created. To examine the implementation of the protocol a case study report was written.

Results: Two rehabilitation protocols were developed for the treatment of both nonsurgical and operative fractures. One case study example of each protocol was conducted. The strengths, limitations and difficulties of both protocols are explored. Early motion and joint position in the splints are the most important factors in both the protocols. This joint position is defined as metacarpalphalangeal joints in 70°–90° degrees flexion and interphalangeal joint in 0°.

Conclusion: Both protocols provided functional results, and most patients were able to go back to work at least after 8 weeks post injury as well as complete daily activities without difficulty. The safe position of the joints in the splints is crucial.

A-0383 Reoperations and revisions following arthroplasty of the proximal interphalangeal joint: A systematic literature review

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Objective: The objective of this study was to investigate the extent of reoperations and revisions subsequent to proximal interphalangeal (PIP) joint arthroplasty based on the type of implant (i.e. silicone, pyrocarbon, and metal-polyethylene) used.

Methods: For this systematic literature review, Medline, Cochrane, Embase, and Scopus databases

were searched for studies investigating reoperations and/or revisions after PIP arthroplasties. We included studies published after 2009, in which any type of PIP arthroplasty was evaluated for reoperations and/or revisions. We defined reoperation as any subsequent surgical intervention without alterations at the implant, such as tenolysis. Revision was defined as subsequent surgery with implant modifications, such as implant removals. Mean reoperation and revision rates were calculated for each implant type.

Results: The literature search yielded a total of 1,130 articles. Thirty-two articles investigating 37 study groups met our inclusion criteria. The mean follow-up time of the studies was 4.8 years. Reoperations and/or revisions concerning silicone implants were reported for 8 study groups including 261 PIP joints. Revisions/reoperations for pyrocarbon implants were investigated in 15 study groups (808 joints) and for metal-polyethylene implants, and data were obtained from 12 groups (454 joints). Two studies investigated various implants. The reoperation rate was highest after metal-polyethylene implants (15% ± 12%) followed by pyrocarbon (9% ± 13%) and silicone implants (2% ± 3%). Pyrocarbon implants had a revision rate of 11% (± 11%), metal-polyethylene 8% (± 10%), and silicone implants 3% (± 5%).

Conclusions: Our results show that reoperations/revisions were the least reported in studies investigating the outcome of silicone arthroplasties and, if investigated, show the lowest reoperation and revision rates. In contrast, reoperations and revisions for pyrocarbon and metal-polyethylene implants were studied more frequently and associated with relatively high reoperation and revision rates. However, these data might be confounded by the different subjective views that surgeons generally have concerning the application of the one or other implant and the indication for reoperation/revisions of metal and pyrocarbon implants versus their silicone counterparts.

A-0384 Ultrasonographic localization of compressive ulnar neuropathy at the elbow

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Objective: Ulnar nerve entrapment (UNE) at the cubital tunnel is traditionally diagnosed by a thorough history, physical examination, and nerve conduction studies. High-resolution ultrasonography of the nerve demonstrates pseudo-neuroma-like swelling just proximal to the site of relevant entrapment and is

used increasingly to evaluate ulnar nerve compression at the elbow. While previous sonographic studies have provided maximum diameter or cross-sectional area values at the site of maximal nerve swelling, these measurements were taken in only two to three designated locations. In this study, an ultrasonographic inching method was used to identify changes in cross-sectional area of the ulnar nerve at the elbow in patients and normal groups.

Methods: We prospectively studied the ultrasound characteristics of the ulnar nerve in 28 patients with UNE and 27 healthy control subjects, at 7 standardized locations across the elbow. The inclusion criteria for the patients were clinical findings and electrophysiological confirmation. For clinical diagnosis of UNE, we looked for symptoms such as numbness and paresthesias of the fourth and fifth digits of the hand, weakness of the intrinsic hand muscles, and medial elbow pain. Exclusion criteria were prior trauma to the upper extremity, previous elbow surgery, all conditions causing peripheral neuropathy, and ulnar nerve subluxation. The cross-sectional area of the ulnar nerve was measured using the trace function on the ultrasound, and values were measured at 2-cm intervals, starting from 6 cm proximal to the medial epicondyle (ME) to 6 cm distal to the epicondyle. There were 13 males and 15 females in the UNE group. The average age of the UNE group was 56.7 years old (range: 26–76 years).

Results: Mean CSA values for the ulnar nerve at levels 6, 4, 2 cm proximal to the ME, ME, and 2, 4, and 6 cm distal to the ME were 0.058, 0.072, 0.094, 0.106, 0.112, 0.090, and 0.074 cm², respectively, in the neuropathic group and 0.070, 0.071, 0.075, 0.071, 0.060, and 0.061 cm², respectively, in the healthy control group. While the cross-sectional area of the ulnar nerve was almost uniform in the control group, the patient group showed significantly increased swelling at the distal areas. The values were significantly different between the two groups at three sites: the medial epicondyle, 2 cm distal, and 4 cm distal. The site at which the affected ulnar nerve was most enlarged was approximately at 2–4 cm distal to the medial epicondyle, which was backed up by intraoperative findings.

Conclusions: In our study, maximal swelling was found mostly at medial epicondyle to distal 4 cm, and this largely correlated with intraoperative findings. In conclusion, ultrasound is useful to localize ulnar nerve entrapment at the elbow, and from our experience, it was important to decompress distal sites of entrapment. The fascial bands between the two heads of FCU should be released in situ decompression. The limitations were that the sample size was small, operators were not blinded to subjects, and duration of symptoms were not checked.

A-0387 Incidence and impact of depression and anxiety in an elective hand surgery clinic

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In October 2015, the Pulvertaft Hand Centre inaugurated a system to collect PROM data on all patients, collecting QuickDASH, GAD-7, and CHQ-9 on all new elective patients. We now have prospective data on 1,500 patients. We correlated the Quick DASH score with the Depression (CHQ-9) score and confirmed the previous findings of David Ring that a score of 50 on the Quick DASH correlates with significant depression. However, the spread of the results makes this useless as a diagnostic criteria. There is evidence that significant anxiety or depression leads to increased pain scores and more resource utilization. We found that the rate of major depression (PHQ-9>10) in our patients was 3 times the rate in the normal population (17%), and the rate of moderate or severe anxiety was double the normal population. These scores are associated with an increased risk of PTSD, panic attacks, and multiple pain conditions suggesting that identifying such patients would allow targeted improvements in counseling, therapy, and pain medication. We suggest that identifying such patients and the possibility of multiple nonorganic pain conditions will reduce waiting lists and outpatient clinics utilization and allow referral for more appropriate therapy. Ten percent of patients scored less than 5 on the QuickDASH suggesting essentially no disability as a score of upto 5 is normal for a healthy population, suggesting that early identification of these patients may lead to cost savings and better resource utilization. We would now recommend screening all patients for anxiety and depression to manage the significantly depressed and anxious more effectively and reviewing the reasons why patients with low QuickDASH scores attend in order to reduce resource utilization and improve patient outcomes.

A-0394 Effectiveness of conventional hand rehabilitation with or without a telemedicine service on treatment frequency and hand function: A prospective cohort study

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Objective: The objective of the study is to explore the value of an online exercise program on treatment frequency and hand function in hand rehabilitation.

Methods: An explorative quasi-experimental study was set up. The control and the intervention group both received conventional hand therapy. Besides, the intervention group received an online exercise program. Hand therapists and patients login to a secured web portal to gain access to this service. Therapists selected appropriate exercises and scheduled when the patients had to do the exercises during that period. Patients were instructed to use this service during the normal rehabilitation period. Hand therapists were allowed to decrease treatment frequency. Conservative- and postoperatively treated hand patients were included in the study. Primary outcome measure was the number of hand therapy sessions at the end of the treatment. Secondary outcome measures were hand function (Michigan Hand Outcomes questionnaire or the Patient Rated Hand/Wrist Evaluation), patient satisfaction with hand function at the end of the treatment. Characteristics of the patients and outcomes are presented as frequencies, means, standard deviations, or (in case of non-parametric data) medians and interquartile ranges. Independent *t*- and Mann-Whitney *U* tests were used to compare means and medians between both the groups at the end of treatment. Fisher exact and χ^2 tests were used to analyze categorical data.

Results: In both the groups 64 patients were included. Number of treatment frequency in the intervention group was significantly lower compared to the control group (7.9 ± 3.8 and 9.6 ± 5.4 , respectively). No significant differences on hand function questionnaires and patient satisfaction with hand function between both groups were observed.

Conclusions: Although further cost-effectiveness studies are necessary, the use of a telemedicine service in hand rehabilitation potentially improves the efficiency without differences in hand function between both the groups.

A-0395 Upper Limb Functionality and core stabilization in patients with rotator cuff reconstruction surgery compared to healthy people

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Objective: Combining upper extremity rehabilitation with core stabilization training improves

neuromuscular coordination between the distal and the proximal segments to provide better motor performance. In this study, it was aimed to compare upper extremity function and core stabilization of patients undergoing rotator cuff surgery with healthy subjects in the same age-group.

Methods: Sixty-six patients (36 females and 30 males), with a mean age of 54.94 ± 9.83 (38–78) who had mini-open rotator cuff reconstruction and 114 healthy subjects (55 females and 59 males), with a mean age of 52.71 ± 6.31 (45–70) were enrolled in the study. Western Ontario Rotator Cuff Index (WORC) and Shoulder Pain and Disability Index (SPADI) were used to evaluate shoulder function. Participants' quality of life was assessed with Rotator Cuff Quality of Life questionnaire. Davies Closed Chain Upper Extremity Stability test was performed to evaluate upper extremity performance and Flexor Endurance test; Prone Bridge and Supine Bridge tests were applied to evaluate the stability of core muscles. All measurements were done at 6 months after surgery for patients.

Results: When the shoulder functions of patients were compared with healthy subjects, there was statistically significant difference in SPADI subscales and WORC subscales in favor of healthy group ($p < .05$). When the quality of life was compared, a statistically significant difference was found in favor of the healthy group ($p < .05$). There was no statistically difference between the groups in terms of Flexor Endurance test and Prone Bridge test; a statistically significant difference was found in the Supine Bridge test in favor of the healthy group ($p < .05$). There was a significant difference in upper extremity stability test in favor of healthy group ($p < .05$).

Conclusions: It was observed that the functional status, quality of life, core stability, and upper extremity performances of the patients undergoing rotator cuff reconstruction did not reach to the level of healthy subjects at the sixth month after surgery. We recommended that core stability exercises should be added to the shoulder rehabilitation program, and further studies are needed to prove the long-term outcome.

A-0397 3D Computer-assisted distal radius osteotomies with patient-specific surgical guides

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Objective: Symptomatic malunions of the distal radius are often treated with correction osteotomies.

However, complex bone deformities can often be difficult to identify because these measures are not completely addressed by conventional preoperative planning techniques.

Methods: From January 2014 to September 2016, 15 patients with symptomatic distal radius malunions were treated in our hospital using a computer-assisted preoperative planning technique. We compared these patients with a control group that consisted of 15 patients with similar deformities who underwent surgery with a conventional planning approach. The computer-assisted group underwent a computed tomography (CT) scan of the injured forearm as well as the contralateral, healthy extremity preoperatively. Using the acquired CT data, three-dimensional (3D), anatomical models were created using specialized open source segmentation software. After that the model of the healthy radius was mirrored to serve as a repositioning template. Both bone models were superimposed, and the planning process was carried out in a computer program developed by our team, implementing an iterative closest point computer algorithm for accurate automatic repositioning of bone fragments. A patient-specific surgical guide was then produced on a 3D printer out of medical grade plastic to transfer the planned correction to the operation room. The computer planning and surgical guide manufacturing process was performed in house, at the clinic where the surgery was carried out, realizing the principle of bedside 3D printing. The control group had X-rays of the affected region taken in AP and lateral views as a preoperative assessment tool. In both the groups, volar locking plates of the same manufacturer were used. We examined the postoperative X-rays, range of motion (ROM), and Disabilities of the Arm, Shoulder and Hand (DASH) score at 3, 6, and 12 months postoperatively in both the groups.

Results: At 3 months postoperatively, all patients in the computer-assisted group showed recovery of ROM, with no statistically significant difference in extension, flexion, supination, and pronation compared to the contralateral side; six patients in the conventional planning group had reduced ROM compared to the contralateral side. Examination of postoperative X-rays revealed a residual volar tilt in these patients. The computer-assisted group had no anatomical abnormalities detected on X-ray. At 12 months postoperatively, there were no significant differences in ROM, and in both groups the mean DASH score was 11.4 in the computer-assisted group, while the control group had a mean score of 16.2. Besides patient functional outcomes and X-ray findings, reduced time of surgery and intraoperative radiation exposure was noted in the computer-assisted group.

Conclusion: Computer-assisted planning with the use of 3D printed patient-specific surgical guides enhances results of corrective osteotomies of the distal radius, facilitating transfer of the computer-generated plan to the operating room. The proposed technology provides more accurate surgery performance and has shown good 12-month functional outcome results while reducing surgery time and intraoperative radiation exposure.

A-0401 Anxiety, Depression, and Quality of Life are associated with self-reported symptom severity but not with electrodiagnostic severity in carpal tunnel syndrome

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Objective: To assess the impact of carpal tunnel syndrome on psychological status and quality of life in patients referred for diagnosis and treatment.

Methods: We conducted a prospective observational cohort study on patients diagnosed with carpal tunnel syndrome confirmed by clinical history and electrodiagnostic testing. Baseline data were collected on electrodiagnostic severity; symptom severity using the CTS-6, Hospital Anxiety and Depression Scale (HADS), the Self-Administered Comorbidity Scale (SAQC), and health utility derived from the EQ5D-3L; and sociodemographics. Nerve conduction test results were used to classify patients into severity grade (mild, moderate, or severe). Data were analyzed using a general linear model.

Results: A total of 753 patients with CTS were recruited to the study. The mean age was 60 years ($SD = 12.7$), and 65% of the sample were female. The mean HADS anxiety score was 6.2 ($SD = 4.5$), and HADS depression score was 4.5 ($SD = 3.8$) points. Health utility (EQ5D) mean was 0.66 ($SD = 0.26$). Patient-reported severity on the CTS-6 was 2.89 ($SD = 0.85$). Electrodiagnostic severity grades were mild (grade 1–2) in 30%, moderate (grades 3–4) in 45%, and severe (grades 5 to 6) in 25% of patients. Multivariable linear regression adjusting for age, sex, ethnicity, duration of CTS, smoking status, alcohol consumption, employment status, body mass index, and comorbidities showed a highly statistically significant relationship between CTS-6 and anxiety and depression and the EQ-5D ($p < .0001$ in each

case). Adjusting for the same independent variables, a significant relationship was seen between electrodiagnostic severity and anxiety ($p = .027$) but no significant relationship with depression ($p = .986$) or the EQ-5D ($p = .257$)

Conclusions: Self-reported anxiety, depression, and QoL are likely to be related to self-reported CTS symptoms. In contrast, there was little or no evidence of any relationship with objectively derived CTS severity. Further research is needed to understand direction of cause and effect and the disparity in these results.

A-0402 The effects of kinesio taping on scapular control in patients with distal radius fracture: 3-dimensional kinematic analyses

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Objective: Distal radius fracture leads to abnormal movement patterns in the scapula immediately following injury and may subsequently cause impaired motor control after recovery. Taping could afford mechanical correction, provide increased proprioceptive input, and optimize neuromuscular control during exercise and daily activity. This study aimed to investigate the effects of taping on postural correction with three-dimensional scapular kinematic analysis during humeral elevation.

Methods: Twenty subjects (age, 44.5 ± 10.9 years; DASH score, 42.9 ± 24.6 points) with unilateral history of distal radius fracture treated by internal fixation and the same rehabilitation protocol participated in the study. Scapular kinematics was assessed using an electromagnetic system during the scapular plane of humerothoracic elevation (elevation: 30°, 45°, 60°, 90°, 120°; lowering: 120°, 90°, 60°, 45°, 30°). First, patients were evaluated without kinesiotape application and then evaluated with kinesiotape application. Application included three separate I-shaped strips aiming to facilitate postural correction. Analysis of variance models were used to make comparisons between the conditions.

Results: Taping showed a significant effect ($F_{1, 19} = 6.322$, $p = .02$) on scapular internal-external rotation (38.9° untaped vs. 31.1° taped) and anterior-posterior tilt (-9.2° untaped vs. -4.8° taped). In general, the scapula was more externally rotated and posteriorly tilted for taping condition.

Conclusions: Kinesio taping exerts beneficial effects on shoulder kinematics by improving scapular

external rotation and posterior tilt, which would be considered a position more likely to produce optimal rotator cuff function during early rehabilitation of patients, such as those who have distal radius fracture.

A-0408 Congenital flexion deformity of the long, ring, and little fingers with an aberrant origin of the flexor digitorum profundus: Differential diagnosis with the Volkmann's contracture

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Objective: To report a series of cases of congenital flexion deformity of the long, ring, and little fingers with an aberrant origin of the flexor digitorum profundus and to compare this disease with the Volkmann's contracture.

Materials and Methods: Five cases of congenital flexion deformity of the long, ring, and little fingers with an aberrant origin of the flexor digitorum profundus were reported. Two of them were children. All the patients were misdiagnosed as the Volkmann's contracture in the local clinics. Radiographs and three-dimensional computed tomography (3-D CT) of the involved forearm were performed. There were no neural disorders in any case.

Results The 3-D CT showed there was a bone prominence on the proximal part of the ulna. During the operation, we could find an aberrant origin of the flexor digitorum profundus of three to five fingers was attached to the bone prominence. Resection of the aberrant origin could achieve a thorough release in children cases, but further muscle-sliding procedure was needed in adult cases.

Conclusion Congenital flexion deformity of the long, ring, and little fingers with an aberrant origin of the flexor digitorum profundus is a potentially ignored disease. Finding the bone prominence on the proximal part of the ulna is helpful for the early diagnosis. Resection of the aberrant origin with muscle-sliding procedure can get good result.

A-0409 Non displaced distal radial fractures in adult patients: Three weeks versus five weeks of cast immobilization

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Objective: Non- or minimal displaced distal radius fractures are mostly treated by a plaster cast for a period of 4–6 weeks. A shorter period of immobilization may lead to a better functional outcome. We conducted a study to evaluate whether the duration of immobilization period in these patients can be safely reduced.

Methods: A randomized controlled trial was conducted that compared 3 weeks of cast immobilization with 5 weeks of immobilization in adult patients with non or minimally displaced distal radial fractures. The primary outcome was the Patient Related Wrist Evaluation (PRWE) and Quick Disability of Arm, Shoulder and Hand (QuickDASH) score after 1 year follow-up.

Results: Seventy-two patients (male/female 23/49; median age 55 years) were included and randomized. Sixty-five patients completed the 1-year follow-up, but 19 of these patients did not completely fulfill the all functional score forms. After 1-year follow up, patients in the 3 weeks immobilization group had better PRWE (5.0 vs. 8.8 points, $p = 0.045$) and QuickDASH scores (0.0 vs. 12.5, $p = .026$). In both groups, one patient had a secondary dislocation.

Conclusion: Three weeks of cast immobilization in adult patients with non- or minimal displaced distal radius fractures is safe and leads to a statistically significant better outcome after 1 year compared to 5 weeks immobilization. Although this outcome may not be clinically relevant, there are no negative side effects as a result of shortening of the immobilization period. Therefore, we recommend 3 weeks of immobilization in these patients.

Evidence level: Level I

A-0413 The quantitative assessment system of hand function

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Objective: To conduct objective quantification of hand function which is important for scientific research and to identify and compare the results of treatment.

Methods: The proposed system of hand function quantification is tested on 252 patients with consequences of hand injuries and upper extremity of

varying severity. The age of patients was 30.5 ± 1.6 years. Patients started treatment with an average of 10.8 ± 2.4 months after injury. It was studied in 205 men and 52 women. The patients were divided based on the severity of damage: first degree – 59, second degree – 60, third degree – 78, and fourth degree – 56 patients. The evaluation system consists of five subsystems: first – sensitivity of fingers and stereognosis; second – motion joint function of the hand and upper limb; third – motions coordination; fourth – hand grabs parameters; and fifth – assessment of fingers amputations. For calculations of joint function and amputation losses, we used American association of surgeons hand system (AAHS). Each of these subsystems is defined in quantitative indicators – percentage. The overall integrated hand function (IHF) was also determined as a percentage, using special formulas.

Results: We determined correlation coefficients, between the sensitivity index and the sensibility for point scale S0–S5 – 0.82; between the index of grips and muscle function point scale M0–M5 – 0.72; between a hand motion function assessment by Strickland – 0.86; between IHF and scores S0–S5 and M0–M5 – 0.92; and between IHF and DASH – 0.69. The coefficient of correlation between the damage severity of limbs and IHF was 0.84 ($p < .00001$) in assessing the long-term results of treatment.

Conclusions: Thus, the introduced assessment hand function system is universal to assess the extent of functional loss in patients with various traumas consequences and well correlates with the known systems evaluation and can be effectively used in a variety of clinical studies.

A-0414 Clinical outcomes of scaphoid nonunions treated with headless compression screw and bone graft

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Purpose: The purpose of this study was to evaluate the clinical results of scaphoid nonunions treated with headless compression screw and 1, 2-intercompartment supraretinacular artery (ICSRA) pedicled vascularized bone graft (VBG) or autogenous iliac bone graft (AIBG).

Methods: Since June 1, 2004, 12 scaphoid nonunions with vascular necrosis were managed with 1,2-ICSRA pedicled VBG combined with headless compression

screw fixation and 41 treated by osteosynthesis with or without bone graft. The mean age was 30.45 years (range, 12–56 years). Serial radiographic evaluations were performed every 4–8 weeks for bone union and follow-up computed tomography scanning.

Results: Bone unions were obtained in all 53 patients. Twelve nonunion cases treated with pedicled VBG gained bone union at 4.9 months (range, 3–9 months) after operation and 41 patients treated by osteosynthesis gained bone union at 5.2 months (range, 3–12 months). For pedicled VBG cases at last follow-up, the average range of motion of was 82.5% and the grip power was 84.1% compared to the contralateral side. On the other hand, for osteosynthesis cases at last follow-up, the average range of motion of was 76.5% and the grip power was 80.5% compared to the contralateral side.

Conclusion: Combined 1, 2-ICSRA pedicled VBG and headless compression screw fixation versus osteosynthesis were both reliable methods for managements of scaphoid nonunions.

A-0415 Tendinous mallet finger: Can we propose a second conservative treatment after the failure of a first conservative treatment?

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Purpose of the study: Management of failure of conservative tendinous mallet finger treatment is both difficult and controversial. Tenodesis, tendon reinsertion or arthrodesis are not unanimous among patients as therapists. Many authors advocate orthopaedic treatment which is less invasive but requires greater patient participation to implement. We report here our experience with patients who had failed the first treatment with dorsal glue nail splint and who underwent a second conservative treatment.

Material and methods: This retrospective study included 14 mallet fingers without osseous lesion, patients who had failed the first treatment in our clinic. All the patients had deficit of active extension greater than 10°, a functional impairment and/or pain following primary treatment. They all agreed to try a second orthopaedic treatment within 1 year after the first procedure. A splint was fashioned for the two distal phalanges and glued to the nail plate filed for this purpose. The splint was fashioned with a rectangle of thermo-malleable plastic dipped in hot water (70°C). This rectangle was molded to the dorsal aspect of the phalanges and then glued to the

nail. The splint was worn for 8 weeks and then worn at night for another 2 weeks. Seven criteria were used to analyze outcome: residual extension deficit, flexion, pain, functional score, observance, complications and patient satisfaction.

Results: Mean follow-up was 5 months (3–15). Complication occurred in 1 patient who presented a transient hypoesthesia of the fingertip. All the patients improved active extension with an average gain of 14°. Four patients recovered normal active extension to 0° compared to the opposite side. All patients were pain free at the end of the treatment. However, all patients lost about 20° of flexion at the IPD joint. The quality of the result depends on compliance; 91% of patients are satisfied with the result.

Discussion: This series unfortunately presents few cases. From 2013 to 2015, we treated 169 tendinous mallet finger. Only 25 of them were treatment failures (loss of active extension >15°); 18 agreed to try a second conservative treatment. The delay between the two treatments was at least 3 months and went up to 30 months. The question of the time for the physiologic healing process remains unsolved. In this series, the observance of the patients was excellent, which explains the absence of complications. The results of this retrospective study are better than those already reported in the literature. These results suggest that surgical indications in case of failure after conservative tendinous mallet finger treatment should be revisited.

Conclusion: In conclusion, our series demonstrates that the adhesive dorsal splint is an effective procedure for failed mallet finger treatment, reducing the number of indications for surgery. Our experience shows that it is possible to propose a second conservative treatment even when the delay of cicatrization has passed.

Keywords: Mallet finger, orthopaedic treatment, failure, observance.

A-0416 Augmented reality simulation for elbow arthroscopy

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Objective: The available evidence supports the use of elbow arthroscopy in the management of conditions such as rheumatoid arthritis, osteoarthritis, tennis elbow, and osteochondritis dissecans. Many intraoperative complications, including serious neurovascular injuries, have been reported in elbow arthroscopy.

The small working space and close correlation between the neurovascular and the arthroscopic portals make elbow arthroscopy a technically demanding procedure. Successful elbow arthroscopy requires extensive knowledge of the spatial correlations among the neurovascular and entry portals and joint structures. Recent advancements in sophisticated image processing technology enabled preoperative simulations that have resulted in useful accuracy. These technologies have become ordinary in clinical practice. However, the use of preoperative plans during surgery is challenging. In this study, we propose increasing elbow arthroscopy safety using a novel technique called augmented reality (AR) in which computer graphics (CG) are superimposed onto the real video.

Materials and Methods:

Experiment 1 – We obtained stereolithographic bone and nerve data from computed tomography and magnetic resonance imaging (MRI) scans of a healthy volunteer's elbow using software (VoTracer; Riken, Wako, Japan) and created a full-size model using a three-dimensional (3D) printer. We performed elbow arthroscopy for this full-size model and superimposed the CG onto the elbow arthroscopy video images. The positions of these data were adjusted using a position tracking device (MicronTracker3; ClaroNav, Toronto, Canada) that uses real-time stereoscopic vision to detect and track specifically marked objects.

Experiment 2 – We used elbow MRI data of a Japanese monkey to create CG of its bones and nerves. We performed elbow arthroscopy using the monkey's anteromedial and posterior portals and superimposed the CG of the bones and nerves onto the elbow arthroscopy video images. We also examined the error range of AR at a 1-cm scope-to-object distance.

Results: We successfully superimposed the CG onto the elbow arthroscopy video images for the full-size model and the Japanese monkey. The arthroscopic view was initially quite different from the superimposed CG due to lens distortion. However, we corrected the CG position and shape to match the arthroscopy view using lens distortion parameters estimated from the calibration pattern. Finally, the AR position and shape errors were within 2.3 mm at a 1-cm scope-to-object distance.

Discussion: The rapid development of endoscopy has enabled less invasive surgeries. However, endoscopy has a spatial perception disadvantage. Endoscopy users need to view the surgical field macroscopically. AR navigation has recently been used during neuro, spinal, plastic, maxillofacial, and several other highly technically demanding surgeries.

However, few studies have focused on its use in upper limb arthroscopy. Although AR for wrist arthroscopy was published previously, AR for elbow arthroscopy, shown here to increase surgical safety, was not previously reported.

Conclusions: The novel AR simulation technique for elbow arthroscopy described here demonstrated acceptable accuracy. This technique will contribute to reducing the serious complications of elbow arthroscopy.

A-0417 An audit of pain scores in patients with depression and anxiety undergoing hand surgery

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Objective: Postoperative pain management has been a common complication in hand surgery and may delay a patient from discharge home. Our aim is to investigate a correlation between preoperative test scores of general anxiety, depression, and catastrophization and increased postoperative pain scores.

Methods: Our study examined depression, anxiety, and catastrophization scores in 122 patients undergoing common hand operations including (1) local soft tissue, (2) regional soft tissue, (3) bony trauma injury, and (4) de novo bony work. Scores were derived from Anxiety and Depression scales of the GAD PHQ questionnaire and catastrophization index.

Results: The highest peak pain scores were found to be in bony trauma injury (8.5/10), second highest in de novo bony work (6.8/10), then local soft tissue cases (4.9/10), and finally regional soft tissue cases (4.6/10). Mean pain scores were found to be highest in de novo bony work (3.8/10), followed by bony trauma surgery (3.4/10), local soft tissue surgery (2.2/10), and regional soft tissue cases (2.1/10). Patients with high depression scores were also found to correlate with high average pain scores ($R^2 = .09$, $p = .001$) and peak pain scores ($R^2 = .05$, $p = .019$). Similarly, anxiety scores from GAD PHQ and catastrophization index were also found to be associated in patients with high peak pain ($R^2 = .06$, $p < .01$) and mean pain ($R^2 = .05$, $p = .02$) scores. Catastrophization scores also correlated with mean pain scores ($R^2 = .09$, $p = .001$), and peak pain scores ($R^2 = .06$, $p = .007$). High preoperative depression scores were also found to be associated

with increased equivalent morphine use ($R^2 = .0779$, $p = .004$), and high preoperative catastrophization scores were also found to be associated with high total amount of morphine-based analgesia ($R^2 = .0282$, $p < .001$).

Conclusions: Patients with high depression and anxiety scores have associated high mean and peak pain scores, and patients with high preoperative depression and catastrophization scores require an increased amount of analgesia. This increase in analgesia management may consequently lead to an increased length of stay while admitted and may also require further input by the surgical team or pain team.

A-0419 Is task-oriented training effective in the hand pain of rheumatoid arthritis

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Objective: Rheumatoid arthritis (RA) is the most common type of autoimmune diseases. The goal of this study is to investigate the effect of hand therapy program and task-oriented training in arthritic hand pain and to compare the superiority of these modalities to each other.

Methods: Twenty-eight women (13 patients in control group and 15 patients in study group) performed the therapy program. Control group received hand exercise therapy (MCP, DIP, PIP mobilization, range of motion exercise, and isometric exercise), and study group received both hand exercise therapy and task-oriented training (fork use, drinking water with a glass, face washing, sit up-stand up, and t-shirt wearing) twice a week for 5 weeks. The results were evaluated before and after the therapy program with visual analog scale (VAS).

Results: Data statistics were made using SPSS-22. One-sample Kolmogorov-Smirnov showed normal distribution in the group ($p > .05$). Then, Students impaired *t*-test showed no significant changes between the groups' VAS scores. The decrease in VAS scores before and after treatment was not statistically significant in both the groups ($p > .05$, control group; $p = .503$, study group; $p = .485$)

Conclusion: According to these results, hand therapy program and task-oriented training are useful methods in rheumatoid hand pain. In addition, hand exercise therapy was combined with task-oriented training, and the reduction in pain was found to be greater. However, our work has not yet come to an end and continues with new participants.

A-0420 An alternative technique in thumb reconstructions: Innervated digital artery perforator flap

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Objective: Disruption of the anatomy and physiology of the thumb tip after an injury adversely affects the hand function. Normal thumb function requires adequate length and normal mobility, with stable, durable, and sensate soft tissue coverage. Reconstruction of the thumb defect is often challenging and must be carefully selected in order to restore normal function. Several reconstruction techniques were reported for thumb reconstructions, such as local advancement flaps, cross-finger flaps, Moberg's flap, heterodigital neurovascular island flaps, and various microsurgical techniques. However, all of these techniques have some shortcomings and disadvantages. In 2006, Koshima et al. described a new entity called digital artery perforator (DAP) flap that uses small perforators which arise from the digital artery. In 2013, we reported a successful fingertip reconstruction technique, the innervated digital artery perforator (IDAP) flap for fingertip reconstructions. The flap pedicle included the terminal branches of the digital nerve, the terminal digital artery perforators, and the subcutaneous venous system. The IDAP flap has several advantages over conventional reconstruction techniques, and we would like to demonstrate our experience with the use of IDAP flaps in acute and late reconstructions of the thumb defects.

Materials and Methods: Between January 2014 and September 2016, 19 patients with traumatic and chronic thumb-pulp and fingertip defects who were reconstructed with innervated digital artery flap were reviewed. Eighteen of 19 patients who were followed up for more than 6 months were included in this study. The mean age was 34.9 years (range, 8–63 years). The defect types were transverse in 9 patients, lateral oblique in 7 patients, dorsal oblique in 1 patient, and pulp in 1 patient. Postoperative evaluation included Semmes-Weinstein Monofilament test, static 2-point discrimination, extension loss, early/late complications, and patient satisfaction.

Results: All flaps survived completely, and there was no donor site morbidity. The mean follow-up period was 12 months (range 6–24 months). The flap sizes were between 2.5×1 cm and 4×2 cm. The Semmes-Weinstein monofilament test results ranged from 2.83 to 4.56 (contralateral 2.44–4.31). Static 2-point

discrimination test results were 3–6 mm (contralateral 2–5 mm). Mild temporary postoperative venous congestion was observed in 2 patients, but no secondary interventions were required to overcome these congestions. Cold intolerance was recorded as complication. Range of motions were examined. All patients were highly satisfied with the result of the surgical procedure.

Conclusions: The IDAP flap is a reliable, easy, single-staged, and versatile option for thumb fingertip reconstruction with excellent sensitivity and aesthetic results with a low complication rate.

A-0422 Does the late zone 2 flexor tendoplasty have any impact on the required graft length

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Objective: It is commonly believed that long delay of zone 2 flexor tendon grafting is fraught with muscle retraction and atrophy, but any supporting facts or its experimental proofs are not often discussed in the literature. We suppose that as far as palm-to-tip grafting is concerned, lumbrical muscles do prevent proximal tendon end retraction and that the fact that the graft length doesn't increase with the time passed from laceration to grafting can be considered as a proof.

Methods: The documentary palm-to-tip graft length data in 885 fingers were analyzed. In 148 fingers, primary FDP grafting procedure had been carried out within the first 24 hours after injury, in 309 fingers conventional FDP grafting had been performed with the average interval from time of laceration to grafting of 9.5 ± 1.2 weeks, and in 428 fingers the two-stage FDP grafting had been accomplished with the average interval from time of injury to grafting of 22.5 ± 1.5 months. In the primary tendoplasty group, graft length had been made as total length of both distal and proximal stumps removed; in conventional and in two-stage grafting groups, the proper graft length measurement technique had been the same. The average graft length was calculated separately for index, long, ring, and little fingers in each group.

Results: The average graft length for 49 index fingers of primary grafting group was 9.6 ± 0.11 cm, for 81 index fingers of conventional grafting group it was 9.3 ± 0.17 cm, and for 97 index fingers of two-stage procedure group it was 9.7 ± 0.13 cm. The average graft length in 25 long fingers of primary grafting group, in 46 long fingers of conventional grafting group, and in 103 long fingers of two-stage procedure group was 10.4 ± 0.17 cm, 10.2 ± 0.17 cm, and 10.6 ± 0.22 cm

correspondingly. In case of 29, 70, and 126 ring fingers of the above-mentioned three groups, the average graft length was 9.3 ± 0.27 cm, 9.3 ± 0.15 cm, and 9.8 ± 0.79 cm correspondingly. In case of 45, 112, and 102 little fingers of the three groups, the average graft length was 7.5 ± 0.16 cm, 8.0 ± 0.75 cm, and 8.1 ± 0.83 cm correspondingly. Likewise, in cases with two-stage FDP reconstruction in the little digit, the average graft length was only 0.6 cm larger than in primary FDP grafting cases ($p > .05$). There was no significant difference between the average graft length for the other fingers in the three groups still less ($p > .05$).

Conclusions: The data provided by this study illustrate the role of carefully preserved lumbrical muscles system in preventing permanent FDP proximal end retraction and muscle impairment such wise keeping a possibility for successful flexor tendon grafting for years after injury. It should be strictly mentioned that these calculated average graft length values for each finger are not in the least for clinical use. Required graft length should be properly measured in course of each FDP grafting procedure.

A-0423 Treatment outcomes in radial dysplasia: A systematic review and meta-analysis

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Objective: Radial dysplasia is a disfiguring, potentially disabling congenital limb anomaly, affecting 1:8,000 births. Specialist centres worldwide advocate several different treatment protocols, but the optimal approach remains unclear.

Methods: Embase, MEDLINE, PubMed, Cochrane Central, ClinicalTrials.gov and the WHO International Clinical Trials Portal were searched for published and unpublished studies in any language from inception to April 2016. Studies including at least 9-year post-operative follow-up were included. The primary outcomes were hand-forearm angle (HFA), ulnar length and "wrist" total active motion. Study quality was assessed using the GRADE criteria. Data were pooled using random-effects meta-analysis and standardized mean differences (SMD) and 95% confidence intervals (95% CI) obtained. Where only post-operative data were available, the mean and standard deviation were calculated.

Results: Of 104 studies identified, 12 were included in this review. Five were retrospective cohort studies,

reporting the outcome of more than one treatment approach and seven were case series. No randomized studies were found. With the exception of the paper by Kotwal et al. ($n = 446$), all were small ($n = 35$ or fewer). The methodological quality was low or very low under the GRADE criteria for all papers. Many centers use both centralization and radialization and choose between them according to the intraoperative soft tissue quality. We therefore calculated the combined results of centralization or radialization after soft-tissue distraction, along with the results for the individual techniques. The HFA of conservatively treated (i.e. unoperated) patients worsened during childhood, from 66° to 84° . Regardless of the surgical approach, all studies reporting multiple follow-up time points observed a similar trend for some loss of HFA correction with growth. Ulnar length was not reported for conservatively treated patients, but "wrist" active motion, at 61° , was better than for most surgically treated patients. When compared to conservatively treated patients, soft tissue distraction with either centralization or radialization achieved the best HFA correction (16° radial deviation). Centralized patients had a larger improvement in HFA (71.4°) than radialized patients (49.1°); in other words, centralized patients had a greater HFA deformity to start with, but both reached similar end results. Radialization maintained better "wrist" movement (46°) and ulnar length than centralization. Free second MTP joint transfer reported better "wrist" movement (83°) and ulnar length than other techniques, at the cost of slightly worse HFA (28°). Isolated soft-tissue release with a bilobed flap had only a slight improvement in HFA over conservative treatment.

Conclusions: This is the first meta-analysis of treatment outcomes for radial dysplasia. Our findings confirm that soft-tissue distraction and a stabilization procedure (centralization or radialization) provide substantial correction of the HFA when compared to conservative treatment, at the cost of some loss of "wrist" motion. Microvascular second MTP joint transfer also provides a large improvement in HFA and improves "wrist" motion over conservative treatment; this is unsurprising, as it is the only technique in the data synthesis which imports tissue, including a true joint to the "wrist."

A-0424 Therapy management of thumb carpometacarpal osteoarthritis: Exploring UK therapist perceptions of joint instability

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Introduction: We explored hand therapists' understanding of joint instability in first carpometacarpal osteoarthritis (CMC OA), as it relates to the complex interaction of laxity, subluxation, and strength. We then explored how this affects the perceived effectiveness of exercise for symptomatic OA.

Methods: A qualitative research design, consisting of individual semistructured interviews, was conducted with nine therapists. Interviews were transcribed and analyzed using a thematic analysis.

Results: Three themes were identified:

- (1) Relationships between instability and laxity – the terms laxity and instability were often used interchangeably. Instability was associated with laxity, subluxation, and disease progression and was perceived to be a problem that includes the whole thumb column.
- (2) Stage of disease – conflicting opinions were expressed regarding instability being present in pre-arthritis lax joints, early disease, or all stages of disease.
- (3) The role of exercise in management – there was disagreement as to whether instability could be modified by developing muscle strength or whether treatment should be focused on compensating for instability.

Conclusion: Different perceptions of instability were reflected in wide-ranging opinions regarding the need to manage instability and regarding the potential for altering instability. The impact of instability on function and the concept of instability were not easily identified. A clearer definition of instability in the CMCJ, with differentiation between laxity (prepathological) and instability (pathological), would allow us to better target our interventions and to develop more appropriate assessments and interventions.

A-0425 Comparison of biceps-to-triceps transfer and deltoid-to triceps transfer to restore active elbow extension in patients with tetraplegia

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Introduction: Elbow extension recovery improves independence of tetraplegic patients in activities of

daily living: manual wheelchair propulsion and control of trajectory and velocity of their arm in space, especially to reach objects above shoulder level. Two current surgical procedures aim at restoring active elbow extension: transfer of the biceps brachii and transfer of the posterior deltoid. As no consensus exists, our goal was to compare the functional results of both techniques at long follow-up.

Methods: We retrospectively reviewed 17 patients between 18 and 55 years of age with cervical-level spinal cord injury, who sustained 5 deltoid-to-triceps transfers and 22 biceps-to-triceps transfers through a medial route. Mean follow-up was 11 years (range, 2–19 years). Assessment of every limb included elbow flexion and extension active range of motion. Strength was measured using a dynamometer in standardized conditions and the Medical Research Council grading system. Pain (VAS), patient satisfaction, and global limb function using the Quadriplegia Index of Function were evaluated as well.

Results: Four patients treated by deltoid transfer and 21 treated by biceps transfer recovered elbow extension graded M3 or more. Analysis of active shoulder and elbow active range of motion as well as strength did not show any statistical difference between both the groups. Elbow extension and flexion strength were, respectively, 24.5 N and 95.8 N in the deltoid group versus 37.7 N and 61 N in the biceps group. The mean elbow lack of extension was respectively 0° in the deltoid group and 6° in the biceps group. All patients had elbow flexion strength graded M4 or more. No patient complained of limited elbow flexion power or loss of preoperative shoulder function. Eighty percent of patients in deltoid group and 91% in the biceps group were satisfied or very satisfied. No complications were encountered.

Conclusions: Both deltoid-to-triceps and biceps-to-triceps transfers are reliable techniques to restore active elbow extension in tetraplegic patients.

A-0426 Pushing the limits in wide awake hand surgery: A trainee's perspective, consecutive patient series retrospective analysis

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Objective: This analysis of a consecutive patient series highlights the trainee's advantages obtained by wide-awake hand surgery. So far, no study has evaluated this perspective. Furthermore, patient satisfaction (also with a view of being operated by a junior surgeon), peri-operative pain and complications

are evaluated. The cost-effectiveness in comparison to regular anesthesia is calculated.

Methods: A retrospective review of the author's personal series of over 50 consecutive patients (in a 12-month time frame) treated at a regional hospital in Switzerland using wide-awake hand surgery was performed (including tendon, vessel and nerve repair as well as fracture fixation, decompression of peripheral nerves and trigger finger release). A 50:50 mixture of ropivacain 1% and lidocaine 1% with 1:100,000 adrenaline provided very effective long-term pain relief. The analysed parameters include time pressure reduction, complaints, patient satisfaction with communication, and waiting time from injury until operation. Furthermore, peri-operative pain as well as patient satisfaction (intraoperatively and up to a minimum follow-up of 6 weeks) were evaluated. Complications (defined as postoperative infection, haematoma, or accidental nerve lesions) were also analysed. We illustrate pushing the limits of wide-awake hand surgery with an emergency patient who had extensive flexor tendon injuries, a lesion of the median nerve and a complete transection of the radial artery. An exceptionally good result was achieved.

Results: Time pressure on the trainee surgeon was greatly reduced. As formal theatre time is limited, wide-awake hand surgery can be performed in an operating room within an emergency department. This allows surgery to take place usually with no delay and with few or no time restrictions. We achieved excellent outcomes in patient satisfaction (unsatisfied patients, $n = 0$) and peri-operative pain (half of the patients did not require any oral analgesia). No complications occurred, and no complaints were received with regard to a trainee being the main operator. Overall treatment cost was significantly reduced when compared to the traditional pathway.

Conclusions: The well-established concept of wide awake hand surgery is safe, cost-effective, and achieves high patient satisfaction scores. Its advantages also include clear benefits for the junior hand surgeon which could allow a higher level of this method's integration into the training structure. The current pressures on medical resources are usually compromising time for educational needs. We by chance found this safe, cost-reducing and effective approach to be ideal for creating educational operating time for the trainee. From the junior's perspective, this has vastly improved surgical exposure with a dedicated trainer in a setting with significantly reduced time pressure. It is evident that the very versatile approach of wide-awake hand surgery has not yet reached its conceptual limits. This should trigger further evaluations to maximize its potential.

Keywords: Wide awake hand surgery, trainees perspective, patient satisfaction, cost-effectiveness

A-0427 Animal bite injuries of the hand: Early versus late treatment

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Objectives: Animal bites on hands are common injuries in the emergency department. If they are not treated adequately, serious complications may occur. In particular, hand function may become limited after the development of an infection. Due to the specific features of hand anatomy, even small wounds can lead to an aggressively spreading infection. The aim of the study was to evaluate the treatment of animal bite injuries at an early stage, (within the first 24 h after injury) versus at a later stage (more than 24 h after injury) retrospectively as well as their outcome.

Methods: Between January 2010 and March 2016, a total of 69 patients with animal bite injuries were treated in our hospital; 34 of them had a cat bite injury and 35 a dog bite injury. The mean age of the patients at the time of the injury was 47 ± 18.83 years. Forty-five patients (42% of cat bites and 58% of dog bites) were presented within 24 hours of injury, and 24 patients (63% of cat bites and 38% of dog bites) were treated more than 24 h after injury for the first time. A retrospective evaluation of the existing clinical data as well as photographic documentation was performed.

Results: In the early-stage group (first treatment within 24 h), 27 were outpatient and 18 were inpatient with an average hospitalization of 3.3 ± 1.12 days. Twenty-nine patients were treated conservatively. A second operation was required in 3 cases. In the later stage group (first treatment after 24 h), 5 patients were outpatient and 19 were inpatient with an average hospitalization of 5.8 ± 1.9 days. An operation was performed in 22 patients, and 2 were treated conservatively. A second operation was required for five patients.

Conclusion: The treatment of animal bite injuries poses a major challenge in the emergency room as it requires acute medical care. In the later stage group, inpatient admission was necessary in 79% of patients and a second look operation in 20% of patients. In the early-stage group, that is, treatment within 24 hours, inpatient admission was required in 40% of patients and a second-look operation in 6% of patients. The duration of in-patient medical care in the later stage group was extended by 1.5 days compared to that of the early-stage group. Therefore, animal bite injuries of the hands should be treated as soon as possible in order to avoid further complications. Treatment should be performed by an experienced hand surgeon.

A-0428 Explanations-based scoring of congenital hand differences for surgeons and parents

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Objective: To determine whether a new patient-friendly grading system can improve parents' understanding of the surgical opinion of the severity of, and prognosis for, their children's congenital hand difference (CHD).

Methods: Seventy parents of children with CHD consented and were split into two independent groups: new parents ($n = 43$) to the clinic and returners ($n = 27$) attending their 3-month postoperative review. We designed a scale formed on a basis of restoration to different degrees of normality (e.g. Mild: Treatment leading to normal condition). New parents were asked, preconsultation, to subjectively score the severity of the CHD using a 1–4 scale; this was repeated postconsultation. Finally, we presented them with our new scale which they completed using our explanations for guidance. Factors that may influence the perceived severity of a condition were explored under two concerns: function and appearance. Two congenital hand surgeons independently grouped the severity of a spectrum of CHD according to this new system, for comparison with parental opinions. Returners used our explanations-based scale to rate their perception, preconsultation, of the severity of the CHD following surgery. The surgeon, also preconsultation, used case notes and presurgical radiographs to score his expected outcome also based on our new scale. The agreement between parents and surgeon was assessed using linear-weighted κ . We performed three κ analyses for new parents – surgeon's scores versus parents' preconsultation, postconsultation subjective, and postconsultation with explanation. For returners, we compared surgeon's and parents' views of postoperative outcomes. We also used a paired t -test to compare new parents' scores pre- and postconsultation and regression analyses to determine whether there was any correlation between parents' scores for appearance, function, and overall severity.

Results: The paired t -test showed no significant change in new parents' appreciation of the CHD following surgical consultation ($p = .15$). This is consistent with the κ analyses, which showed both the pre- and the postconsultation agreements between the new parents' subjective severity scores and surgeons' gradings were "marginally worse than by chance" ($\kappa = -.14$ and -0.12 respectively – κ analysis

descriptors follow Landis and Koch). However, using the explanations-based scale, postconsultation agreement improved to "fair" ($\kappa = .33$). For Returners, the consensus on severity between parents and surgeon was "moderate" ($\kappa = .52$) displaying that the surgeons' application of the explanations matches real-world outcomes. Linear regression analyses showed no correlation ($p > .1$) between parents' scores for appearance, function, and overall severity showing that parents favor neither concern when assessing the severity of the CHD.

Conclusion: Consultation alone is inadequate in improving agreement between parents and surgeon regarding the severity of CHD and its prognosis. When written explanations were added to guide parents, agreement improved significantly. This indicates that our simple numerical grading system, with a rationale based on restoration to different degrees of normality, may benefit both the parents and the surgeons in managing expectations. We recommend other centers extend this survey to improve statistical power and, if replicated, it becomes part of standard procedure for communicating results of congenital hand surgery. We also note its potential benefit more widely.

LEVEL OF EVIDENCE: II

A-0429 Reducing a volar marginal fragment of the distal radius using a hook-plate extension to a volar locking plate

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Introduction: Articular fractures of the distal radius may include a small fragment from the volar margin of the lunate fossa: volar marginal fragments (VMFs); these fragments are prone to loss of fixation, avascular necrosis, and often result in wrist subluxation. Biomechanical studies have demonstrated that the centroid of force application is located palmarly on the lunate fossa, and because the lunate fossa is offset in a palmar direction relative to the radial shaft, the VMF carries high loads and is difficult to stabilize.

Objective: We present our experience using a hook-plate extension to a volar locking plate to manage acute VMF's.

Methods: We retrospectively reviewed the records of all patients treated at our facility with a hook plate extension for a VMF. Medical charts were examined for complications and functional results. We treated 21 patients, 14 females and 7 males (ages 38-87, average 68.6 years \pm 11.9 years), with a volar hook

plate extension for management of a VMF (15 left wrists and 6 right wrists). Fracture fixation was obtained using the volar distal radius plate system with a hook plate attachment in a modular part of this system. Of the 21 patients treated, 17 used the hook plate extension during the primary reduction (first surgery; 81%), and 4 used the hook plate extension during a secondary procedure for a failed volar marginal fragment (19%).

Results: Overall, the hook plate extension was successful in reducing the VMF and maintaining the reduction in 19 (90%) of 21 cases. The hook plate extension was successful in reducing the VMF and maintaining reduction through final follow-up in 17 (100%) of the 17 patients treated primarily. Of the four revision cases for failed VMFs, two (50%) failed to heal.

Conclusions: We conclude that hook plate fixation of the VMF is an effective means of fixing the acute VMF. Other methods of treatment may be more appropriate for some failed or chronic VMF's such as those being addressed in a secondary procedure.

A-0431 Early experience with a stabilized saddle trapeziometacarpal hemiarthroplasty

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Background: The goal in the treatment of trapeziometacarpal (TM) arthritis is to alleviate pain while maintaining function. Current surgical options address these goals in a limited manner, as arthrodesis limits motion, trapezium excision limits strength, and available implant arthroplasties have failed or demonstrated limited survivorship. Total joint TM replacements have shown that failure often occurs at the trapezium side. Ball and socket hemiarthroplasties also fail as they subside into the soft trapezium. We have used a stabilized saddle-shaped TM hemiarthroplasty (Stablyx[®], Skeletal Dynamics, Miami Florida) for the treatment of TM osteoarthritis refractory to conservative management. The metacarpal joint surface is replaced with a metallic implant and the trapezium reshaped for proper articulation (trapezioplasty) while preserving most of the strong subchondral plate. Stability is provided by a saddle geometry that is more congruous than that of the native metacarpal and a by a 30° dorsal redirection of the articular surface, along the lines of the Wilson osteotomy.

Objective: We present our initial experience with the Stablyx CMC hemiarthroplasty system.

Methods: Thirty patients were treated for CMC OA using the Stablyx CMC hemiarthroplasty system and followed for a minimum of 12 months. Grip and pinch strength were measured in comparison with the contralateral hand. QuickDASH scores were taken to assess function/ disability. Range of motion was evaluated using the Kapandji scoring system. Passive (while resting) and active (while opening a jar) pain was evaluated using a 10-point visual analog scale (VAS). Trapezial heights were measured over time to evaluate trapezial wear; height measurements were compared with baseline measurements taken during the first postoperative visit.

Results: Twenty-five patients were evaluated after 12 months, and 12 patients were evaluated after 24 months. The average grip strength was 81.2% of the contralateral hand at 12 months and 110.0% at 24 months. Similarly, the average pinch strength was 88.2% of the contralateral hand at 12 months and 117.9% at 24 months. QuickDASH scores were 16.3 at 12 months and 1.5 at 24 months. Kapandji scores of 9.1 and 9.2 were achieved at 12 and 24 months, respectively. At 12 months, passive and active pain was reported as 1.1 and 3.1, respectively. By 24 months, passive and active pain was reported as 0.05 and 0.22, respectively. Trapezial heights were measured and compared to the height measured at the first postoperative visit. Trapezial heights were maintained at 97.7% at 12 months and 99.3% at 24 months.

Conclusion: Our early results of treating TM osteoarthritis with a stabilized saddle hemiarthroplasty are encouraging. Pain relief, as measured by VAS scores, is comparable with the historical results of trapezial excisional procedures. DASH scores, strength, and motion seem to compare favorably. In the 2 years that we followed our patients, we did not find evidence of progressive trapezial erosion. We will continue to follow these patients to see how these results stand up to the test of time.

A-0438 Buddy taping versus splint immobilization for pediatric finger fractures: A randomized controlled clinical study

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Objective: The objective of this study was to prospectively compare the outcome of conservative treatment of pediatric finger fractures with interdigital taping versus forearm splint immobilization. The randomized trial assessed the outcome regarding secondary dislocations, post immobilization range of motion, time of tape or cast application, and patient comfort.

Methods: Ninety-nine children with finger fractures were randomized to either taping ($n = 52$) or splint immobilization ($n = 47$). There were no significant differences regarding age, sex distribution, fracture types, or rate of reduction. Inclusion criteria were fractures of the proximal or middle phalanx of the digits 2–5 in children aged 4–16 years. Exclusion criteria were dislocated intra-articular fractures, comminuted fractures, open fractures, and multiple fractures of one hand. Treatment consisted of reduction if needed, followed by interdigital taping with the neighboring finger, or volar forearm splinting, according to randomization. Clinical and radiographic evaluations were performed at 1, 3, 6, and 24 weeks. Patient comfort was assessed with a visual analogue scale.

Odds ratios were calculated using Fisher's exact test, and calculations were done in R (V 3.2.5)

Results: Secondary dislocations were found in 4 (4%) patients, 1 (1.9%) in the taping and 3 (6.4%) in the splinting group. The risk difference p between taping and splinting is estimated as -0.045 with a 95% confidence interval of $[-0.154, 0.047]$. Patient comfort was significantly higher in the taping group ($p = .01$) and application of the tape was significantly shorter than casting ($p = .00$), whereas the total active range of motion at any time of the follow-up as well as analgesia intake did not differ significantly.

Conclusions: There was no significant difference between the two groups on maintaining position and reestablishing an excellent range of motion. Taping is quicker and involves less costly materials than casting, resulting in a lower cost of treatment. This and the higher patient's comfort encourage us to propose taping as an alternative to splinting for the above-mentioned finger fractures.

A-0440 Normative data for the Patient-Rated Wrist Evaluation

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Introduction: The Patient-Rated Wrist Evaluation (PRWE) is a validated 15-item questionnaire that focuses on measurement of wrist pain and disability in activities of daily living and is extensively used to evaluate treatment after wrist and hand injuries. To evaluate if patients have returned, or at least come closer, to normative ranges of functioning, it is important to know the population-based normative data. This allows to compare the data of injured patients with data from a normal, age- and gender-adjusted population. Today, the normative data for the PRWE are unknown. Therefore, the aim of our study was to determine the normative data for the PRWE questionnaire. Secondary, we aimed to determine whether there were any differences based on age, gender, and socioeconomic status.

Methods: A cross-sectional prospective study of 1,046 adult visitors and employees of 4 hospitals in the Netherlands was performed. Excluded were all participants who were scheduled for surgery or where in treatment or after-treatment of an injury of the wrist or hand within 1 year after trauma. All participants were asked to complete the PRWE questionnaire and were asked about their age, gender, and occupation. In addition, the socioeconomic status was determined based on the zip code of the participants. Data were divided based on age in three different groups: 18– 40 years, 40– 65 years, and 65 years or older.

Results: The mean age of the population was 50 years (*SD* 16.9), and 56% was female. The mean PRWE was 7.7 (*SD* 15.0). Female participants had significantly higher PRWE scores compared to male participants (8.6 (*SD* 15.9) vs. 6.5 (*SD* 13.6), $p = .013$) and a significant correlation between the PRWE score and age was found (Spearman's Correlation Coefficient = .085, $p = .006$). Participants aged 65 years and older had the highest PRWE score of 9.2 (*SD* 16.0), and participants younger than 40 years the lowest (5.5 (*SD* 11.7)). For patients between 40 and 65 years old, the PRWE score was 8.3 (*SD* 16.0). The socioeconomic status of the participants was not correlated with the PRWE score.

Conclusion: The normative value of the PRWE is 7.7 (*SD* 15.0). This value increases with age and is gender dependent.

A-0444 Does neuroproprioceptive wrist rehabilitation effect the patients' global hand and wrist functional outcome

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Objective: In recently published studies, concerning the histological findings regarding the density of mechano-receptors that have been found in the wrist, therapists have been encouraged to formulate specific wrist neuroproprioceptive rehabilitation protocols that specifically solicit improving reaction movement time; joint position sense; kinesthesia; and wrist neuromuscular control. The purpose of this study is to verify if neuroproprioceptive wrist rehabilitation truly affects the patients' global hand and wrist functional outcome.

Methods and materials: The first group consists of 10 healthy and 10 wrist injury patients who will undergo a 4-week neuroproprioceptive standardized protocol conducted by the same two therapists. The second group is a control group consisting of 10 healthy and 10 wrist injury patients who will not undergo neuroproprioceptive standardized protocol. All 40 people will be tested for grip strength, AROM, reaction movement time, joint position sense, kinesthesia, wrist dexterity, and wrist neuromuscular strength using the E-LINK evaluation and exercise medical device by Biometrics Ltd. Initial and final testing will be conducted in a double blind study by two other therapists. Patients who underwent surgery were operated by the same surgeon.

Results and conclusions: In course of completion at the present time.

A-0449 Scaphometacarpal arthroplasty: 10 cases of trapezio-metacarpal prosthesis revision and failed trapeziectomy

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Introduction: Trapeziometacarpal (TM) prosthesis has shown good results in the surgical treatment of rhizarthrosis. One of the main causes of failure is

tapezium loosening. For the revision of a failed prosthesis, trapeziectomy can be a solution. Another possibility is to implant a cup into the distal extremity of the scaphoid, thus performing a scaphometacarpal arthroplasty. This scaphometacarpal arthroplasty can also be used in the event of failed trapeziectomies. The purpose of this study is to present preliminary results of 10 cases of scaphometacarpal prosthesis.

Methods: A retrospective multicentric study was carried out on 10 patients, 9 women and 1 man, with an average age of 74 years, who underwent surgery between 2009 and 2015; four had revision surgery after trapeziometacarpal arthroplasty, five after trapeziectomy, and one had a revision of silicone implant. The prosthesis used was MAÏA® Prosthesis, with long or extra-long neck.

Assessment covered: Visual Analog Pain Scale, mobility, strength, Quick-DASH, satisfaction score, preoperative, postoperative, and the most recent X-rays (Kapandji incidences).

Results: Nine patients were assessed, with a mean follow-up of 34 months; one patient was lost to follow-up. Of these nine patients, we had one failure due to an early scaphoid cup loosening. Four of nine patients underwent surgery on their dominant hand. Four patients said they were very satisfied with the outcome, four were satisfied, and one was not very satisfied. The average pain score was 1.2 of 10, and the average Quick-DASH was 38.5. The mean mobility of the carpometacarpal joint was 48° in abduction, 40° in antepulsion, opposition according to Kapandji was 8.6, and retropulsion was 1.9., Thumb strength measurements were 3 kg for key pinch and 13.6 kg for grip strength. Radiographic assessment showed only one scaphoid cup loosening, and measurement of the length of the thumb column showed a shortening of 0.2 cm after surgery.

Conclusion: Scaphometacarpal arthroplasty is a reliable medium-term solution for revision of the loosening of a trapeziometacarpal prosthesis with trapezium damage as well as for failed trapeziectomy.

A-0450 Regional variations in the incidence of hospital-diagnosed carpal tunnel syndrome and carpal tunnel release surgery in Sweden: A population-based study

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Objective: To estimate the incidence of carpal tunnel syndrome (CTS) and carpal tunnel release (CTR) surgery in the general population over time and across different regions in Sweden.

Methods: From the nationwide patient registry managed by the Center for Epidemiology at the Swedish National Board of Health and Welfare, we identified all individuals aged ≥ 18 years who had consulted a doctor at any hospital in Sweden from January 2001 through December 2009 and received CTS diagnosis (International Classification of Diseases, 10th Revision [ICD-10] code G560). We also identified all individuals who had CTR surgery (code ACC51 according to the Swedish Classification of Healthcare Interventions) in conjunction with the CTS diagnosis. Data on population statistics were retrieved from Statistics Sweden. The incidence rates of CTS and CTR surgery were calculated according to sex, age, and county (for the 21 counties in Sweden). Each individual was included only once (first-time diagnosis and first-time surgery). All incidence rates shown are per 100,000 person-years with 95% confidence intervals (CI).

Results: During the 9-year study period, 108,699 persons (75,799 women and 32,900 men) were diagnosed with CTS at a hospital in Sweden. The incidence in women was 232 (CI 230–233) and in men 104 (CI 103–105). In women, the incidence peaked in ages 50–59 years and in men in ages 70–79 years. The incidence of hospital-diagnosed CTS in women increased from 216 (CI 211–221) in 2001 to 243 (238–248) in 2009, and in men from 95 (CI 92–98) in 2001 to 119 (CI 115–122) in 2009. Among the 21 counties, the incidence over 9 years varied from 172 to 364 in women and from 71 to 175 in men. Of the 108,699 persons with hospital-diagnosed CTS, 70,120 (65%) had CTR surgery (49,440 women [65%] and 20,680 men [63%]). The incidence of CTR surgery in women was 151 (CI 150–152) and in men was 65 (CI 64–66). In women, the incidence peaked in ages 50–59 years and in men in ages 70–79 years. The incidence of CTR surgery in women increased from 117 (CI 114–121) in 2001 to 168 (CI 164–173) in 2009, and in men from 52 (CI 49–54) in 2001 to 78 (CI 75–81) in 2009. Among the 21 counties, the incidence over 9 years varied from 106 to 251 in women and from 40 to 117 in men. The proportion of individuals with hospital-diagnosed CTS treated with CTR surgery was lowest in the ages 18–29 years (women 52% and men 52%) and highest in the age ≥ 80 years (women 69% and men 73%). Among the 21 counties, the proportion varied from 53% to 81% in women and from 51% to 77% in men.

Conclusion: The incidence of hospital-diagnosed CTS and of CTR surgery in Sweden 2001–2009 increased

significantly over time among both women and men. There was large regional variation in the incidence of CTS and CTR surgery as well as in the proportion of CTS-diagnosed individuals treated with surgery. This raises concern with regard to the important goal of equality in health care.

A-0452 Defining an international standard set of outcome measures for patients with congenital hand and upper limb malformations: Consensus of the international consortium of health outcomes measurement congenital hand and upper limb malformations working group

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Background: Congenital hand and upper limb malformations (CHULM) are complex conditions that profoundly influence patients' health-related quality of life. However, there is scarce information regarding outcomes during the follow-up of CHULM patients. Uncertainty regarding treatment outcomes coupled with unsustainable growth in health-care expenditures has driven interest in the development of standardized health outcome measures for comparing the effects of treatment across populations and for assessing the quality of care delivery. Therefore, standardized routine outcomes measurement may serve as a strategy for catalyzing patient-centered health-care improvement across the globe. Here, we present a patient-centered set of outcome measures for monitoring, comparing, and improving care for pediatric patients with CHULM.

Materials and Methods: An international working group of plastic and orthopedic surgeons, hand and occupational therapists, genetic, and outcomes researchers was assembled to review existing literature and practices. In a series of teleconferences, a modified Delphi process was used to reach consensus on what outcomes matter most to patients with CHULM. Patients' opinions and interests were obtained from a focus group and included in the set.

Results: The working group reached consensus on a patient-centered core outcome set to evaluate four domains comprising 16 key outcome areas: psychosocial (relationships, anxiety, depression, and

health-related QoL), functional (sensory functions, muscle strength, joint mobility, fine hand use, grasping, carrying and moving, recreation and leisure, school activities, and self-care), appearance (aesthetics), and burden of care (utilization of health services and major complications). Case-mix variables were identified to allow comparisons among providers. The outcomes are measured at eight time points until the end of pediatric care and include patient, clinician, and administrative reported data.

Conclusion: We have defined a standard set of outcome measures recommended for monitoring the care of children with CHULM. We believe this standard set provides meaningful, comparable, and easy to interpret measures that are ready to implement in clinic and/or registries globally. We view this as an initial step to facilitate value-based health-care improvements in the treatment of CHULM.

A-0457 Eccentric exercise training in chronic de Quervain's tendinosis: A pilot study

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Objective: When therapy or injections in de Quervain's disease do not provide the desired outcome, surgical release of the first extensor compartment is usually performed to relieve complaints. Eccentric exercise training in chronic Achilles tendinopathy has shown to be effective. We hypothesized that this could also be true in de Quervain's disease, especially in the more chronic cases. Eccentric training increases tensile strength, normalizes disorganized fibers of the tendon, and neovascularization (which is possibly the cause of pain in chronic tendinopathies) disappears. The purpose of our study was to evaluate the results of an eccentric training program in chronic de Quervain's tendinosis.

Methods: We included patients with chronic de Quervain's tendinosis existing longer than 6 months with a hard thickening of the retinaculum and a minimum of five of seven criteria of De Quervain Screening Tool (DQST). The eccentric training program is combined with splint therapy (with a maximum of 50% wearing time during the day) and health education. Twenty-one patients were included, 1 male and 20 females, with an average age of 45.5 years (range 20–70). In this 12-week protocol, two eccentric exercises were being instructed and were performed 3 × 15 times, twice a day. Outcome measurements were

pain on a visual analogue scale (0–100), the functional questionnaire PRWHE (0–100), and the severity of de Quervain by DQST (0–7) at 4, 8, and 12 weeks. These values were at baseline: 63.1/6.7 for max/min pain (*SD* 20.0/16.7), mean PRWHE was 54.6 (*SD* 16), and mean DQST was 5.4 (*SD* 1.0). The mean duration of the follow-up was 9.5 months (range 4–24 months). For significance, a *p* value < .05 was used.

Results: The average VAS, PRWHE, and DQST decreased significantly 12 weeks after start of the program. The maximum and minimum VAS score decreased 39.8/6.2 points to 23.3/0.5 (*SD* 24.3/1.7), respectively, in 12 weeks (*p* < .001/.09). In 14 cases with a follow-up of 4–24 months, the VAS score improved further to 5.7/0.0 (*SD* 14.3/0.0), respectively. The mean PRWHE improved 40.3 points to 14.3 (*SD* 12.7) after 12 weeks of training (*p* = .01). Fourteen cases followed 4–24 months after training decreased slightly to 11.2 (*SD* 14.1). The mean DQST criteria improved from 5 to 2.5 (*SD* 1.6) out of 7 after 12 weeks (*p* < .001). The DQST of the seven cases with a follow up of 4–24 months was 1.6 (*SD* 1.6). Four patients had to stop the program at 2 and 4 weeks due to increased pain. Seventeen patients experienced such decrease in pain that surgery was not necessary.

Conclusions: The results of this paper indicate that eccentric training can be effective for a select group of patients with chronic de Quervain's disease. Because splinting and health education were also used in this pilot, it still remains unclear if eccentric training is the main contribution in the positive outcome. A prospective randomized controlled trial is warranted to answer the question whether eccentric training, splinting, health education or a combination of these three is beneficial in treatment of de Quervain's disease.

A-0459 Dorsal versus volar approach for proximal interphalangeal joint arthroplasty with a surface gliding implant

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Objective: For proximal interphalangeal (PIP) joint arthroplasty, the dorsal or volar approach can be used. There is only weak evidence supporting the superiority of each approach. The objective of this study was to analyse a case series of PIP arthroplasty patients with a single surface gliding implant applied by two surgeons with the dorsal versus volar approach.

Clinical and patient-reported outcome parameters were compared.

Methods: We collected data from our prospective registry, which included all patients treated with a CapFlex-PIP arthroplasty. We performed the dorsal approach according to Chamay and the volar approach as described by Simmen. Patients were assessed before surgery (i.e. baseline) and 1 year after surgery. Range of motion (ROM) was measured with a goniometer, and patients completed the brief Michigan Hand Questionnaire (briefMHQ). Differences between the outcomes at baseline and 1 year after the dorsal and volar approach interventions were analysed using the Wilcoxon rank-sum test.

Results: We included 79 patients (55 females and 24 males) with 80 PIP arthroplasties. Thirty-five patients were operated using the dorsal approach and 45 with the volar approach. One year after surgery, dorsal approach patients showed an active flexion of $63^\circ \pm 22^\circ$, while patients after the volar approach had a flexion of $77^\circ \pm 10^\circ$ ($p = .002$). Extension deficit was $10^\circ \pm 13^\circ$ and $20^\circ \pm 15^\circ$ for the dorsal and volar approach, respectively ($p = .001$). The total range of motion ($56^\circ \pm 23^\circ$ vs. $58^\circ \pm 17^\circ$; $p > .05$) was similar for both the groups. However, the briefMHQ score differed between the dorsal and the volar approach (63 ± 16 vs. 73 ± 17 , respectively; $p = .016$). Three patients showed a swan neck deformity after the dorsal approach, while this phenomenon was not seen in patients after the volar approach.

Conclusions: Our results indicate that the total range of motion is similar in PIP arthroplasty patients using the dorsal versus volar approach. The latter offers more 1-year postoperative flexion. In addition, there is no residual risk of developing swan-neck deformity with the volar approach of Simmen. Overall, the volar approach seems to offer better patient-reported outcome based on the briefMHQ, which suggests that better flexion leads to more functionality and provides some advantages in two component implant arthroplasty for the PIP joint. Ideally, these results need to be proven in a randomized controlled trial.

A-0463 The role of the central band of the interosseous ligaments in maintaining ulnar variance

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Introduction: Ulnar impaction syndrome is a degenerative wrist condition caused by increased loads of the ulnar head onto the carpal bones, resulting in painful degeneration of the triangular fibrocartilage complex and bony structures. Radiographic evaluation of these patients often reveals relative loss of radial height resulting in an ulnar positive wrist. We hypothesize that elongation of the central band of the forearm interosseous ligaments may change longitudinal radial-ulnar relationships, resulting in an ulnar positive wrist and therefore carpal abutment.

Materials and Methods: Six cadaveric, human forearms were used to measure the displacement experienced by the radius relative to the ulna during axial loading of the radius. Skin, muscles, tendons, vasculature, and nerves were discarded. The interosseous ligament complex, triangular fibrocartilage complex, distal and proximal radio-ulnar joints, and the elbow collateral ligaments were preserved. The humerus was cut mid-shaft, and the metacarpals were removed. The ulnar shaft was oriented vertically and rigidly fixed to an adjacent vertical beam. We applied axial loads onto the lunate fossa of the distal radius. Radial heights were measured in supination and pronation under a 5lbF preload. Gradual axial loads were applied up to 50lbF, and the resultant axial displacement was measured in supination and pronation. All measurements were evaluated with the interosseous ligament intact and repeated with the central band of the interosseous ligament cut while preserving all other components.

Results: Data showed that when the central band of the interosseous ligament was cut, the resulting ulnar variance increased by 3.02 ± 0.80 mm in supination and 2.15 ± 0.79 mm in pronation, under a 5 lbF preload. In supination, when the loads were increased from the 5 lbF preload to 50 lbF, ulnar variance further increased from 1.40 mm (intact central band) to 3.00 mm ($p \leq .001$) when the central band of the interosseous ligament was cut. In pronation, when the loads were further increased from the 5 lbF preload to 50 lbF, ulnar variance increased from 1.57 mm (intact central band) to 2.84 mm ($p \leq .001$) when the central band of the interosseous ligament was cut.

Conclusion: Excising the central band was used to simulate its clinical failure. Due to a parallelogram effect, the radius shifted proximally under a 5 lbF preload, creating an ulnar positive wrist relationship. Dynamic loading of the forearm after ligament excision resulted in significant additional radial

displacement relative to the intact forearm (increased ulnar variance), suggesting dynamic impaction often observed clinically.

A-0465 Wide-awake hand surgery

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Traditionally, tourniquet is utilized in hand surgery operations in order to achieve bloodless field which causes tourniquet pain after 20–30 min. Recently, the mixture of epinephrine and lidocaine is used for local anesthesia to get a bloodless field through vasoconstriction, which can eliminate the need for a tourniquet. We aimed to present our surgical procedure types and experience with wide-awake local anesthesia no tourniquet technique (WALANT). Between April 01, 2016, and November 20, 2016, 158 procedures in 147 patients were performed via WALANT. For local anesthesia, the mixture of 1% lidocaine and 1:100,000 epinephrine was prepared. In order to buffer the acidic pH of lidocaine, 1 mg of 8.4% bicarbonate was added for every 10 mg of lidocaine 1%. The infiltrative local anesthesia was performed 25 min before procedure to everywhere that will be dissected. The mean duration for surgery, the need for intraoperative sedation, and intraoperative patient cooperation were evaluated. Patients' fingers were observed for circulatory compromise 2 h postoperatively. The mean duration for surgery was 27 min. The mean age of the patients was 44.5. Any of the patients did not need intraoperative sedation, and intraoperative patient cooperation was excellent. Patients obeyed to orders of surgeon throughout the procedure (e.g. to hold the fingers during tendon surgery). No circulatory compromise was observed postoperatively. The procedures were as follows: release for carpal tunnel syndrome (14), ulnar digital nerve repair (1), tenolysis (4), tendon transfer or repair (17), benign tumor excision (32), local flaps application (10), phalanx fracture fixation (24), autograft harvest from olecranon (1), finger amputation (3), polydactyly ablation (1), implant or foreign material extraction (8), metacarpal fracture fixation (8), metacarpal boss resection (3), trigger finger release (28), nail matrix repair (2), and debridement for lateral epicondylitis (2). No tourniquet and no sedation increases patient comfort and cooperation. Rotation control after fracture fixation, tension adjustment during tendon procedures, or the

sufficiency of tenolysis are some of the intraoperative advantages of procedures done with WALANT. Because there is no need to sedation, the delay in surgery is decreased. On the other hand, outpatient procedures are cost effective. To compare WALANT with other local anesthesia techniques (e.g. Bier block) in regard to patient satisfaction and complications would be future research considerations.

A-0470 Scapholunate reconstruction: A biomechanical analysis of a novel technique

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Objective: We hypothesize that the biomechanical properties of the novel scapholunate (SL) reconstruction technique will not be significantly different than those of the dorsal portion of the native SL ligament.

Methods: Six matched pairs from male donors with an average age of 44.2 were used for this study. One limb from each pair was randomly assigned to be repaired; the contralateral limb was assigned to the control group. The reconstruction was performed using two 3.5 × 8.5 mm DX SwiveLock SL Suture Anchors, a 2-mm wide extensor carpi radialis brevis (ECRB) tendon autograft, and LabralTape Suture as an InternalBrace augmentation. The ECRB was whip stitched at both ends. Proper drill hole placement was confirmed using fluoroscopy, and a 3.5-mm drill bit was used. The SwiveLocks were inserted into the proximal pole of the scaphoid and the lunate. The strength of the repair was tested using an Instron to obtain linear stiffness (N/mm), linear load to failure (N), load to 3 mm displacement (N), and failure displacement (mm). The volar and central native ligaments were resected, leaving the dorsal component intact. The dorsal native ligament was subsequently tested and analyzed within the same parameters as the reconstruction.

Results: The load to failure for the native and the repair construct were 136.2 ± 42.6 N and 77.7 ± 48.1 N, respectively ($p = .049$). However, we reanalyzed the data excluding one specimen in which the SwiveLock was removed and repositioned in a new, adjacent drill hole. In this specimen, the bone surrounding the first drill hole fractured at only 15.57 N. When we reanalyzed the data excluding this sample, the load to failure was 90.1 ± 41.6 N, which was not significantly different than that of the native ligament ($p = .1$). The force to 3 mm gap formation was not

significantly different regardless of whether the outliers were included or excluded in analysis.

Conclusion: When excluding the specimen that contained two separate drill holes in the scaphoid, our data agrees with our original hypothesis that the described technique provides a strong construct to reconstruct the dorsal aspect of the SL ligament. SL ligament tears are the most common form of wrist injury. This novel treatment option provides surgeons with a reproducible alternative to reconstruct an injury to the dorsal component of the SL ligament. We caution against moving the SwiveLock to a new drill hole after placement, as it may compromise the integrity of the scaphoid.

Level of Evidence: Biomechanical study

A-0471 Terrible triad injury of the elbow: Clinical outcome of 29 patients

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Objective: Terrible triad injury represents a complex pattern of elbow instability that is associated with risk of persisting posterolateral instability, stiffness, and loss of elbow function. Restoration of the elbow stabilizers is essential to obtain a stable joint and allow early rehabilitation. The aim of this study was to evaluate the clinical outcome in a series of patients after treatment for terrible triad injury of the elbow.

Methods: Twenty-nine patients with terrible triad injury of the elbow were evaluated (19 men, 10 women; mean age, 47 years; range, 26-70 years). Twenty-three patients presented with type 1 coronoid fracture, 5 with type 2, and 1 with type 3 fracture, according to the Regan and Morrey classification. Twelve patients presented with Mason type II and 17 patients with Mason type III radial head fractures. In type 2 and 3, coronoid fractures fixation was achieved with a screw while in type 1 fractures with suture anchors. Radial head fractures were treated with osteosynthesis or arthroplasty. Lateral collateral ligaments were repaired with suture anchors. In 10 patients with persistent instability, the medial collateral ligament was also repaired. In no case a hinged external fixator was deemed necessary. All patients followed the same rehabilitation protocol that initiated within the first postoperative week, in a hinged elbow brace. Mean follow-up was 29 months (range, 24-40 months).

The elbow function was assessed evaluating elbow range of motion and Mayo Elbow Performance Score (MEPS). Imaging evaluation included assessment of arthritis and heterotopic ossification.

Results: At the last follow-up, mean extension was 9° and flexion 138°. The mean MEPS was 91.2 points, which corresponded to 70% excellent results, 21% good results, and 9% fair results. No patients underwent surgery for elbow stiffness. No patient developed posttraumatic arthritis. Two patients presented heterotopic ossification, however, with no functional deficit.

Conclusions: Radial head fixation or arthroplasty, coronoid fracture fixation, and repair of the lateral collateral ligament is the mainstay of treatment in terrible triad injury of the elbow. However, in cases of persistent instability, additional medial collateral ligament repair should be conducted. Optimal restoration of elbow stability combined with early mobilization is expected to achieve excellent or good functional outcome in most of cases, minimizing complication rates.

A-0472 Anatomic-topographic and arthroscopic correlation of landmarks and safe corridors in arthroscopic resection of dorsal and volar wrist ganglions

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Objective: The evolution in arthroscopic instrumentation, as well as a boom in the development of more refined techniques, has allowed the expansion of indications for therapeutic arthroscopy on the wrist. Despite the misgivings from many surgeons about performing the arthroscopic resection of dorsal and volar ganglions, the present work aims to help define in an objective manner the safe zones for this procedure using an arthroscopic-anatomical topographic correlation in cadaveric specimens.

Methods: We used four cadaveric specimens that were mounted in the laboratory for the arthroscopic procedure. In all specimens, the two authors established conventional portals (3-4R, 4-5, 1R, and 6R) previously described in the literature for the arthroscopic ganglion resection. We replicated the arthroscopic resection procedures for the two locations, followed by a detailed anatomic-topographic dissection demarcating the noble structures potentially at risk and establishing safe zones and safe distances. Arthroscopic parameters were also established to ensure the adequate resection margin, preventing injury to noble structures.

Results: We did not find damage to extensor tendons, flexors, median nerve, neurovascular bundles, or other structures after the anatomical-topographic dissection following the validated arthroscopic techniques.

Conclusions: The open and mini-incision techniques continue being the most used today for dorsal and volar ganglion resection in the wrist. These procedures involve extensive surgical dissection compared to the arthroscopic technique. Our detailed description, and the safe margins/anatomic landmarks proposed, here could be useful for the surgical hand community. The arthroscopic resection may be associated with shorter surgical time, a better postoperative period, better cosmetic results, and less surgical trauma in properly trained hands.

Level of evidence: Cadaveric topographic study

A-0476 Arthroscopic Repair of triangular fibrocartilage complex: Biomechanical comparison between the foveal and the conventional outside-in capsular repair for Atzei-EWAS Class 2 Tears

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Objective: To compare the biomechanical strength of the foveal repair (distal ulnar tunnel technique) and the traditional outside-in repair to the capsule in Atzei-EWAS Class 2 tears.

Methods: The distal ulna and the triangular fibrocartilage complex (TFCC) of eight matched pair cadaveric wrists were dissected. We created an Atzei-EWAS Class 2 tear in each specimen. In eight wrists, the tear was repaired with the conventional outside-in technique to the capsule with two 2-0 fiber wire vertical mattress stitches. In the other eight wrists, the tears were repaired by drilling a 3-mm tunnel at the distal ulna from the lateral cortex to the fovea. The 2-0 fiber wire sutures pierced through the superficial and Deep portions of the TFCC were recovered out through the tunnel on the lateral cortex. The TFCC was pulled back down to the fovea. The final fixation in this group was obtained by securing the sutures to the cortex with a small anchor coupled with a 3×8 mm interference screw in the tunnel after dialing proper suture tension. The strength of the repair was assessed with a Materials Testing Machine (MTS). The repairs were subjected to load until a 2-mm gap was created on the site of the repair and subsequently increased the load to produce failure. Load up to form a 2-mm gap, loading up to failure, and failure mechanism was obtained for each repair.

Results: The foveal repair was statistically stronger ($18 + 4$ N) than the capsular outside ($2.5 + 1$ N; $p <$

$.05$) for the 2-mm gap formation and load to failure ($82 + 2$ N and $51 + 5$ N respectively; $p < .05$). Loosening of the sutures was the mechanism of failure for both repairs.

Conclusions: The arthroscopic distal ulnar tunnel technique was stronger than the capsular outside-in biomechanically. Class 2 tears compromising both the superficial and deep portion commonly course with distal radio-ulnar joint (DRUJ) instability. A capsular repair may not be enough under these circumstances. The arthroscopic distal ulnar tunnel is a very reproducible technique, which allows repair of the superficial and distal portions of the TFCC back to the bone (original anatomical point) preventing DRUJ instability.

Level of evidence: Biomechanics study

A-0479 Fingertip replantation at the nail level using of arch elevation method

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Objective: Fingertip amputation at the nail level has many various methods of reconstruction and nowadays have better results with the development of micro-technique replantation. The venous drainage is important in many reports of success of the fingertip replantation, but at nail level amputation, artery anastomosis is one of the important factors which give better results. Therefore, the authors introduce the necessary elements of the successful fingertip replantation at nail level.

Method: Artery anastomosis with the arch elevation method was performed in 14 cases, and venous drainage was also performed by multifocal intermittent incision technique in 94 cases. We divided them into four majors for studying: artery anastomosis, venous drainage, bone fixation, and suture technique.

Result: Artery anastomosis with arch elevation method were confirmed successfully 12 of 14 cases. Venous drainage way with multifocal intermittent incision technique survived in 83 (88%) cases of 94 cases of patients.

Conclusion: Reducing tension of artery anastomosis at the nail level in fingertip replantation is important so that fracture should be fixed for reducing the gap as much as possible. And vessel shift with arch elevation may be used. Multifocal intermittent incision technique is one of the good venous drainage methods. After the nail bed is exactly sutured and does not remove the nail, which should be maintained as much as possible, you may prevent the deformation of the nail after surgery. The well implementation of these principles of fingertip replantation at the nail level is believed to be able to get a good result.

A-0487 Ulnar head arthroplasty, short- to long-term results

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Objective: Arthritic changes at the distal radioulnar joint (DRUJ) can lead to pain, worsening of grip strength, and function disability of the wrist. Resection of the distal ulna, among other reconstruction methods, has been used resulting in destabilizing the wrist as well as forearm. To restore stability and resist the pressure loads, ulna head arthroplasty (UHA) has been introduced. The purpose of this study is to report short to long term results using ulnar head replacement in treatment of painful disorders of the DRUJ.

Methods: Twenty-four ulnar head arthroplasties have been implanted from February 2005 to September 2016. u-Head Ulnar Head was used in 19 cases and Eclipse in 5. Of these, five u-Head Ulnar Head prosthesis and two Eclipse prosthesis of the DRUJ were combined with remotion total wrist arthroplasty (TWA) of the ipsilateral radiocarpal joint. Mean follow-up was 38.8 months (range -141 months). There were 9 men and 14 women (1 case was operated bilaterally) with mean age of 58 years (range 36-80 years). Rheumatoid arthritis was diagnosis in 4 cases, degenerative arthritis in 12, post-traumatic arthritis in 7, and Kienboeck in 1 case. Assessments of pain (VAS score) and satisfaction, range of motion (ROM), grip strength, and Dissabilities of the Arm, Shoulder and Hand (q - DASH) score were measured preoperatively and at the follow-up.

Results: No intraoperative complications have been recorded. Pain, grip strength, and the q-DASH values improved significantly ($p < .05$) after the treatment. The value of pain (mean) on the VAS score was 66/28 and Quick DASH value was 60/39, preoperatively and at the follow-up, respectively. The mean grip strength improved from 14 Kilogram Forces (KgF) preoperatively to 20 KgF, postoperatively. The postoperatively measured ROM in degrees improved, some significantly: extension (mean) was 35 (36), flexion was 40 (34), ulnar flexion was 20 (26), radial flexion was 11 (7), pronation was 73 (74), and supination was 70 (71) preoperatively and at the follow-up, respectively. Overall implant survival over the observation time was 87.5%. One of the implants has been revised due to infection, one revision was caused by painful instability, and One due to pain. One case was revised due to ectopic bone formation and joint stiffness development, reoccurred 1 year after revision surgery. Eighteen patients of 24 were very satisfied or satisfied at the follow-up.

Conclusions: Ulnar head arthroplasty showed significant improvements in pain, grip strength, and the function at the short- to long-term follow-up. The treatment by UHA had minor clinical implication on the patient's wrists range of motion. The implant survival over the time was acceptable.

A-0488 Outcome of conservative treatment for carpometacarpal osteoarthritis: A prospective cohort study

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Objective: Most treatment guidelines for carpometacarpal (CMC) osteoarthritis (OA) advise patients to start with conservative treatment before electing surgery. However, it is unknown how many patients respond well to conservative treatment, how many patients eventually undergo surgical treatment, and at what time after start of treatment. Therefore, the aim of this study is to describe outcome of conservative treatment for thumb CMC OA and to identify when and how many patients need additional surgical treatment.

Methods: In this prospective cohort study, 809 patients who received conservative treatment between 2011 and 2014 were included. Conservative treatment consisted of splinting and two sessions of hand therapy per week. Pain, function, and satisfaction were measured with Visual Analogue Scale (VAS) and Michigan Hand Questionnaire (MHQ) and recorded at baseline, 6 weeks, 3 months, and 12 months. After multiple imputation for missing values, outcome was compared with baseline values using analysis of variance and post hoc tests. Subgroup analysis was performed based on baseline pain levels. In addition, all subsequent surgeries in this population between 2012 and 2016 were recorded, and time until surgical treatment was scored.

Results: Pain improved significantly from 49 ± 21 (mean \pm SD) at baseline to 40 ± 21 at 12 months. Function improved significantly from 64 ± 14 to 72 ± 10 at 12 months. Satisfaction with their hand (VAS) significantly improved from 41 ± 22 to 58 ± 23 at 12 months. Post hoc tests showed that improvements in pain, function, and satisfaction were only significant between baseline and 6 weeks and stabilized until 1

year after start of treatment. When categorizing patients based on baseline score, pain only improved significantly in groups where pain at baseline was scored higher than 45 points. After a mean follow-up of 2.2 ± 0.9 years, 124 (15%) patients were surgically treated. The majority (75%) of these operated patients were operated within the first year after start of conservative treatment, and the median number of days until surgery was 160 (IQR 40–280) days.

Conclusions: Conservative treatment of CMC OA significantly reduces pain, function, and satisfaction. Most improvement was seen in the first 6 weeks and stabilized 1 year after treatment. Subgroup analysis showed that patients with high baseline pain levels significantly improved, while patients with low baseline pain levels significantly worsened at 12 months after conservative treatment. After a mean follow-up duration of 2.2 years, 15% patients underwent surgical treatment.

A-0489 Predicting outcome after conservative treatment for carpometacarpal osteoarthritis: A prospective study

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Objective: It is unknown which patients respond well to conservative treatment of carpometacarpal (CMC) osteoarthritis (OA), which patients may benefit more from early surgery, and which patients who initially received conservative treatment eventually end up with surgery. Therefore, the aim of this study is (1) to identify predictive factors for outcome of conservative treatment and for conversion to surgical treatment, and (2) to measure how many patients that did not improve in pain within 6 weeks after start of treatment, will eventually improve after 3 months.

Methods: In this prospective cohort study, 809 patients who received conservative treatment between 2011 and 2014 were included. Conservative treatment consisted of splinting and two sessions of hand therapy per week for 12 weeks. Outcome in pain and function were measured with visual analogue scale (VAS) and Michigan Hand Questionnaire (MHQ) and recorded at baseline, 6 weeks, and 3 months. Patient demographics and pretreatment baseline

outcome scores were considered as predictors for pain, function after 3 months, and conversion to surgery. In addition, we performed a sensitivity analysis for outcome pain (VAS) and function (MHQ) to test how often clinically relevant improvement occurs after 3 months when there was no clinically relevant improvement after 6 weeks.

Results: Univariate analysis showed that pretreatment baseline scores, sex, age, workload, and treated hand side correlated with outcome. For change in pain after 3 months (VAS), the multivariable regression model explained 33% of the variance in outcome ($p < .001$), with pain at baseline as significant predictor. For change in MHQ after 3 months, the multivariable regression analysis model explained 41% of the variance in outcome ($p < .001$), with MHQ at baseline and satisfaction with hand function at baseline as significant predictors. For receiving surgery, Cox regression analysis resulted in two significant predictors: MHQ at baseline and pain during last week at baseline. Sensitivity analysis yielded a 76% negative predictive value for pain, and 77% negative predictive value for MHQ, meaning that when a patient did not improve clinically relevant in the first 6 weeks, and the chance that the patient will not improve after 3 months as well is 76% and 77%, respectively.

Conclusion: In this study, we found that prognostic factors could be identified to predict pain, function, satisfaction, and conversion to surgery after conservative treatment. Multivariable regression models yielded explained variances between 31% and 42% for pain and function with pretreatment scores as most important predictors. Sensitivity analysis showed that in 76%–77% of the time, we can identify patients who will not benefit from conservative treatment after the initial 6 weeks. Further research should focus more on other factors influencing outcome, such as depression, attribution, and coping mechanisms.

A-0492 Platelet-rich plasma to improve the prognosis of medium nerve neurolysis in severe and very severe carpal tunnel syndrome

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Introduction: Platelet-rich plasma (PRP) is a potential treatment for patients with different types of musculoskeletal disorders. Although recent studies

have demonstrated the beneficial effect of PRP for the regeneration of peripheral neuropathy in animals, its evaluation in humans is scarce. We propose a prospective study of the effect of PRP on severe and very severe carpal tunnel syndrome (CTS), a pathology with a more limited recovery prognosis.

Objectives: To quantify the clinical, ultrasound, and neurophysiological effects of the addition of, autologous and previously activated, 3 cm³ of PRP on the median nerve released by surgical neurolysis.

Materials and Method: Prospective, experimental study including 30 patients with severe and very severe CTS, compared to simple median neurolysis. Local addition to the median nerve of 3 cm³ of PRP previously activated, during surgical neurolysis, after opening of the annular carpal ligament. They were immobilized with an elastic bandage for 2 weeks. Primary outcomes: pain and paresthesias (Boston test). Secondary outcome measures: Durkan, Phalen, Tinel test, gripper and clamp strength (Jamar dynamometer); cross-sectional area, perimeter, and vascularization of the median nerve (ultrasound); motor and sensory electrophysiological study.

Results: Valuation at 6 months. Outcomes with PRP: 100% of patients refer to clear improvement in their symptomatology (EVA, Boston test); 37% have occasional residual paresthesias in the third and fourth fingerpost; the pain disappears in all cases; progressive improvement in the grip and clamp force was observed, surpassing in 67% the contralateral side; the magnification of the tunnel perimeter as well as its diameter and the reduction in the vascularization before the tunnel are statistically significant; EMG also quantifies a significant improvement in latency, amplitude, and conduction velocity.

Conclusion: PRP provides the structural support necessary for cell migration, proliferation, and three-dimensional growth of the tissues on which it acts. At the level of the peripheral nerve, PRP accelerates and improves the functional outcome in the most complex cases of compressive neuropathy.

A-0495 Does ulnar nerve transposition improve neurolysis outcomes?

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Introduction: The surgical treatment of the ulnar compressive syndrome tries to avoid the persistence of its symptomatology and, above all, the progression of the neurological deterioration. Its principles should be to release all points of possible compression, to

preserve the vascularization of the nerve at the level of the cubital tunnel, and to promote its early mobilization. Hence the controversy between the different surgical procedures.

Objectives: To compare the clinical and functional results of the two main techniques: neurolysis with or without anterior subcutaneous transposition.

Materials and Method: Prospective study of the compressive lesions of the ulnar nerve as it passes through the cubital tunnel. Comparison of cases in which neurolysis is performed as a simple surgical gesture, with the addition of anterior subcutaneous transposition. Preoperatively, patients were classified according to McGowan, clinical evaluation (paresthesia, pain), sensitivity (2-point discrimination test TPD and Tinel test), and motor function (Wartenberg, Froment, first dorsal interosseus muscle atrophy, and ulnar claw). The degree of lesion was assessed by electromyography.

Results: 100% of the patients recognized an improvement in their symptoms, with an excellent modified Wilson and Knout score in 42% (33% in neurolysis and 44% in transpositions). The improvement correlates with the initial injury. No statistically significant differences were found in pain or paresthesias, between the two surgical techniques, nor in motor exploration. There is an improvement on the Tinel test in the transpositions. There are no cases of ulnar claw in the postoperative period. The TPD does not improve of 10 mm in any patient in the distal ulnar dermatoma.

Conclusion: Both surgical techniques are effective, safe, and comparable for the improvement in clinical results. In order to do so, the indication depends on the patient's history, verifying that if it transposes, the quality of the subcutaneous tissue is assured in the absence of microvascular lesion or previous fractures that modify the anatomy.

A-0499 Evaluation of vitamin D receptor in subsynovial connective tissue of carpal tunnel syndrome

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Studies suggest that the pathophysiology of carpal tunnel syndrome (CTS) is associated with pathologic changes in the vascularity and physical properties of the subsynovial connective tissue (SSCT) in the carpal tunnel. In this study, we aimed to evaluate whether vitamin D receptor (VDR) is present in the SSCT

endothelial cells in patients with CTS and whether its expression is associated with clinical features of CTS. We obtained specimens of SSCT from 54 patients with CTS during open carpal tunnel release, and stained VDR in the SSCT endothelial cells using immunohistochemistry. We evaluated correlation of VDR expression with clinical variables such as serum vitamin D level, age, body mass index and symptom duration, and electrophysiologic severity in terms of motor conduction velocity and distal motor latency. Diverse expression of VDR was observed in endothelial vessels of SSCT. VDR expression was found to be significantly correlated with age, symptom duration, and distal motor latency but not with other variables. This study found that VDR exists in the endothelial cells of the SSCT in patients with CTS. The association of a higher VDR expression with age, symptom duration, and electrophysiologic severity of the disease suggests that VDR may be upregulated and contribute to disease progression by provoking angiogenesis. Further studies are necessary to confirm the role of vitamin D and VDR in patients with CTS and to determine whether vitamin D supplementation could be helpful for prevention and treatment of CTS.

A-0500 Retrospective study of management and outcomes of bite injuries to the hand

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Introduction: Human or animal bite injuries to the hand are regularly seen in A&E, and historically high infection rates have been perceived after these injuries. Antibiotic cover and lavage \pm debridement form the basis of initially management of these injuries, usually initiated in the A&E setting. The severity of this type of injury is broad, ranging from minimal soft tissue disruption with contamination through to large soft tissue defects with involvement of other structures such as tendon or bone. This study observed the current management of these injuries from presentation with the main outcome being whether infection developed.

Methods: Consecutive patients with bite injuries to the hand attending an A&E unit in a UK teaching hospital from January to June 2016 were investigated. Patients only resident to the hospital catchment area were included. Demographics, time to presentation, type of bite and location, number of puncture wounds/lacerations, other structures involved, management, and outcomes were recorded.

Soft tissue injury was quantified by cumulative length of lacerations (puncture wounds were given a nominal value of 2 mm)

Results: In all, 123 patients provided 125 individual cases. Age range 14–80 years (mean of 43 years) 70 cases were treated in A&E and discharged, 55 were admitted to hospital. Overall, the majority presented within 12 h of injury, and 64% of cases were dog bites. Number of punctures/lacerations: mean = 1.7 (range 1–5). Average cumulative length of wounds = 1.2 cm (range 0.2–7.0). A&E treatment only group ($n = 70$): average number of punctures/lacerations = 1.5; average total length of wounds = 1 cm; 70% received both Abx and lavage; no patients returned with infection as a problem. Admission group with isolated soft tissue injury only ($n = 28$):

26 went to theater and 2 treated with antibiotics; number of punctures/lacerations: mean = 2.3; average cumulative length of wounds = 1.5 cm, Admission group with soft tissue injury plus additional structure injury, for example, bone ($n = 27$): All patients went to theater; number of punctures/lacerations: mean = 1.8; and average cumulative length of wounds = 1.4 cm.

Conclusion: The study demonstrated that bite injuries to the hand causing a soft tissue defect only can be safely managed solely by treatment in A&E, provided adequate treatment is given. None of our study patients in the “A&E only” group returned with infection. This group was very similar in terms of severity of injury and time to presentation as the patients admitted into hospital with purely a soft tissue defect. The majority of this group could have potentially been treated safely in the A&E department only. All patients in the third group had damage to other structures such as bone or tendon and were therefore correctly managed with assessment and treatment in theater. This study highlights that bite injuries causing soft tissue damage are not necessarily associated with high infection rates provided adequate care in A&E is provided and many patients may be going to theatre unnecessarily, impacting on costs, and resources in hospital.

A-0503 3D printing for planning of paediatric upper limb corrective osteotomy

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Objective: To describe results for paediatric patients with forearm and elbow deformity and motion block receiving osteotomies planned using three-dimensional (3D) printing.

Method: Computed tomography scans of both normal and malunited forearms and/or elbows were obtained. 3D printed PLA models of the malunited

side and mirrored normal were generated in our department. After articulation of the models, trial osteotomies in plasticus were made to verify satisfactory correction of rotation block. Surgery was then performed to make the planned corrective osteotomies using standard surgical techniques with no resort to custom jigs.

Results: We describe six cases of paediatric upper limb deformity with motion block following fracture malunion corrected with 3D printed planning. Three had an isolated forearm rotation block which was improved by an average arc of 36.7°, and two had elbow motion block which was improved by an average arc of 45°. One patient who had multiple operations on a complex Monteggia injury with a combined forearm rotation, and extension block did not receive satisfactory resolution.

Conclusion: Having the ability to assess 3D printed models of abnormal and mirrored normal anatomy does assist a surgeon's ability to predict how an osteotomy will behave for correction of paediatric rotation block due to forearm and elbow malunion. The information gained by having an articulated model and the ability to do surgery in plasticus gave surgeons significantly more information quickly on where rotation block was occurring and how to correct it than use of virtual 3D modelling with a medical CAD engineer. An additional advantage is the ability to use standard surgical techniques with no reliance on custom jigs and associated extra soft tissue stripping required for these jigs.

A-0504 Orthopaedic 3D printing on a budget

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Objective: To describe a low-cost, rapid-turnaround workflow to provide 3D printing to orthopaedic departments.

Method: To develop a low-cost, rapid-turnaround three-dimensional (3D) printing workflow, a budget commercial 3D printer was acquired 2 years ago. Open source and low cost modelling software was used throughout the project.

Results: 3D printing for surgical planning is available to our orthopaedic department at a low cost with turnaround typically under 24 h. Costs are modest: 3D PLA printer ~ €1,000–1,400, workflow software ~ €0–150, marginal material cost per upper limb model ~ €3–8. Modelling time to achieve a printable model from a raw computed tomography scan varies

from 4 to 12 min. Models of fractures or malunions, as well as mirrored contralateral anatomy normal, can be produced in under 24 h and assist in surgeon understanding of 3D deformity and correction.

Conclusion: It is possible to develop a low-cost 3D printing workflow on a modest budget to help with pre-operative planning. We will describe our workflow steps and open source/low cost software packages that can be used. The information gained by having a 3D printed model and the ability to conduct surgery in plasticus gives surgeons significantly more information more quickly than use of virtual computer 3D modelling with a medical CAD engineer. It does need to be stressed that having a suitably interested person to drive the 3D modelling and printing process is more important than the capital cost of the printer.

A-0508 Radial shaft fracture obliquity is a predictor of distal radioulnar joint instability

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Purpose: We assessed the utility of using radial shaft fracture obliquity measurements on radiographs as a predictor of distal radio-ulnar joint (DRUJ) instability. We also clinically validated previously described predictors of DRUJ instability which included fracture line within 7.5 cm of the lunate fossa, radial shortening >5 mm, and ulna styloid fracture.

Methods: We retrospectively analyzed the radiographs of all surgically managed patients in our unit with radial shaft fractures from 2006 to 2016. The degree of obliquity was analyzed on the basis of the maximum fracture-line angle in either the coronal or the sagittal plane. Patient demographics, mechanism of injury, and other radiological parameters were also analyzed.

Results: A radial shaft fracture obliquity >30° is associated with DRUJ instability, $p = .001$. Radial fracture shaft obliquity >30° was the most sensitive radiological parameter for predicting DRUJ instability, 76.1%. Previously described radiological parameters were found to be clinically significant for predicting DRUJ instability but were of moderate sensitivity.

Conclusion: Oblique radial shaft fractures appear to be associated with increased incidence of DRUJ instability. This new radiologic parameter may be used in combination with preexisting parameters in predicting DRUJ instability prior to surgery.

A-0513 Fixation of closed proximal phalangeal fractures

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Specific Aims and Objectives: Early studies on fixation of closed fractures in the hand using lag screws (S) and/or plates (P) showed excellent outcomes (Dabezies, 1986; Bosch, 1993; and Pun, 1991). However later studies which included compound fractures showed high levels of complications (Stern, 1998). Studies included low numbers of phalangeal fractures and combined these with metacarpal fractures, with a lack of differentiation between screws and plate fixation. The aim of this study was to review and compare the outcomes of closed proximal phalangeal fractures fixed with contemporary hand specific screws and/or plates.

Methods: Adult patients with closed proximal phalangeal fractures treated with screw or plate fixation, with a minimum follow-up of 1 year, were reviewed. The primary outcome was PIPJ arc of motion. Secondary outcomes were total active motion (TAM), grip strength, the Patient Evaluation Measure (PEM), Quick-DASH (Disabilities of Arm, Shoulder and Hand) Questionnaire, and Patient-Rated Wrist Hand Evaluation (PRWHE). Complications were recorded.

Results: A total of 100 patients have been reviewed with 103 digits (S: 56, P: 47). A sample size of 114 digits is required to provide sufficient power to determine a significant difference between the two groups. Data collection is ongoing and will be completed before the presentation date. So far, the primary outcome of PIPJ arc of motion averages 80° and 76° in the screw and plate group, respectively. TAM was 227° and 222° for the screw and plate groups, respectively. In the screw group, 57% of digits had good/excellent results for TAM; in the plate group, 58% had good/excellent results for TAM. Subjective outcome measures revealed no difference in PRWE and PEM but a small statistically significant difference in the Q-DASH score (S:P) Q-DASH: 6.4:12.9, PRWHE 11.3:13.9, and PEM 83%:83%. No infections were reported, and the number of metalware removals was S: 4 and P: 6.

Discussion: This study compared outcomes of lag screw with plate fixation of proximal phalangeal fractures. Excluding compound injuries allowed for a specific evaluation of implant related effects on the outcomes. The overall good objective and subjective outcomes may not be transferable to compound fractures, and this will require further studies.

A-0520 Preoperative planning of ulnar artery perforators using colour Doppler ultrasonography

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The radial artery perforator (RAP) flap can be raised and rotated to reconstruct soft tissue defects around the hand and wrist. As with the RAP, the ulnar artery perforator (UAP) flap is a well-known and useful flap for covering defects on the ulnar side of the hand and wrist; however, no anatomical report is available on the study of UAP using colour Doppler ultrasonography (US). The purpose of this anatomical study was to investigate the number, location and direction of the UAP using colour Doppler US. Forty forearms of 20 healthy volunteers (10 females and 10 males, mean age 25.6 years, range 24–29 years) were examined. We used colour Doppler US (Venue40; GE Healthcare Japan Corporation, Tokyo, Japan) with a high-frequency transducer. The transducer was placed on the volar side of the wrists axially (short-axial view). The ulnar artery was detected first around the pisiform, and the transducer was then slowly moved from the distal to the proximal side. The ulnar artery was traced 100 mm from the proximal pisiform. The total number of UAPs in each arm was recorded. The origins of the perforators arising from the ulnar artery were also identified in short-axial views. The distances between the origin and the pisiform were recorded. The origin was divided into four areas: the radial, ulnar, superficial, and deep aspects of the ulnar artery. A Mann-Whitney *U* test was employed to assess statistically significant differences, and a *p* value of <.05 was considered statistically significant. In total, there were 205 perforators arising from the ulnar artery, with an average of five perforators per forearm. Fifty perforators were detected in right forearms and 51 perforators were in left forearms (not significant). Regarding the perforator location, 58 (28%) were located 0–20 mm from the proximal pisiform, 39 (19%) were 21–40 mm, 36 (18%) were 41–60 mm, 42 (20%) were 61–80 mm, and 30 (15%) were 81–100 mm. Origins based on axial views, we identified that 44 (21%) perforators were located in the radial aspect of the ulnar artery, 64 (31%) in the ulnar aspect, 32 (16%) in the superficial aspect, and 65 (32%) in the deep aspect. About half of the perforators (*n* = 97, 47%) were located within 40 mm proximity of the proximal pisiform, of which most (*n* = 80, 82%) were located in the ulnar and deep aspect of the

ulnar artery, which is important for nourishing and elevating the UAP flap. This study demonstrated that there were many UAPs within 40 mm proximity of the proximal pisiform and in the ulnar and deep aspect of the ulnar artery. This noninvasive, convenient and real-time technique using colour Doppler US could be useful for preoperative planning and for reliably elevating UAP flaps.

A-0521 Learning curve analysis of trainee hand surgeons for endoscopic carpal tunnel release in a single unit

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Objective: Endoscopic carpal tunnel release (ECTR) is a well-established technique. There is however still great controversy about its safety in comparison to open surgery. This led us to a critical analysis from a trainee's perspective. Our study assessed the ECTR learning curve of junior hand surgeons in a Swiss regional hospital and evaluates its safety.

Methods: A retrospective learning curve analysis for our three trainees during their first year in hand surgery was carried out (combined $n = 228$ ECTRs with a cutoff at 60 per surgeon – all performed in intravenous regional anesthesia; first trainee $n = 63$, second $n = 94$, and third $n = 71$). The patients were grouped into the first (Group 1) and second 30 (Group 2) consecutive cases. For the first 30 cases, the trainee received scrubbed support by the designated consultant trainer. Subsequent case assistance was provided by a final year medical student or nonhand surgery junior with the trainer remaining unscrubbed but in reach. Operating time, intraoperative complications with the need for conversion to open surgery, and postoperative complications (nerve lesion, significant hematoma, and infection) were assessed. Patients and their satisfaction with the procedure were assessed postoperatively at day 3 and at week 6–8. The trainees' satisfaction and feedback was assessed at the respective exit interviews.

Results: A major reduction in operating time was noted between Groups 1 and 2. There was no patient ($n = 0$) with intraoperative complications and subsequent need for an open conversion. No postoperative complications occurred. Patient satisfaction with the procedure being performed by a trainee scored highly.

Conclusions: Endoscopic carpal tunnel release performed by trainee surgeons supervised by a consultant trainer is a safe technique. The learning curve is steep as demonstrated by the reduction in operating time. Junior hand surgeons were thus able to gain

valuable operating experience. The high incidence of carpal tunnel syndrome ensures that there are sufficient cases to grow confidence and competence. In the current climate of ever increasing health resource constraints, as well as limitations in working and training time, ECTR in our unit (as well as the open approach in wide awake technique) proved to be a very useful and safe method to teach young colleagues hand surgery fundamentals.

Keywords: endoscopic carpal tunnel release, learning curve, trainee hand surgeons

A-0527 3D preoperative planning and patient-specific instrumentation for treatment of intra-articular malunions of the distal radius

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Objective: Posttraumatic bone deformity of the distal radius may lead to reduced range of motion, joint instability, pain, and in case of intra-articular involvement to degenerative arthritis justifying corrective osteotomies to restore normal anatomy and function as close as possible. We present our experience with a three-dimensional (3D) planning tool and 3D printed patient-specific bone surface contact drilling and sawing guides used for corrective osteotomies of the forearm bones.

Methods: From 2008 to 2015, 30 patients were treated with intraarticular corrective osteotomies (in 17 patients combined intra- and extraarticular osteotomies with up to 3 independent parts). Eighteen patients were male, mean age was 49 years, range 26–66 years, *SD* 10.4 years. All patients had a minimal follow-up control after 1 year. Preoperatively, a computed tomography scan of the malunited and the contralateral bone was performed. 3D model generation was performed with a commercial segmentation software. Analysis of malposition and OP planning was performed with the in-house developed software CASPA (Balgrist CARD AG, Zurich Switzerland). The program features include automatic volumetric fitting (overlay of mirrored bone areas on malunited bone), quantification of malposition, calculation of the optimal rotation axis / single, and multiple plane cut and the complete construction of individualized bone surface contact drilling and sawing guides (MyOsteotomy, Medacta SA, Castel San Pietro Switzerland). The osteotomies were performed in an outside-in technique with serial drill holes along the cutting planes which were connected finally with a chisel usually leaving the joint capsule intact.

Results: All osteotomies consolidated. After 1 year, 16 had no pain, 9 had slight pain during heavy work, and 4 had still moderate pain with no improvement compared to the preoperative situation although joint kinematic and range of motion improved. One of them needed a secondary STT fusion. The residual error of the osteotomy was calculated from the 2 months postoperative CT scan. Intra-articular fragments were corrected to a residual error of 2°–6° and steps were decreased to 0–0.8 mm. There was no infection so far.

Conclusion: The technology can improve precision not only by enabling the surgeon to quantify deformities and to simulate the intervention preoperatively in 3D but also by generating a surgical plan of the required correction. The short time promising results concerning accuracy, feasibility of complex intra-articular cases, and patient satisfaction justifies the preoperative extra expense of time and effort.

A-0528 Factors affecting composite graft outcomes in digital tip amputation

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Hypothesis: Fingertip amputations are the most common type of upper extremity amputation injuries, and multiple treatment options have been described. When an amputated tip is too distal for microvascular replantation or vessels are severely injured, a composite graft can be a treatment option. Few studies have reported outcomes using composite grafts. We report the outcomes and factors affecting graft outcomes in digital tip amputations to determine the efficacy of this treatment modality and present evidence for its use.

Methods: In a retrospective study, we analyzed 7 years of surgical data for 168 digital amputations in 163 patients. Patients with at least 12 months of follow-up were included and other combined injuries of the same hand were excluded. Age, level (tip, tip to mid-nail, mid-nail to nail fold, and nail fold to distal phalanx) and pattern of injury (transverse, volar oblique, and dorsal oblique), bony injury (presence of fractures), injury type (crush or guillotine), smoking, and outcomes were reviewed. Outcomes were determined after follow-up examination by the authors and were divided into four groups: complete survival (grade 4), partial survival and healed by secondary intention within 6 weeks (grade 3), partial flap survival and healed with surgical management or resulting complications (grade 2), and total flap loss (1). Statistical analysis was performed for the injury category and overall final grade.

Results: Of the 168 amputated digits, 33.93% showed complete survival. Partial survival (groups 3 and 2) occurred in 35.12% and 26.8%, respectively. Only 4.17% resulted in total necrosis. Total necrosis was treated with stump revision (2 patients), reverse island flap coverage (3 patients), and V-Y advancement flap coverage (2 patients). Of 45 grade 2 patients, 7 were treated with skin grafting, 4 with reverse island flap coverage, and 3 with V-Y advancement flap coverage and stump revision. Five patients healed only with surgical debridement, and others healed with secondary intention after a few months. Seven patients developed a nail deformity and five had sensory difficulty. Age, injury type, injury level, and bony involvement were statistically correlated with outcomes ($p < .05$). Logistic regression analysis showed that age, injury type, injury level, smoking, and bony involvement were associated with complete graft survival. Young and nonsmoking patients with a distal injury and no bony involvement had uncomplicated graft healing.

Conclusions: Survival rates were increased in young, nonsmoking patients with a clean cut, lack of bony involvement, and a more distal injury. Even when partial necrosis occurred, the graft acted as a biological dressing with minimal risk until subsequent treatment was performed. However, old age and history of smoking, amputation more proximal than mid-nail, and stump involving a fracture led to a low graft survival rate and healing with complications such as sensory difficulty or nail deformity. Survival rates may improve if certain criteria are met to qualify for a composite tissue graft, which could be an alternative treatment option for selected patients.

A-0530 Arthroscopic CM arthroplasty with suture-button suspensionplasty: Short-term follow-up

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Objective: Surgical techniques for CM arthroplasty has developed such as arthroscopic hemitrapziectomy with Tight Rope (TR) suspension method recently. The aim of current study is to introduce our surgical technique and evaluate the results.

Methods: Our technique is shaving only subchondral trapezium and beak osteophyte completely in order to medialization for first metacarpus. TR is inserted from first metacarpal base just volar APL attachment to second metacarpus. Seventeen cases included 2 male, and 15 female were operated arthroscopic

hemitrapeziectomy with Tight Rope suspension method. Averaged age was 60.8 years, and mean follow-up period was 7.4 months. Palmar abduction angle and radial abduction compared to contralateral side before operation and after operation, respectively. Visual analogue score (VAS), pulp pinch power, and DASH score were evaluated 3 months after operation and 6 months after operation, respectively, regarding clinical evaluation. Trajectory (distance between proximal joint space to TR insertion point divides length of second metacarpus) and subluxation between metacarpal base and trapezium edge on lateral XP regarding XP evaluation.

Results: Postoperative palmar abduction and radial abduction were 91.5% and 93.5%, respectively. Preoperative, 3 months after operation, and 6 months after operation of VAS were 72.2 ± 20.5 , 19.3 ± 15.7 ($p < .05$), 14.3 ± 18.0 ($p < .05$), respectively. Preoperative, 3 months after operation, and 6 months after operation of Pulp Pinch (kg) were 3.1 ± 1.7 , 3.6 ± 1.1 ($p = .41$) 4.0 ± 1.3 ($p = .15$), respectively. Preoperative, 3 months after operation, and 6 months after operation of DASH Score were 40.1 ± 18.8 , 27.7 ± 21.6 ($p = .12$), 21.2 ± 27.2 ($p < .05$), respectively. Trajectory was 0.35 ± 0.08 . Preoperative, 3 months after operation, and 6 months after operation of subluxation (mm) were 2.19 ± 0.74 , 3.60 ± 1.82 ($p < .05$), and 4.79 ± 2.27 ($p < .05$), respectively. Although there was no correlation between trajectory and postoperative ROM ($r = .28$), there were weak negative correlation between trajectory and V.A.S. ($r = .39$).

Conclusion: This method may change the axis of thumb rotation and make suspension effect for CM joint. There was no correlation between trajectory and postoperative ROM under 1/2 of metacarpus. There was weak negative correlation between trajectory and VAS in spite of short-term follow-up.

A-0531 Intracapsular course of the posterior interosseous nerve and the distribution of its terminal fibers within the dorsal capsule

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Purpose: The posterior interosseous nerve (PIN) has been shown to innervate the central two-thirds of the posterior wrist joint capsule, including the radiocarpal joint, ending with mechanoreceptors responsible for proprioception. The aim of this study was to analyze the intracapsular course of the PIN via means of

microscopic dissection, to describe the distribution of PIN terminal branches to mechanoreceptors within the entire dorsal capsule, and to develop a clinically useful classification of the intracapsular course of the PIN.

Material and Methods: Sixty dorsal wrist capsules (50 male and 10 female) with a 1cm of PIN trunk before penetration of the capsule were harvested from 30 fresh cadavers within 12 hours of death. The material was divided into 2 parts: 30 capsules were stained using Sihler's nerve staining technique. This was followed by dissection of the entire PIN trunk within the dorsal capsule under 8–16 \times magnification. The PIN lateral and terminal branches were mapped and classified. Second group of 30 capsules were appropriately prepared and immunostained in order to analyze the distribution of PIN terminal branches to mechanoreceptors and create a 3D spatial map of terminal branches distribution. Appropriate statistical tests were employed to analyze the data.

Results: We will present the intracapsular course of the PIN with its lateral and terminal branches.

Conclusion: The presented classification and 3D spatial map of the distribution of PIN terminal branches will allow for better understanding of PIN contribution in wrist innervation and proprioception.

A-0533 The postoperative dressing regime in pediatric hand surgery

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Objective: In order to obtain a safe and less painful postoperative dressing regime without frequent dressing changes, we compared two different regimes after elective pediatric hand surgery. The first dressing regime consisted of frequent dressing changes after 2 weeks (STD) and the second regime consisted of a long-term dressing regime (LTD) of 6 weeks without dressing changes.

Methods: Clinical data of children undergoing elective hand surgery followed by immobilization (desyndactylization, correction osteotomy, pollicisation, opposition plasty, and ray amputation) in the period 2002–2015 were retrospectively collected from our hospital database. Children were divided in two groups: (1) The STD group, who received the dressing for 2 weeks, followed by daily dressing changes by the parents; (2) The LTD group received the dressing for 6 weeks, and the dressing was removed at the outpatient clinic after this period. The groups were compared based on the number and type of adverse events, the number of postoperative hospital visits,

and the type of treatment after an adverse event. A chi-squared test was conducted and a P value of $<.05$ was considered significant.

Results: The STD group consisted of 191 hands, and the LTD group consisted of 212 hands. Types of surgery were comparable between both the groups. No difference in adverse events were seen between the two groups (STD = 66 vs. LTD = 43, $p = .289$). However, in the STD group, 27 infections were reported in contrast to no infections in the LTD group. No difference in unplanned hospital visits was observed between the two groups (STD = 52 vs. LTD = 42, $p = .936$). Antibiotics were prescribed 25 times in the STD group, although not all prescriptions were related to infections of the hand. No prescriptions for antibiotics were observed in the LTD group. Reoperation as a result of an adverse event was reported 6 times in the STD group and 4 times in the LTD group.

Conclusions: This study shows that LTD in elective pediatric hand surgery is a safe dressing regime without more risk on adverse events or unplanned hospital visits. Against our own expectations, more infections were reported in the STD group, with a higher rate of prescribed antibiotics. Advantage of LTD is the avoidance of frequent dressing changes, which can be painful and stressful for child and parent affecting the bonding between them.

A-0535 Foot function in children with preaxial polydactyly of the foot compared to age- and sex-matched healthy controls

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Objective: Congenital hand surgeons are frequently confronted with the challenges of congenital foot surgery, because these malformations are often seen in combination with each other. Treatment of preaxial polydactyly of the foot, a duplication of the hallux, consists of excision of the extra ray in order to improve shoe fitting. To evaluate the effect of surgical removal of a duplicated hallux on foot function, we studied the differences in foot function between patients surgically treated for preaxial polydactyly of the foot and healthy controls.

Methods: A cross-sectional study was performed with 39 children treated for preaxial polydactyly (age range: 4–17) and 39 age- and sex-matched healthy controls. Foot function was studied with plantar pressure measurements during walking using an Emed platform (peak pressures), and clinical examination

of the foot (range of motion, width, length, and circumference of the foot and toes). Wilcoxon matched paired tests were used to compare peak pressures and clinical examination parameters between patients and controls. In addition, patient reported outcomes were studied in the patient group with the use of VAS-scores for pain and function of the foot, and with the Oxford Ankle Foot Questionnaire for Children (OxAFQ-c).

Results: The patient group had a significantly lower peak pressures beneath the hallux than the control group (148 kPa (101–243) vs. 272 kPa (204–378), $p < .01$). In contrast, patients had a significantly higher peak pressures beneath the second metatarsal and the third and fifth metatarsal (respectively 217 kPa (145–341) vs. 166 kPa (141–243), $p < .01$, and 214 (142–294) vs 161 kPa (136–235), $p < .01$). Furthermore, the hallux was more deviated in the patient group (20° (15°–28°)) than in the control group (17° (15°–20°), $p < .01$). The patient group showed a reduced plantar flexion of the first IP-joint (15° (10°–20°) vs 20° (15°–30°), $p < .01$) in the control group. VAS scores in the patient group for pain and function were high (respectively, 8.8 (6.3–9.8) and 7.6 (5.8–9.4)), indicating little pain and a good function. This was also confirmed by the high mean score of the OxAFQ-c (0.84 (0.63–0.93)).

Conclusion: Patients with surgically treated preaxial polydactyly of the foot have a more laterally oriented pressure load during roll-over than healthy controls, shown by the higher peak pressures under the lateral forefoot. Reason may be the ineffective use of the first ray due to a more deviated hallux and the reduced IP flexion. Nevertheless, no perceived functional impairment during daily activities or major foot pain were observed. Therefore, the data suggest that treatment of preaxial polydactyly results in abnormal foot function but not at the cost of perceived functionality of the foot.

A-0537 Routine outcome data collection in clinical practice using the Pulse system: The perspective from the hand therapist

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Objective: The use of routine outcome assessment in hand therapy is important to provide evidence for the therapeutic effect of interventions and to improve our health care. However, structured data collection is a

challenge to achieve with the busy schedules common in daily practice. We developed a web-based measurement system. The goal of this measurement system is a transparent and structured data collection to evaluate patient- and clinician-rated outcome after surgery or conservative treatment.

Methods: Pulse is a web-based quality system in the field of hand surgery and rehabilitation. Patient characteristics, baseline functioning, and outcome of treatment of all patients are registered on standardized evaluation moments. Patient-reported outcome measurements are automatically e-mailed to patients.

Results: After the introduction of the routine outcome measurement in a group of 16 hand surgery and hand therapy centers, we have collected 24.000 completed PRHWE questionnaires, 45.000 MHQ, and 16.000 completed Levine questionnaires. We will also discuss the barriers in the use of outcome questionnaires for hand therapists. Loss to follow-up varies from 90% at intake to around 40% 12 months after surgery.

Conclusion: We have successfully integrated an outcome measurement system within our health-care process. Hand therapists can use this information for patient education, treatment evaluation, and shared decision-making. In addition, the database has been successfully used for research projects on comparative effectiveness in hand surgery and hand therapy.

A-0538 Strategic analysis of distal radius osteosynthesis since 2011: Evolution and novel algorithm of care

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Introduction: Following the development of various novel technologies such as variable angle, volar-rim plates, low profile concept, and arthroscopic approach, our operative strategies to the distal radius fractures have evolved. This study presents our experience with surgical treatment of distal radius fractures and proposes a novel treatment algorithm in light of innovations.

Materials and method: Between 2011 and 2015, we treated 1058 patients for distal radius fracture with a mean age of 53 years; 947 were treated by volar plate, 52 by volar-rim plate, and 59 by dorsal plating. Fifty-eight patients had dual approach, and an arthroscopy was conducted in 38 patients. Fractures were classified according to the AO classification. The mean follow-up was 34 months. Standard clinical evaluation was performed, and radiographic angle measurements were made preoperatively and after surgical reduction. We analyzed type of shear, comminution, and complication rate in all cases.

Results: The mean values for the palmar plate, volar-rim, and dorsal plate were, respectively, 78°, 65°, and 57° in flexion/extension; 151°, 148°, and 140° in pronation-supination; 85%, 80%, and 82% of grip strength compared to the nonfractured side. Radiographic evaluation of surgical reduction showed a range of radiological angle normality, respectively: 91%, 88%, and 90% on both radial sagittal inclination, frontal inclination, radial height, and ulnar variance. We reported respectively 100%, 21%, and 90% of metaphyseal shear; 3.4%, 92%, and 7% with shear on watershed line; 94%, 88%, and 92% with posterior comminution; 13%, 29%, and 81% with scaphoid or lunate die punch. Removal was performed in 58%, 75%, and 82% mostly for tenosynovitis; 87% of arthroscopy was for type B and 13% on type C AO classification, and in 89% only for checking reduction. Finally, 83% of dual approach required fixation on both sides.

Conclusion: Nowadays, the priority of operative treatment is to restore joint surface whatever the surgical technique, then consider an early removal of bulky material. Anterior metaphyseal shear could be managed by standard volar plating. However, comminution and shear beyond the watershed line required a volar-rim plate, contrary to dorsal comminution and intra-articular die punch where the dorsal procedure seems better. In case of association or high comminution, we use a dual approach with a distractor system. Finally, the use of arthroscopy could prevent rotational malunion on type B AO fracture.

A-0539 Reconstruction of fingertips with a composite artificial skeleton and island flap

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Patient with multiple finger amputations or thumb amputations find their best reconstruction with single or multiple toe transfer. Unfortunately, not always it is possible to perform this technique due to local and general conditions of the patient or because of the patient will against a toe transfer. We present the reconstruction of three digits in the same patient performed with a customized osteointegrated titanium skeleton, joined with a 3D carved silicon part. The artificial skeleton was then covered by an island flap. The implants all protruded of the from the tip of the reconstructed finger within 3 months, and the embedded artificial skeletons were then converted into conventional osteointegrated implants. The aesthetic result and the function at three months (before the protrusion) and at 1 year

are presented. The reason for the failure of the implant is also discussed with a focus on the possibilities for future development of this technique.

A-0540 Are 2 weeks of antibiotics enough after native septic joint arthritis drainage? A randomized controlled trial

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Introduction: Acute native joint septic arthritis (SA) is generally considered a surgical emergency, requiring immediate drainage within hours, often during night shifts. Postoperatively, the addition of an antibiotherapy for several weeks is necessary. However, the length of antibiotic treatment remains unknown based on various literature. We conducted a study to assess benefit of 2 versus 4 weeks postoperative antibiotherapy.

Methods: We performed a prospective randomized controlled trial of adult patients in our department since 2015 with culture-proven arthritis of the hand. All patients had surgical drainage and subsequent antibiotherapy in a hospital setting following the suspicion of SA and potential resistance. Patients were randomized to receive 2 or 4 weeks antibiotics, and then a standardized follow-up was organized. We identified functional evolution by pain score and range of motion as well as radiological joint impact and blood inflammatory markers at 6 weeks and 6 months. Furthermore, all postoperative complications were reported.

Results: Up to May 2016, 19 of the 37 patients included for episodes of SA involved the hand. The interdigital segment was affected on 16 (84%) patients and the wrist or metacarpal joint on 3 (16%) patients. Eleven patients were in the group of 2 weeks then 8 on 4 weeks. All patients underwent surgical drainage and received targeted systemic followed by an oral antibiotherapy. Sequelae of varying severity occurred in 6 (32%) patients equal in each group: the 6 had stiffness then 3 with pain, 1 recurrences of SA in the 2 weeks group with development of antibiotic resistance, and 5 secondary radiological arthrosis. Two patients didn't recover their normal range of motion, without reported increase of pain (one on each group). None of patients presented an increase in blood inflammatory markers during follow-up.

Conclusions: Our preliminary data suggest that either 2 or 4 weeks at antibiotherapy after surgical joint drainage in SA seems to have a similar complication rate. These trends may be confirmed with the inclusion to come of more patients. Finally, a well-conducted surgical drainage would it be enough on acute native joint septic arthritis management.

A-0541 Does daily use of hand earlier really affect the functional status after tendon repairs?

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Objective: Recent surgical techniques in tendon repair encourage earlier use of hand in daily life activities. In our previous study, we showed that patients showed functional improvement with use of hand since fifth week. However, fifth week is recognized as an earlier time point to perform daily activities according to the tendon rehabilitation protocols in the literature. Thus, there was no comparison of the outcomes of starting use of hand at fifth and sixth weeks. The aim of this study is to compare the outcomes of starting daily use of hand at fifth to sixth week in patients with tendon repairs.

Methods: Fifty-four patients with primary tendon repairs participated in the study. Patients were divided into 2 groups: Group 1 reduced splint use during daytime and started daily use of hand in light activities at sixth week and group 2 at fifth week. All the patients received regular physiotherapy twice a week and home exercises were also instructed. Assessments were performed at three consecutive time points for each group: for Group 1 at the end of sixth, seventh, and ninth weeks and for Group 2 at fifth, sixth, and eighth weeks postoperatively. By this way, assessments were repeated after 1 week and 3 weeks use of hand within each group. Grip and pinch strengths were measured and Nine-Hole Peg Test (NHPT) was performed. Turkish versions of Disabilities of Arm, Shoulder and Hand (DASH-T) and Tampa Scale for Kinesiophobia (TSK-T) were filled by patients in all 3 assessments. Both within group and between group analyses were performed.

Results: All outcome measures improved by time ($p < 0.05$) and changes were similar within each group ($p > 0.05$). Comparison of outcomes after 1 week use of hand showed that functional measurements of Group 1 except tripod pinch are significantly better than Group 2 ($p < .05$). Comparison after 3-week use of hand also showed that Group 1 has better outcome results except NHPT than Group 2 ($p < .05$).

Conclusions: Our results showed that starting daily use of hand earlier does not really affect the functional status. It was concluded that despite the remarkable advances in surgical techniques, and they improve physiological healing and clinical processes very fairly. Besides, it should be noted that not

only technical but also patient-related factors may affect the outcomes. Thus, clinical experience and encouragement should always be supported with evidence based data.

A-0542 Displaced Scaphoid fractures: Are they spontaneously reduced perilunate dislocations

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Background: The purpose of this study was to analyze the soft tissue injuries in displaced scaphoid fracture, which were very like those found in perilunate dislocations.

Methods: Eighty cases of perilunate dislocations presenting to a trauma referral center were reviewed retrospectively between 2009 and 2016. All patients had X-ray, CT scans, and MRI when needed at presentation in ER. These 80 were reviewed for analyzing fracture patterns of scaphoid and associated soft tissue injury. The associated soft tissue / ligamentous injuries which were found were Rupture of LT ligament, SLIL injuries, and TFCC injuries depending on the severity of initial trauma.

Results: Of the 47 cases of scaphoid fractures, 69 had LT injury, 25 had SLIL injuries, and 39 had other injuries. Involvement of other carpal bones was seen in 33, extension to involve the radial styloid in 21, and ulnar styloid in 29. The soft tissue injuries were strikingly similar to those found in displaced scaphoid fractures.

Conclusion: Similar soft tissue injuries found in displaced scaphoid fractures and those found in transscaphoid perilunate dislocations indicated that in all possibility, displaced scaphoid fractures could present as spontaneously reduced transscaphoid perilunate dislocations in the ER.

Level of Evidence: Level III.

Keywords: scaphoid fracture, perilunate injury

A-0545 Comparative study of clinical and cosmetic outcomes of reverse flow homodigital artery and innervated homodigital artery perforator flap for fingertip reconstruction

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Objective: In the present study, we aimed to compare clinical and cosmetically outcomes of the reverse

flow homodigital island flap and innervated digital artery perforator flap in fingertip reconstruction.

Methods: A total of 34 patients were followed for 12 months. The reverse flow island flap was used in 19 patients and innervated homodigital artery perforator flap in 15 patients. Evaluations included defect size, flap survival rate, complications, operation time, cold intolerance, two-point discrimination, range of motion (ROM), quick disabilities of the arm, shoulder, and hand (DASH) score, cosmetically patient satisfaction, and return to work time.

Results: No significant differences were observed between the two flaps for flap survival rate, complications, cold intolerance, 2-point discrimination, quick disabilities of the arm, shoulder, and hand (DASH) score, esthetical patient satisfaction, and return to work time. Whereas the range of motion was significantly better and the operation time was significantly shorter in the idap flap group.

Conclusions: Although we obtained similar results for some parameters between the two flaps, idap flap was found technically more suitable for application and reverse flow island flap was found more favorable for large defects.

A-0546 Nail phalanx reconstruction after bone tumors resection

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Objective. Long-term outcome assessment after resection and reconstruction of the bone and nail bed for distal phalanx tumors. The aim the present study: bone grafts integration and DIPJ mobility, the force tip pinch thumb – long finger and sensitivity of the pulp (2PD), and effectiveness of using tinfoil nail splint to recover the aesthetic appearance of the nail.

Methods. Between 2000 and 2015, we operated 43 benign phalangeal bone tumors of which 20 were located in the P1 and P2 and in 23 patients in the nail phalanx. Surgical treatment of tumors of the distal phalanx must respect the following principles: (1) complete excision of tumor tissue – preventing relapse; (2) reconstruction of the phalanx length – preserving joint biomechanics; (3) preserving the functional and/or reconstruction of flexor profundus tendons and distal insertion of the extensor apparatus; (4) avoid digital nerve damage and pulpar scars, and (5) preserving aesthetics of the nail and pulp. Histological examination was performed in all cases

for accuracy of diagnosis. The tumors of the P3 were: 7 enchondroma, 6 glomus tumor, 4 aneurysmal bone cyst, 4 epidermoid cyst, 1 osteoma osteoid, and 1 tumor with giant cells. The surgical approach was in mouth fish (for cases with tumors developed at or toward pulp) and transungual – for cases with deformity of the nail and swelling of the distal phalanx. In the cases with small bone lytic lesion and cortex expansion, we applied the bone curettage but in geographic lytic lesion we performed partial or complete amputation at the distal phalanx associated with reconstruction by bone graft (one case half P3 and in two cases whole phalanx with arthrodesis DIPJ) and reconstruction of the nail matrix. We used the tinfoil nail splint for nail bed recovery. The amount of bone graft was determined preoperatively (dimension and geometry) by imagistic examination 3D reconstruction and was harvested from distal epiphysis of the radius. Follow-up at 3, 9, 12, and 36 months.

Results. Long-term follow-up revealed complete graft integration in all cases. Force pinch evaluation in all 23 cases revealed: 17 very good results, 2 good results, and 3 (bone grafted cases) satisfactory results but with a well bone graft vascularization. For tumors developed at or toward the pulp, the scars left by the “fish mouth” approach preserved a normal pulpar sensibility 8–10 mm 2PD without cold intolerance. Well preservation of the nail form and pulp in 17 cases and in 2 cases with longitudinal striae were present. We used in addition a tinfoil nail splint for recovery of the nail bed, but the aesthetic results were unsatisfactory in three cases (one case half P3 and in two cases whole phalanx) – presented nail irregularities despite using a nail splint. No recurrence after 3 years follow-up.

Conclusions: We consider that the quality of the final result depends on preserving the nail bed, dorsal cortical portion, and the base phalanx joint, followed by an anatomic (geometric) reconstruction with well-fitted bone graft determined by imagistic 3D examination.

A-0549 Turkish version of the Hand10 Questionnaire: cross-cultural adaptation, validation, and reliability

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Objective: Patient-reported outcome measurements rely on not only clinical status of patients but also their intellectual level. Hence, translation of a questionnaire's original version to patients' native language is important. The Hand10 Questionnaire is

composed of 10 questions to measure upper extremity disability level. Questions are illustrated and easy to understand so that it is applicable to children and elderly people. The aim of this study was to test the validity and reliability of the Turkish version of the Hand10 Questionnaire.

Methods: Translation and back-translation of the Hand10 were performed, according to Beaton guidelines. Patients who had stable symptoms for the previous 4 weeks in their upper extremity were included to study. They completed the Turkish version of Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH-T) once and the final version of the Hand10 Questionnaire twice with a 7-day interval. Patients who were illiterate and using splint during day time were excluded. Reliability was assessed by test-retest reliability (Cronbach's α). Correlations between Hand10 and DASH-T scores were analyzed by Spearman correlation coefficient.

Results: Fifty-seven patients participated in the study. The Turkish version of the Hand10 met set criteria of reliability and validity. Hand10 demonstrated excellent test-retest reliability. ($p < .05$, $r: .937$). Hand10 showed good correlations with DASH-T scores ($p < .001$, $r: .647$).

Conclusions: Our results show that the Turkish version of the Hand10 has excellent test-retest reliability and good validity. As a result of this study, we determined that Hand10 is a useful instrument to measure upper extremity disabilities of Turkish-speaking patients.

A-0552 Volar shift as an independent radiological predictor of instability in distal radius fractures

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Purpose: Surgical indications in distal radius fractures are unacceptable displacement with fracture instability. Lafontaine et al. and MacKenney et al. proposed predictors of instability based on patient age and radiographic parameters. Philips et al. further suggested that alignment of volar cortex postreduction predicted need for surgery. We propose that volar shift at prereduction may be an independent predictor of instability.

Methods: Radiographic films from 2013 to 2014 were analyzed at presentation, post-M&R, and 1 week and 4 weeks postinjury. Parameters studied included volar shift, volar tilt (VT), radial inclination (RI), and radial height (RH). Inclusion criteria are extra-articular and intra-articular fractures. Exclusion criteria are partial articular fractures and fractures with

associated carpal injuries. Instability was classified into Early (Post-M&R), early (1 week), and late (4 weeks). An instability occurs when VT is not within -5° to 10° , RI is not more than 11° , or RH is not more than 6mm; or more than 50% loss in reduction compared to the post-M&R imaging.

Results: The first 200 fractures of our institution's distal radius fracture registry were reviewed, and 80 were included in our study. Of the 66 cases that had volar shift, 60 (90.9%) were noted to have early instability (1 week) ($p = .009$) and 63 (95.5%) had Late Instability ($p = .004$).

Conclusion: Volar shift is a significant independent risk factor to predict fracture instability. Although it may not predict early instability at post-M&R, it is significantly associated with instability at 1 week and 4 weeks postinjury. We further extend our study with a larger sample size and present the results.

A-0555 Fracture distance of the radiocarpal surface: Does it determine the surgical technique

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Introduction: Fractures of the distal forearm are the most common bone fractures in childhood. Fractures located on the border of the distal metaphysis of the radius can be operatively treated with K-wires, dorsally inserted titan elastic stable intramedullary nail (ESIN) and short titan elastic stable intramedullary nail (SESIN).

Aim: To compare the advantages and disadvantages and efficacy of the three surgical techniques (K-wire, ESIN, and SESIN).

Patients and methods: Between January 2009 and December 2014, 131 children (97 boys and 34 girls) were treated because of fracture of the forearm in the distal third and isolated fracture of the distal radius. Gender of the patients, different types of surgical techniques, number of postoperative X-rays, date of metal removal, and degree of axis deviation after the metal removal were studied. Distance of the fracture line from the radiocarpal surface, the diameter of the distal epiphysis of the radius, and the cumulative diameter of the distal epiphysis of the ulna and radius were analyzed. Based on these parameters, results of the different surgical techniques were analyzed.

Results: Of the 131 children, stabilization of the fracture was achieved by K-wire in 94, by ESIN in 30, and by SESIN in 7 cases. Control X-ray image was

required on average in 4.3, 2.6, and 2.6 cases after K-wire, ESIN, and SESIN treatment, respectively. The average time of metal removal was significantly shortest (3.8 months), following stabilization with K-wire. In children treated with K-wire, axis deviation of less than 5° in 82 patients, 5° – 10° deviation in 6 patients, while in 6 further children the deviation was above 10° . In the children treated with ESIN, less than 5° axis deviation in 26 patients and 5° – 10° deviation in 4 patients were observed. In all the seven children treated with SESIN, an axis deviation of less than 5° was measured. The fracture distance from the radiocarpal surface was on average 24.8 and 48.4 mm in the children treated with K-wire and ESIN, respectively.

Conclusions: Fracture distance from the radiocarpal surface might determine the surgical technique is need for. If the distance of the fracture line is less than the diameter of the distal radius, osteosynthesis with K-wire, and if the distance of the fracture is more than the cumulative diameter of the radius and the ulna, then ESIN might provide better results. The use of SESIN might be applied in cases when the transition zone is injured.

A-0556 Is there a benefit in biopsy of nerve related tumors

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Objective: The Swiss national sarcoma advisory board (SNSAB) recommends incisional biopsy in case of each subfascial lesion, superficial lesion >3 – 5 cm, and lesions suspicion for malignancy in T1- or T2-weighted magnetic resonance imaging (MRI) images. Recently false-positive biopsy results and the risk of possible nerve damage by performing an incisional biopsy of nerve related tumors question this approach. Our objective was to evaluate the relative prevalence of malignancy among nerve-related tumors and to determine the rate of accurate diagnosis as well as complications in performed biopsies.

Methods: We reviewed patient charts with surgical treatment for nerve-related tumors between January 2007 and November 2016. Tumor location, pre- and postoperative pain, and presence of Hoffmann-Tinel sign and sensomotoric deficit were recorded. All patients had preoperative diagnostic imaging (MRI) and/or sonography. The number of preoperative performed biopsies was recorded. Excision of all nerve related tumors was performed. The diameter and related nerve were assessed and histopathological analysis was carried out. Suspected MRI findings as

well as biopsy findings were compared with the definite histopathological report.

Results: In the 9-year period, we identified 54 patients with 58 nerve-related tumors; 26 (48%) were male, and the median age was 52 (IQR 41–63). 53% of the tumors were located in the upper limb, and the tibial nerve (21%) was most affected. In definite histopathology, 9% of the tumors were malignant, whereas 76% were diagnosed as schwannomas. Of 49 (91%) performed MRI images, 40 (82%) were suspect for a benign and 7 (14%) for a malignant finding. Two (4%) images were nondistinctive. Two (5%) of the MRI-suspected benign tumors showed malignancy, and 5 (71%) of the suspected malignant tumors showed benign findings in definite histopathological report. In 12 (22%) cases, a preoperative biopsy was performed (8 fine needle aspiration biopsies and 4 incisional biopsies). Seven biopsies diagnosed a benign and two a malignant tumor. Three biopsies were nondistinctive (25%). In 58% of cases of taken biopsies, the finding was confirmed by the definite histopathological report. None (0%) of the diagnosed benign biopsy but both (100%) of the malignant biopsy turned out to be misdiagnosed compared with the definite histopathological report. Against the SNSAB guidelines, we performed a marginal resection to preserve the brachial plexus in this patient. Two (17%) patients suffered a nerve lesion while performing biopsy. In both cases, definite histopathological report showed a benign tumor, but one had preoperative suspected malignancy in MRI images.

Conclusion: Nine percent of suspected nerve-related tumors were malignant. Suspected MRI diagnosis was confirmed in 75%, but the diagnosis of biopsy could only be confirmed in 58% of cases. Our cohort showed no false-negative but 100% false-positive biopsy results. This misdiagnosis can lead to severe morbidity when treated with wide resection according to the SNSAB. Furthermore, two patients showed a nerve lesion after biopsy. These findings suggest excisional but no incisional biopsy in nerve-related tumors if clear relation to the involved nerve by sonography or MRI can be demonstrated.

A-0557 The time when ceiling effects are appeared in the data assessed with the patient-rating score is 6-month following surgical treatment of the distal radius fracture

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Objective: We aimed to detect the time the ceiling effects emerges in the data assessed for determining the surgical outcomes of distal radius fractures using two patient-rating scales, the Disability of the Arm, Shoulder and Hand (DASH) and Patient-Rated Wrist Evaluation (PRWE).

Methods: A total of 95 patients who underwent surgical fixation using volar locking plate for the unstable distal radius fracture between September 2014 and March 2013 were enrolled in this study. All subjects had serially completed the DASH and PRWE questionnaires at 1, 2, 3, and 6 months after surgery. The ceiling effects in the outcome data assessed for each scale were estimated at each time. "Standard distance" was calculated for detecting ceiling effect.

Results: Ceiling effects were not appeared in the surgical outcome data assessed with both the DASH and the PRWE score until 3 months following surgery. Severe ceiling effects were appeared at 6 months follow-up in the data assessed with both the DASH and PRWE score.

Conclusions: We found that, after 6 months of follow-up, the data assessed with DASH and PRWE for evaluating surgical outcome of the distal radius fracture could be distorted by severe ceiling effect. Because ceiling effect affects the reliability and validity of the scale and also could increase the likelihood of a type II error, researchers should be aware of the ceiling effect in the data assessed with DASH and PRWE score.

A-0558 Dupuytren's down under: A dedicated clinic, data collection tool and outcomes

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The first dedicated Australian public health Dupuytren's clinic was started at Peninsula Health, Victoria, Australia, in March 2016 providing comprehensive care for Dupuytren's disease. We report the development of this clinic, including the development of a new electronic data collection tool, the use of the "Patient SET" patient reported outcome measure (PROM), and comparison to the URAMS and Southampton PROMs. We confirm the efficacy, improved quality of life, and

cost-effectiveness of the clinic. The “REDCaps” data collection tool, which is free to users, could be implemented worldwide to facilitate multicentered, collaborative data collection for Dupuytren's patients.

A-0559 Triangular fibrocartilage complex lesions with distal radio ulnar joint instability: conservative management with an exercise program improves function and reduces surgical rate

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Objective: To determine the effects of an exercise program, distal radio ulnar stabilization training (DRUST), in patients with a TFCC Palmer 1B lesion and distal radio ulnar joint (DRUJ) instability in reducing pain, functional limitations and surgical intervention.

Method: An explorative prospective cohort intervention study was designed. Patients with MRI or wrist arthroscopy diagnosed TFCC Palmer 1B lesion with clinical DRU instability were included. Primary outcome measure were pain and functional limitations measured with the Patient Rated Wrist Hand Evaluation. Secondary outcome measures were surgical rate, number of treatment sessions and satisfaction (NRS 0–10). Patients were assessed at the start of the therapy, three and six months after the start of the exercise program and at long term with a minimum of 1 year. Wilcoxon rank sign tests were used for comparison of the baseline assessment with the follow up assessments for PRWHE scores.

Results: 21 subjects (8 male, 13 female) with a mean age of 33,2 years (SD 10,4) were included with a median time of symptom onset of 8 months (IQR 5-24). PRWHE total scores improved from a median of 51 points at baseline to 13 points at three months ($p=0.01$), 9.25 at six months ($p=0.03$) and 10 points at long term ($p=0.13$). There are no significant changes between the follow up assessments at three and six months and long term. The level of pain and functional limitations are reduced to such a degree that surgical intervention is no longer considered in 71% (15/21) of the patients at six months follow-up and in

62% (13/21) at the long term follow up. The median satisfaction with the results of the DRUST program at long term follow up (N=13) on a numeric rating scale (0 = very dissatisfied and 10 = very satisfied) was 8 (IQR 7.25-8). The total of 21 patients received a mean of 9 (SD 3,62) treatment sessions.

Conclusions: The DRUST program has a statistical significant and clinical relevant positive effect on PRWHE total, pain and activity scores after three and six months in comparison with the baseline assessment and surgical intervention is reduced. This suggests that conservative management with stabilizing exercises may be one of the first steps in the treatment of DRUJ instability of patients with a TFCC Palmer 1B lesion.

Level of evidence: Therapeutic 2.

A-0561 Radiologic index of coronal shift might not affect surgical outcome of the distal radius fracture

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Objective: Recent literature described that the coronal shift of the distal radius fracture might be important new parameter for assessing optimal reduction in the distal radius fracture. The aim of current study is to compare surgical result of the distal radius fracture treated with volar locking plate (VLP) between two groups divided by the final alignment of the coronal shift.

Methods: Ninety patients with surgically treated distal radius fracture were included in current study. The surgical outcomes were assessed with the Disabilities of the Arm, Shoulder and Hand (DASH) score and Modified Mayo wrist score (MMWS) at final follow-up. On the radiographs taken at the final follow-up, coronal shift was evaluated; the ratio between the width of the lunate ulnar to the long axis of the ulnar border of the radius shaft, to the whole width of the lunate in anteroposterior view of the wrist radiographs. Coronal shift with the less than 50% were considered malalignment of the distal radius fracture, that is, radial shifting of the distal fragment. All subjects were divided into two groups according to the alignment of the coronal shift and compared.

Results: Mean age of the subjects was 64.0 [48–88] years. Mean follow-up was 25.41 [12–45] months. The mean coronal shift was 55.34% [24.2–86.3%]. No significant difference was found between two groups.

Conclusions: Although recent literature was described that the coronal shift might be the important indicators for optimal reduction of the distal radius fracture, we could not find any significant difference in outcome assessment between two groups divided by the reduction alignment of the coronal shift.

A-0568 The effect of low-dose FK506 on motor nerve regeneration after cold- and cryo-preserved nerve allograft

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Background: Nerve allografts did not gain broad acceptance during the ensuing decades because of

the need for immunomodulatory therapy and the risk of disease transmission, despite the capacity to provide equal regeneration and function to that of an autograft. Decellularization of the allograft nerve has been advocated to obviate immunosuppression, but this processed allograft with no live Schwann cells does not promote axonal regeneration in long segment nerve defect. The purpose of this study was to evaluate the axonal regeneration in a rat model after sciatic nerve reconstruction with allograft nerves pretreated with either cold preservation or cryopreservation for decreasing their antigenicity and/or destroy the cellular components. Additionally, we investigated the effect of the FK 506 on motor recovery of those pretreated allograft nerve.

Methods: Sixty-five male Lewis rats were randomized into five groups (13 rats per each group). In each group, had a unilateral 10-mm sciatic nerve gap repaired with an ipsilateral autologous graft (group I), allograft nerve pretreated with cryopreservation for 12 weeks (group II), and allograft nerve pretreated with cold preservation in UW solution (group III). Group IV and V had the same nerve gap reconstructed with an allograft nerve pretreated with cryopreservation and cold preservation, respectively, and received low-dose FK506 (0.1 mg/kg) until sacrifice. At 20 weeks, motor nerve regeneration was evaluated based on the ankle contracture, compound muscle action potential (CMAP), maximal isometric tetanic force (MITF), wet muscle weight of the tibialis anterior (TA) as well as histomorphometry of the peroneal nerve and immunohistochemistry of the reconstructed sciatic nerve.

Results: There were no significant difference in functional motor recovery between autograft (group I) and cold (group II) and cryopreserved (group III) allograft groups, although levels of the ankle angle, CMAP, MITF, and wet muscle weight of TA of the three groups were 88% [range, 86%–91%], 59% [range, 59%–63%], 60% [range, 60%–61%], and 71% [69%–72%] of the contralateral side, respectively. The two allograft groups treated with FK 506 after surgery showed better motor recovery compared to the other allograft groups receiving no FK 506, but the differences were significant in terms of ankle angle ($p < .001$) and wet muscle weight of the TA ($p = .001$). Histomorphometry showed better recovery in the group V than the others, but the differences were significant with the group II.

Conclusion: The data indicate that pretreatment of the allograft nerve can be an effective alternative in the reconstruction of peripheral nerve defect. Administration of low-dose FK 506 accelerates

motor recovery after nerve reconstruction with a cold- or cryo-preserved allograft.

Clinical Relevance: Based on this rat model, using cold- or cryo-preserved allograft nerves from cadaveric donors can be a valid surgical strategy to restore motor function of the damaged peripheral nerve without the need for immunosuppression.

A-0570 Corrective osteotomy for malunited diaphyseal forearm fractures using preoperative 3D planning and patient-specific surgical guides

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Objective: Malunion of diaphyseal forearm fractures is a frequent cause of functional impairment. When indicated, surgical correction is a complex procedure, due to the nature of the deformity. Three-dimensional (3D) computer planning based on computed tomography (CT) images of the malunited and mirrored contralateral forearm allows precise preoperative simulations of corrective osteotomies and the fabrication of patient-specific osteotomy guides. This study assesses the precision and clinical outcome of this technique.

Methods: Prospective study with 17 consecutive patients. The mean age at operation was 21 (7–46) years. Patient-specific osteotomy guides were used for multiplanar corrective osteotomies of both forearm bones. Patients were assessed preoperatively and postoperatively after a mean follow-up of 15 (9–29) months. Results were reported as mean or mean (range).

Results: The mean preoperatively planned corrections of the ulna and radius were 9.9° and 10.5°, respectively. The actually obtained mean postoperative corrections were 10.2° and 11.2° with corresponding mean errors in correction of 1.7° (0.2°–5.2°) and 1.3° (0.2°–2.7°). Forearm supination improved significantly from 50° (0°–90°) preoperatively to 87° (73°–90°) at final review, $p = .009$. Forearm pronation improved from 63 (40 to 90) degrees to 78 (64 to 90) degrees, $p = .002$. Additionally, there was a statistically significant improvement in pain (from VAS 3.9 to VAS 1.5, $p < .001$) and increase in grip strength (from 22 N to 28 N, $p = .008$).

Conclusions: This study demonstrates that 3D planned patient-specific guides allow the surgeon to perform precise corrective osteotomies of complex

multiplanar forearm deformities with predictable and satisfactory preliminary results.

Level of Evidence: Therapeutic Level IV.

A-0573 Arthrodesis versus carpometacarpal joint preservation in tetraplegic patients: A comparative study of two thumb column positioning strategies in 40 key grip procedures

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Objective: Construction of a “lateral key pinch” (KP) is a universal aim of any functional upper-limb surgery program for tetraplegics. Three stages are required: activating the pinch mechanism by tendon transfer to the flexor pollicis longus (FPL) (so-called active KP) or tenodesis of FPL to the radius (so-called passive KP); simplifying the polyarticular chain; and positioning the thumb column if there is no spontaneous contact between the thumb and the lateral side of the index finger in wrist extension. To achieve the latter stage, the two main strategies are carpometacarpal joint (CMC) arthrodesis and tenodesis of abductor pollicis longus (APL) to the radius. The aim of our study was to compare outcomes of patients who sustained CMC joint arthrodesis, with those of patients in which CMC joint was preserved, whether they required APL tenodesis to achieve a proper positioning of the thumb or not because of satisfactory spontaneous thumb positioning.

Methods: Forty cases of KP were reviewed at a mean follow-up of 7.4 years: 18 with active KP and 22 with passive KP. In the first group, 11 had CMC arthrodesis, and 7 had APL tenodesis. Among the patients with passive KP, 6 had CMC arthrodesis, 10 had APL tenodesis, and 6 did not require a thumb positioning procedure. Both active and passive KP cases were statistically comparable in terms of median ASIA motor scores, wrist, and elbow extension strength. At the last follow-up examination, strength of the pollicis-digital pinch grip was measured. Key-grip opening was evaluated as well by measuring the distance between the tips of the thumb and the index finger, first during wrist flexion (tenodesis-induced opening) and second during large objects grasping tasks (passive-induced opening).

Results: Active KP cases with CMC arthrodesis had significantly stronger pollicis-digital pinch strength than those without arthrodesis. For passive KP cases,

the difference between arthrodesis and cases with joint preservation was not significant. Regarding key-grip opening, tenodesis-induced opening did not differ significantly between the CMC arthrodesis and CMC preservation groups, whether the KP was active or passive. However, passive-induced opening was greater in CMC preservation cases, particularly if KP reanimation was passive.

Conclusions: Regarding thumb positioning techniques, we recommend CMC arthrodesis for active KP cases, as this leads to a stronger pinch grip. However, CMC arthrodesis limits the key-grip passive opening when grasping large objects. CMC joint preservation should be preferred on the other side when the patient requires also a thumb-positioning procedure. For passive KP, it seems to be preferable to preserve the CMC joint as CMC arthrodesis significantly limits passive opening, with no significant gain in strength.

A-0580 Current attitudes regarding surgical treatment of cubital tunnel syndrome in the United Kingdom

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Objective: The aim of this survey was to identify the current attitudes of hand surgeons in the United Kingdom and Ireland toward the surgical treatment and outcome assessment for cubital tunnel syndrome and inform the debate regarding treatment efficiency evaluation in a randomized control trial.

Methods: A short electronic survey was created using an online survey tool and was distributed by the secretariat of the British Society for Surgery of the Hand to the registered membership. Descriptive statistical methods were used to summarize the data.

Results: There were 149 responses. The majority (71%) of these were from orthopedically trained hand surgeons. Most of the survey respondents had a relatively large cubital tunnel practice with ~70% of them performing more than 10 cubital tunnel procedures per year. The preferred primary procedure for the majority of respondents was simple open decompression with over 90% of respondents. The vast majority of respondents would perform at least some intraoperative assessment of the nerve with over 90% saying they would assess the nerve for subluxation and 33% assessing for tension. This intraoperative assessment was viewed with considerable importance by respondents with 89% saying that they would alter their plan on the basis of it, with 27% of

these choosing to proceed to medial epicondylectomy and 69% to anterior transposition. Most respondents used patient-reported symptoms and clinical examination for assessment of outcome with relatively few using neurophysiology, McGowan grading, Wilson Krout score, and both general upper limb and condition-specific, patient-reported outcome measures (PROMs).

Discussion: The results of this survey identifies open decompression as the preferred primary procedure for cubital tunnel syndrome but also identifies the significance placed on intraoperative assessment of the nerve and continued relevance of 'secondary' procedures such as anterior decompression and medial epicondylectomy. Survey responses also reflect the absence of a widely accepted standardised outcome measure. These findings are important in identifying areas for future research into surgical management of cubital tunnel syndrome.

A-0581 A systematic review of medial epicondylectomy as a surgical treatment for cubital tunnel syndrome

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Objective: To review literature of decompression of cubital tunnel with medial epicondylectomy (ME) and to assess its reported outcomes and complications, both in isolation and in comparison with other surgical procedures for cubital tunnel syndrome.

Methods: A systematic search using the terms "medial" and "epicondylectomy" was performed on MEDLINE, CINAHL, and EMBASE. Case reports, case series, cohort studies, and controlled trials published in English, where treatment was a surgical procedure involving resection of the medial epicondyle for the management of cubital tunnel syndrome were eligible for inclusion. Two reviewers read full-text articles for inclusion, assessed their methodological quality using the Methodological Index For Non-Randomised Studies (MINORS) instrument, and extracted data on demographics of study population, the outcome measures used and methods of measuring them, the presence or absence of concurrent treatment and the duration of follow-up. The resultant data were analyzed using descriptive statistical methods.

Results: 218 study titles were identified on search of MEDLINE, EMBASE, and CINAHL databases using key words "medial" and "epicondylectomy.". 29 studies of 27 study populations were included for review: 21 were case series and 6 were comparative studies. Case series reported on a total of 886 MEs.

The majority of these studies had relatively small patient numbers with a median of 29 MEs per study. Of six studies using change in McGowan grade postoperatively, the mean number of patients obtaining and improvement in one or more McGowan grade was 79% (range 51%–92%). Of 13 studies using the Wilson Krout grading of outcome, the mean number of patients obtaining good to excellent results of surgery was 83% (range 66%–100%). The most common complication reported was pain at osteotomy site which was reported in 11 of 21 case series, affecting between 15% and 52% of patients. The six comparative studies identified were of relatively low methodological quality with a median MINORS score of 10/24 (range 6–17/24). Only a single study (Geutjens, 1996) was a prospective RCT, others being cohort studies. There were also no common outcome measures used: four compared ME and transposition procedures; one compared ME with both simple decompression and transposition procedures, and one compared partial and minimal ME. Two of these studies showed no significant differences in outcomes between ME and transposition procedures, and three studies reported better outcomes in some or all domains with ME. One study reported similar outcomes between ME and simple decompression. The study comparing partial and minimal ME found no significant difference in outcomes between procedures but recommended minimal ME due to lower incidence of manual instability of the elbow.

Conclusions: Existing literature on ME is of limited methodological quality but suggests outcomes with this procedure are similar to simple decompression and equivalent or superior to decompression and transposition. Further studies of this procedure are indicated and should aim for high methodological quality, randomized comparison with simple decompression or anterior transposition, and should utilize standardized outcome measures.

A-0583 Long-term outcome of surgical treatment for Kienbock's disease using an articular-based approach

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Objective: The optimal surgical treatment for Kienbock's disease is controversial. We previously described an arthroscopic-based algorithm for the treatment of Kienbock's disease. The aim of this study was to validate our algorithm.

Methods: We prospectively identified and followed patients with Kienbock's disease at our institution between 1995 and 2014. Prospective data were collected. Subjective assessment included pain and satisfaction ratings. Functional assessment was with a modification of the Gartland and Werley score. Objective assessment was with grip strength using a Jamar dynamometer. Other data were collected from the medical records.

Results: Thirty-one patients were operated on for Kienbock's Disease between 1995 and 2014. Twenty-seven patients were assessed (12 males and 15 females). Mean age at the index procedure was 47.0 years. Median follow-up after the index procedure was at 10 years (2–18). On the Bain and Begg classification, there were five patients at grade 0, four at grade 1, five at grade 2a, eleven at grade 2b, and one at grade 3. The median pain visual analogue scale, improved from a preoperative 5 (IQ range 5–6.), to postoperative score of 2 (IQ range 0–3), ($p = .002$). Median postoperative satisfaction score was 9 (IQ range 7–10). The median functional scores from the modified Gartland and Werley score improved from 67 (IQ range 57.0–78.5) to 97 (IQ range 90.0–97.0), ($p = .001$). Eighteen of 20 working patients returned to the same level of work. There was a significant improvement in power grip and tip pinch following surgery ($p < .05$). Six (23%) patients had further surgery. There were no patients who required a salvage procedure, and there were no infections or nonunions of the partial wrist fusions or radial shortening osteotomies. No patient required a full wrist fusion or arthroplasty.

Conclusions: This study confirms that an arthroscopic assessment, and an articular-based approach to Kienbock's disease, provides a high probability of good long-term relief of pain and a minimal chance of requiring a salvage procedure.

A-0587 Fixation of the fractured lunate in Kienbock's disease

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The management of Kienbock's disease remain varied and controversial. However, when the cortical integrity of the lunate is intact, lunate unloading and revascularization procedures are considered. When the cortical integrity is lost, with fracture and collapse, then salvage procedures such as limited wrist fusions and proximal row carpectomy become options. Computed tomography (CT) scan is a useful investigative tool for this assessment.

In the past 16 years, seven patients without a traumatic history, presented with Kienbock's disease. CT scan of the lunate in these patients showed sclerosis and a coronal split fracture of the lunate. The surgical technique utilized cortical screw fixation with revascularization and joint unloading procedures. The direction of screw passage was determined by the location of the coronal fracture. One patient underwent cortical screw fixation without revascularization. One patient had cortical fixation and revascularization using the fourth dorsal compartment artery as described by Hori. Two patients had cortical fixation and revascularization with a vascularized bone graft of the fourth dorsal compartment artery as described by Shin as well as radial shortening osteotomy for negative ulnar variance. One patient underwent fixation, revascularization, radial shortening osteotomy, and temporary scaphocapitate wire fixation. Two patients were lost to follow up. There were three female and two male patients. The average length of follow-up was 88.8 months (range, 5–186 months) after surgery. The average age at the time of surgery was 28.2 years (range, 17–44 years). At follow-up, all patients were pain free at rest. The average visual analogue pain score at activity was 3.4 (range, 1–6). The average DASH score was 17.7 (range, 0–51.7). The average PRWE score was 26.8 (range, 3–57). There was an average wrist flexion of 56° (range, 30°–70°), wrist extension of 62° (range, 45°–75°), and ulnar and radial deviation 86% and 95% of the contralateral limb. Pronation and supination were full. Grip strength averaged 74% of the contralateral wrist (range, 52%–94%). Follow-up radiographs demonstrated union of the coronal fracture and no deterioration in the Lichtman stage in all wrists compared to the preoperative films. The modified carpal height ratio was on average 1.49 (range, 1.45–1.58). The average scapholunate angle was 50.6° (range, 36°–60°). The average Stahl index was 0.52 (range, 0.44–0.64). There was no observed joint space narrowing in the radiocarpal or midcarpal joints. All patients returned to full work duties. There were no associated complications. Three patients rated their wrist as excellent at follow-up, one patient rated as good and one rated fair. CT scan is a useful investigative tool in the management of Kienbock's disease to determine salvageability of the lunate. When a coronal fracture of the lunate is diagnosed, the lunate may be salvaged by fixation

A-0590 Concomitant surgical approach of ulnar nerve at elbow and Guyon's tunnel in layered compression syndrome

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Objective. Establish criteria to choose the surgical treatment correlated with the severity of ulnar neuropathy. Selection of cases which require concomitant surgical approach at elbow and Guyon's tunnel ulnar nerve (UN) release based on clinical examination and electrodiagnostic criteria.

Methods. In this study, we evaluated the association of double crush syndromes in layered UN compressions. Between 2010 and 2015, a total of 168 patients with ulnar nerve neuropathy, 50 (29.76%) patients with cubital tunnel at elbow, 75 (44.64%) patients with cubital tunnel and Guyon's canal, and 50 (29.7%) patients with Guyon's canal and carpal tunnel. All the patients presented with positive Froment, Wartenburg sign, intrinsic muscle atrophy, positive cross-finger test, Tinel sign in advanced stages, and UN compression at elbow. Clinical findings correlate with electrodiagnostic studies: The presence of compound muscle action potentials (CMAPs) which are of good amplitude even if low conduction velocities are present suggest the need for concomitant decompression of UN at elbow and Guyon tunnel. The management of mild compression is nonoperative with ergonomics and night splints for 3–6 months avoiding flexion of the elbow. Moderate and severe compressions have an operative management. For cubital tunnel, we proceeded with an ulnar release at the elbow with subcutaneous anterior UN transposition with special attention to Osborne ligament, proximal and distal intermuscular septum and arcade of Struthers; Guyon's canal implies release of the tunnel, isolation of sensory and deep motor branch, which can be compressed by the thumb adductor observed in 80% (47.61%) of patients. Patients with Guyon tunnel were of II-IIIrd degree McGowan. The association of carpal tunnel and Guyon was seen in 29.76% of cases, the majority patients with AVF for dialysis. Decompression of both nerves was done through a singular surgical approach.

Results. During the study period, 168 patients with aged 27–71, with follow-up at 3 and 6 months. One-year follow-up was done in only 65 (38.7%) patients, 30 patients (17,85%) with concomitant elbow and Guyon. At each follow-up, patients were evaluated clinically and by electro diagnosis. Motor and sensory recovery was with very good results in 93 % of cases. Only 12 (7.14%) patients who had preoperatively an advanced intrinsic hypotrophy recovered with poor

results. The association of cubital tunnel and Guyon's canal, although in small number, is a clear statement of double crush syndrome. The high number of cases recorded with concomitant involvement of carpal tunnel compression and Guyon's canal can be explained by the osteofibrous complex encircling the median and ulnar nerve. In 50 (29.76%) patients with concomitant Guyon and carpal tunnel, especially patients with AVF for dialysis, clinical improvement was recorded.

Conclusions. Ulnar nerve compression at both elbow and Guyon's tunnel is a common clinical entity, with 44.64% of cases requiring concomitant release. Presence of the clinical signs for ulnar neuropathy associated with CMAPs which are of good amplitude and low conduction velocities advice for surgical treatment. The selection of cases based on clinical and electrodiagnostic criteria guide the surgeon to perform when needed the layered elbow and Guyon tunnel release.

A-0591 3D-printed wire guide for retrograde percutaneous scaphoid fixation: comparison with standard fluoroscopic technique in a cadaver study

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Objective: Central screw placement in the scaphoid is the key of a rigid and safe percutaneous retrograde fixation of scaphoid fractures. Cannulated compression screws are most frequently used. This technique requires perioperative control of the position of the guide wire. The standard fluoroscopic method has many disadvantages: irradiation, multiple passes needed to obtain a proper position of the wire in two planes, and duration of the surgical procedure. The purpose of this study was to compare a patient-specific, three-dimensional (3D) printed wire guide (PS) and the standard fluoroscopic technique (FT) in cadaver specimen.

Methods: Twelve cadaver wrists were divided into 2 groups. In the FT group (6 wrists), the wire was inserted using the standard fluoroscopic method. In the PS group (6 wrists), a patient-specific wire guide was used. Preoperative computed tomography (CT) scan allowed reconstruction of cutaneous envelope and identification of ideal path for the wire into the scaphoid. Based on these data, we modeled a « mold-guide » including a wire guide sleeve aligned with the planned ideal path, and printed it using 3D-printing technology. Fluoroscopy was used in the

latter group only to check the absence of prominence of the head screw. To assess the accuracy of screw placement in both groups, we analyzed on postoperative CT scans the angular deviation of the screw with the ideal screw axis planned on preoperative CT scans (performed in both groups). Moreover, the operative time, the fluoroscopic time, and the number of trial guidewire placements were evaluated.

Results: The angular deviation between the screw position and the ideal screw axis was significantly lower in the PS group than in the FT group (respectively $p = .001$ et $p = .02$ for coronal and sagittal planes). The duration of procedure was significantly lower in the PS group (5.3 min) than in the FT group (17 min) ($p = .007$). Number of trial placements and fluoroscopic time were also significantly lower in the PS group.

Conclusions: The use of a patient-specific 3D-printed guide for scaphoid percutaneous fixation allows a more accurate placement of the screw than with the standard fluoroscopic method. As several trial placements of the guidewire are not necessary, the operative time is decreased and the procedure is getting simpler. This new technique is promising and should be evaluated in clinical practice.

A-0593 Best anaesthetic technique for short hand procedures

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Objective: Short procedures constitute a large proportion in hand surgery. Distal nerve block is an ideal anaesthetic technique for this type of procedures. In this article, we compare anatomical landmark-based and ultrasound (U/S)-guided nerve blocks for median, ulnar and radial nerve at the forearm level.

Methods: A total of 40 patients scheduled to undergo short hand procedures at Ain Shams University hospital were randomly enrolled in equal groups (each 20), anatomical landmark-based nerve block group (A) and U/S-guided nerve block group (B). Block failure, pain during the block, time to perform the block, time to sensory loss and neurovascular injury were recorded. Data are presented as mean \pm (SD) and were analysed using the *t* test. The software SPSS v 15.0 for Windows was used for statistical analysis.

Results: Comparing anatomical landmark-based with U/S-guided distal nerve block, for the median nerve, no statistical difference was recorded except for pain during block that was significantly higher in the anatomical landmark-based group, while for the ulnar nerve, failure rate was statistically higher in the anatomical landmark-based group, but for the

superficial radial nerve, failure rate and time to perform the block were statistically higher in the U/S-guided group.

Conclusion: Distal nerve block is an excellent option for short procedures of the hand and wrist. Different methods of nerve blocks are performed. We recommend U/S-guided median and ulnar nerve block at the mid forearm level while anatomical landmark-based superficial radial nerve 3 cm proximal to the styloid radius.

A-0604 anatomical variability and histological structure of the ulnar nerve in the Guyon's canal

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Objectives: The goal of our study was to analyze the prevalence of variations, branching patterns, and the histology of the ulnar nerve (UN) in Guyon's canal to address its significance in hand surgery. Of importance and focus was the influence of anatomy on the treatment of ulnar tunnel syndrome or Guyon's canal syndrome.

Methods: Fifty fresh cadavers were dissected bilaterally, and the nerve in the area of Guyon's canal was visualized. A "Z"-shaped incision was made from about 1/3 of the way from the distal end of the arm, curving through the wrist furrow and continuing along the axis of the fourth metacarpal. Morphometric measurements of the hands and structures dissected were taken and samples for histology were acquired and prepared for examination. The collected data was then analyzed. Ethical approval was obtained through the Jagiellonian University Bioethics Committee and the study was performed in accordance with the Declaration of Helsinki.

Results: No significant differences were observed in the morphometric measurements of the hands or the histological studies when compared by laterality or by sex. Three major branching patterns were found. Division into deep and superficial UN was the most common (85%), followed by trifurcation (13%) and the formation of two nerve trunks (2%). Branching patterns were similar bilaterally in most cases (78%). Additional findings included a majority (70%) presenting with a cutaneous branch within the canal, and/or with an anastomosis of its distant branches with those of the median nerve (57%).

Conclusion: The UN demonstrates considerable variation as it passes through the area of Guyon's canal. It is most commonly found to divide into a superficial and deep ulnar branch within the canal and most often does so bilaterally. It is important to consider that additional branches and anastomoses are common. Depending on the area of Guyon's canal that is compressed and the anatomy present within, patient presentation and treatment can vary. Therefore, anatomic variations of the UN should be taken into careful consideration when approached during surgery in this area, particularly during decompression procedures of Guyon's canal.

A-0606 Functional outcomes of two different surgery procedures and conservative treatment in patients with Thumb CMC joint osteoarthritis

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Objective: Some guidelines on thumb CMC-joint osteoarthritis promote conservative treatment as the first choice before surgery. Many surgical procedures have been compared, but less is known about functional outcomes of surgery in comparison with conservative treatment. Purpose of this study is to compare the functional outcomes time between two surgical procedures and standardized hand therapy of patients with thumb CMC-joint osteoarthritis.

Methods: Conservative treatment was standardized and consisted of individual training on active thumb stability and group counseling on dealing with thumb CMC-joint osteoarthritis in daily practice. The conservative treatment was compared with the Weilby procedure and with trapeziectomy alone.

The functional outcomes used in this study were: pain (NRS [0-10]), pinchforce (lateral grip, Preston gauge) and disability (DASH). Measurements were done pre-operative or at intake, and after 3, 6 and 12 months. In the statistical analysis differences at start were accounted for by normalizing the data of the follow up measurements by the initial measured value.

Differences between treatment groups were calculated with ONE-WAY ANOVA. Post-hoc analysis were conducted with the Bonferonni test. Differences over time within each treatment group were calculated by using the Wilcoxon signed rank test. Spearman correlation was used to investigate relations between certain variables. The significance level was set at $p \leq 0.05$. In order to take into account certain trends in the data we also indicated differences with $p < 0.10$.

Results: Significant and strong clinical relevant improvements were seen in all three groups for pain (improvement >1 point) and disability (improvement > 10 points) after 12 months. Patients who underwent surgery showed a greater improvement in pain (Weilby 67%, trapeziectomy 63%) and in disability (Weilby 62% trapeziectomy 54%) than those treated conservatively (pain: 45% and disability: 25%). The pinchforce in the Weilby group showed a significant improvement at 12 months (38%), whereas this effect was not seen in the conservative and trapeziectomy group (respectively 12% and 10%).

At 12 months the absolute pinchforce showed a moderate correlation with pain intensity in the Weilby group ($\rho=-0,42$, $p=0,04$) but very poor correlation in the trapeziectomy group ($\rho = -0,05$, $p=0,79$) and a poor correlation with the conservative group ($\rho=-0,35$ ($p=11$)).

At 6 and 12 months there was a significant higher pain intensity in the conservative group compared to the trapeziectomy group. At 6 months the conservative group showed significant more disability compared to the trapeziectomy group.

Conclusions: During the 12 months follow up all three methods showed improvement on all functional outcomes. Both surgical procedures improved more than the conservative group on pain and disability, but are not proven to be superior to another. However, only the Weilby group showed a significant and clinical relevant change in pinchforce after 12 months. Furthermore, the low correlation in the trapeziectomy group indicates that pain is not the main cause of pinchforce impairment. This might indicate that biomechanical issues in trapeziectomy might explain the differences in pinchforce between surgery procedures.

A-0607 Correlations between patient rated questionnaires and clinicians' objective measurements in rheumatoid hand: Preliminary results

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Objective: Rheumatoid arthritis (RA) is a chronic inflammatory rheumatic disease that mainly affects distal segments of extremities, leading to structural damage and functional disorders. Rheumatoid hand

disease is caused by progressive inflammation of synovial tissue, and joint damage occurs in the course of disease. Hand involvement is seen most of RA patients, resulting in functional hand disability. For this reason, assessments of functional outcomes become significant. Both clinicians' objective measurements and patient-rated questionnaires are used for functional assessments. However, functional conditions which is reported by patients aren't always congruent with clinicians' objective measurements. For this reason, the aim of this study is to investigate correlations between patient-rated questionnaires and clinicians' objective measurements in patients with rheumatoid hand.

Methods: Thirty (30) patients with RA were involved in study. Exclusion criteria were determined as patients with cognitive impairment, the history of upper extremity injuries in 1 year and illiterate patients. In assessments grip strength, Nine Hole Peg Test (9-HPT), Turkish version of Michigan Hand Outcome Questionnaire (MHQ-T), and Turkish version of Disability of Arm, Shoulder and Hand Questionnaire (DASH-T) were used. Both correlation between patient-rated questionnaires and clinicians' objective measurements and correlation between each others were analyzed by using Spearman's correlation coefficient and Pearson's correlation coefficient.

Results: Grip strength and 9-HPT of dominant side showed correlation ($p < .05$, $r: -.478$). Grip strength and 9-HPT of nondominant side showed correlation ($p < .05$, $r: -.417$). The correlations between DASH-T and dominant MHQ-T ($p < .05$, $r: -.745$), DASH-T and nondominant MHQ-T ($p < .05$, $r: -.687$) were obtained. The patient-rated questionnaires and clinicians' objective measurements showed correlations in some parameters. The correlations between grip strength of dominant side and DASH-T, dominant MHQ-T were ($p < .05$, $r: -.663$), ($p < .05$, $r: .548$), respectively. The correlations between grip strength of nondominant side and DASH-T, non-dominant MHQ-T were ($p < .05$, $r: -.508$), ($p < .05$, $r: .479$), respectively. The correlations between 9-HPT of dominant side and DASH-T, dominant MHQ-T were ($p < .05$, $r: .414$) and ($p < .05$, $r: -.452$), respectively. The correlations between 9-HPT of nondominant side and DASH-T, dominant MHQ-T ($p > .05$, $r: .196$) and ($p > .05$, $r: -.189$), respectively.

Conclusions: Our results demonstrated that patient-rated questionnaires and clinicians' objective measurements more correlated among each other. Functional status which is reported by patients aren't always congruent with clinicians' objective measurements. Grip strength demonstrated more correlations than 9-HPT with patient-rated questionnaires.

However, patient-rated questionnaires reflect patients' views; 9-HPT is not enough for assessing functional status of upper extremities in daily living. Also, we observed that DASH-T were more correlated with clinicians' objective measurements than MHQ-T. This result may be based on patients with RA who have both hand involvement, generally, and DASH-T consists of questions involved both hand activity.

A-0611 Correlation between disease activity, quality of life, level of disability and scapular dyskinesis in patient with rheumatoid arthritis

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Objective: The aim of this study is to investigate correlation between disease activity, quality of life, level of disability, and scapular dyskinesis (SD) among patients with rheumatoid arthritis (RA).

Methods: Fifty-six patients with RA were evaluated for the study, and they were divided equally into two groups with the following criteria: Patient has SD or patient do not has SD. Demographic information of them recorded and following tests applied to every patients: Disabilities of Arm, Shoulder and Hand questionnaire (DASH), Shoulder Pain and Disability Index (SPADI), Rheumatoid Arthritis specific Quality of Life questionnaire (RAQoL), Rheumatoid Arthritis Disease Activity Index-5 (RADAI-5), and Visual Analog Scale (VAS). Range of Motion (ROM) of shoulder's flexion, extension, abduction, external, and internal rotation was evaluated with goniometer. Moreover, patient's muscles strength, such as shoulder flexion,

abduction, internal and external rotation, elbow flexion, and supraspinatus, muscle was assessed using the manual muscle test. Lateral Scapular Slide Test (LSST) and observational methods were used to identify presence of SD.

Results: Both groups are similar in terms of body age, mass index, duration of shoulder pain, and course of RA. Results of the patient with SD (Group 2) is significantly worse than those of the patient without SD (Group 1) in DASH ($p = .001$), SPADI ($p < .001$), RADAI-5 ($p < .001$), RAQoL ($p < .001$), VAS right shoulder ($p = .002$) and left shoulder ($p = .001$). In terms of ROM, we did not find any significant differences between groups. Moreover, when looking at ROM scores, no significant difference was found between all patients' left and right shoulders. In Group 2, the side (left or right shoulder) with SD has less external rotation muscle strength compared to the other shoulder ($p = .046$). However, there not is significantly difference in Group 1 patients' muscle strength such as shoulder flexion, abduction, internal and external rotation, elbow flexion and supraspinatus. Moreover, although the difference for pain between right and left shoulders of Group 2 is bigger than Group 1; this is not a significant difference.

Conclusions: SD can exacerbate quality of life and functional capacity of patient with RA. In conclusion, when studying with 56 patients with RA, we found the patients with SD had worse clinical results than the patients with no SD. In RA, shoulder involvement can trigger SD. In RA, inflammatory process that affects joints is also risk for shoulder. By looking at the results, we believe disease activity and level of pain contribute to SD. Overall, we do recommend patients with RA getting scapula evaluated regularly.

A-0613 Association between ultrasound assessment of median nerve deformation and excursion and clinical outcome after carpal tunnel release

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Objective: Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy. The syndrome is characterized by increased pressure in the carpal tunnel, which results in compression of the median nerve. If conservative treatment is ineffective, carpal tunnel release (CTR) is commonly performed to reduce the pressure within the carpal tunnel. Although CTR is effective in reducing pressure,

70–90% of the patients have residual symptoms. Previous sonographic studies have shown that the shape and motion patterns of the median nerve are altered in patients with CTS compared to controls. These ultrasound parameters can potentially serve as predictors for clinical outcome after a CTR. The aim of this study was to assess whether there is an association between median nerve deformation and excursion and clinical outcome after CTR.

Methods: Forty-eight patients diagnosed with idiopathic CTS and scheduled for CTR were prospectively included in this study. The Mayo Clinic Institutional Review Board has approved the study. Patients underwent sonographic examination prior to CTR. Images were acquired using an iU33 machine (Philips Electronics, Best, The Netherlands) equipped with a 7–15 MHz linear array transducer. Subjects were asked to make a fist ("fist flexion") and to maximally flex their wrist with their fingers extended ("wrist flexion"). Ultrasound clips were reviewed using Analyze 12.0 software, and the initial and final frames of motion for the "fist flexion" and "wrist flexion" were selected. Polygons were placed manually on the outside border of the nerve. From the polygons, the following parameters were calculated: area, perimeter, and circularity of the nerve. In addition, the following dynamic measurements were calculated: median nerve displacement during "fist flexion" and "wrist flexion." Clinical outcome was assessed using the Boston Carpal Tunnel Questionnaire (BCTQ): Symptom Severity Score (SSS), Functional Status Score (FSS), and Visual Analog Scale (VAS) filled out at baseline and 3 months follow-up. To assess whether there was an association between ultrasound parameter and clinical outcome multivariable regression models, adjusting for age, gender, baseline VAS or BCTQ and EMG severity were built.

Results: After surgery, the mean \pm SD change in SSS, FSS, and VAS pain score was a decrease of 1.74 ± 0.78 , 1.18 ± 0.83 , and 2.3 ± 2.1 , respectively. Multivariable regression analyses showed that preoperative circularity of the median nerve ($\beta = .95, p = .019$), perimeter of the median nerve ($\beta = .16, p = .009$) and median nerve excursion during fist flexion ($\beta = .18, p = .025$) were significantly associated with VAS score at 3 months postoperative follow-up after adjustment for age, gender, baseline VAS score, and EMG severity. We did not find a significant association between ultrasound parameters and BCTQ at follow-up.

Conclusion: This study shows that both static and dynamic ultrasound measurements at baseline are associated with short-term outcome after CTR. These parameters may ultimately improve the ability to predict outcome after CTR.

A-0615 Pre- and postoperative dynamic ultrasound assessment of the median nerve in patients undergoing carpal tunnel release

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Objective: Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy. Although the etiology is often unknown, the syndrome is characterized by increased pressure in the carpal tunnel, which results in compression of the median nerve. If conservative treatment fails, carpal tunnel release (CTR) is commonly performed. Although CTR is effective in reducing pressure, 70–90% of the patients have residual symptoms. Previous studies have shown that the shape and motion patterns of the median nerve are altered in patients with CTS compared to controls. These parameters might also indicate whether CTR is effective. The aim of this study was to sonographically assess the effectiveness of CTR on median nerve deformation and excursion.

Methods: Forty-eight patients diagnosed with idiopathic CTS and scheduled for CTR were prospectively included. Mayo Clinic Institutional Review Board has approved the study. Patients underwent sonographic examination prior to and 3 months post-CTR. Images were acquired using an iU33 machine (Philips Electronics, The Netherlands) with a 7–15 MHz linear array transducer. Patients were asked to make a fist (“fist flexion”) and maximally flex their wrist with their fingers extended (“wrist flexion”). Ultrasound clips were reviewed using Analyze 12.0 software and the initial and final frames of motion for “fist flexion” and “wrist flexion” were selected. Polygons were placed manually on the outside border of the nerve. From the polygons, the following parameters were calculated: area, perimeter, and circularity of the nerve. In addition, the following dynamic measurements were calculated: nerve displacement during “fist flexion” and “wrist flexion.” Clinical outcome was assessed using the Boston Carpal Tunnel Questionnaire (BCTQ): Symptom Severity Scale (SSS) and Functional Status Scale (FSS). To assess whether there was significant change in the sonographic parameters, a paired *t*-test was performed. Correlation between parameters and clinical outcome was assessed using Pearson’s correlation coefficient.

Results: After surgery, the mean \pm SD change in SSS and FSS was a decrease of 1.74 ± 0.78 and 1.18 ± 0.83 , respectively. The area and perimeter of the

median nerve significantly decreased after CTR: area from 14.9 ± 4.9 mm² to 13.5 ± 5.0 mm² ($p \leq .001$) and perimeter from 18.5 ± 2.8 mm to 17.8 ± 3.3 mm ($p = .029$). Decrease in nerve area was significantly associated with decrease in SSS ($R = .33$, $p = .023$). At baseline, the average displacements of the median nerve were 3.0 mm and 1.9 mm in the ulnar and dorsal direction for “wrist flexion.” Post-CTR, the displacements were 2.9 mm and 2.7 mm in the ulnar and dorsal direction (ulnar: $p = .916$, dorsal: $p = .005$). Displacement during “fist flexion” did not significantly change.

Conclusions: This study shows that morphology of the median nerve can change after CTR and that this change can correlate with clinical outcome. Excursion of the median nerve tends to increase after CTR. The reason we did not find a change in “fist flexion” might be that the excursion is relatively small. These findings might contribute to understanding of the kinematic and morphological changes of the median nerve after CTR.

A-0619 Nonspanning radiocarpal arthrodesis with a low-profile locking plate

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Objectives: To assess the safety and efficacy of our technique for nonspanning radiocarpal arthrodesis and compare outcomes to those reported in the literature for traditional compression plating techniques which span the carpometacarpal joint.

Methods: A retrospective review was conducted to identify patients who underwent nonspanning radiocarpal arthrodesis at our institution with one of two hand surgeons. Nonspanning arthrodesis was performed in 27 wrists for 26 patients (13 M, 13 F) using a 2.4/2.7 mm or 3.5mm fixed angled locking T plate. Average patient age was 56 years (range, 38–82). Indications for fusion included rheumatoid arthritis, posttraumatic arthritis, primary osteoarthritis, juvenile inflammatory arthropathy, brachial plexopathy, failed 4CF, and failed PRC. Autogenous bone graft was harvested in 26 cases, whereas demineralized bone matrix was used in 1. Fusion was confirmed in each case by the treating surgeon using clinical and radiographic criteria.

Results: Fusion was achieved in 26 of 27 wrists by 7 weeks (range, 4–11). Complications occurred in 5 (20%) wrist. Hardware removal was performed in 3

(12%) wrists. Tendon transfer was performed for EPL rupture 23 months postoperatively in 1 (4%). One (4%) patient developed nonunion and underwent successful revision with bone graft and hardware exchange.

Conclusion: We achieved wrist fusion in 96% of patients with a 20% overall complication rate, comparable to rates reported in previous series of spanning wrist arthrodesis. Complications at the CMC joint occurred in only 4% of patients, comparing favorably to reported rates for spanning arthrodesis (12%). We introduce a new and straightforward technique for nonspanning fusion of the radiocarpal joint, with a high union rate and minimal complications at the CMC joint.

A-0620 Long-term follow-up (more than 10 years) for rheumatoid arthritis patients in outcomes of metacarpophalangeal (MP) joint arthroplasty

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Objectives: The ulnar deviation in the metacarpophalangeal (MP) joints of patients with rheumatoid arthritis is not only problematic in terms of appearance but also functional disorders such as difficulty in power pinching with the thumb. Our arthroplasty for this ulnar deviation in the MP joints consists of synovectomy, retraction of the dorsal joint capsule, reattachment of the radial collateral ligament into the metacarpal bone, crossed intrinsic transfer, and optionally insertion of the implant. We will report on the treatment outcome of more than 10 years of this operation.

Patients and Methods: The subjects were 16 (2 male, 14 female) who underwent MP joint arthroplasty for the ulnar deviation, 50 MP joints (index 14, middle 12, ring 12, and little finger 12). The age at the time of surgery is 58 years (38–72), the period of rheumatic disease is 12 years, and the period of postoperative observation is 14 years (12–19). In the surgical procedure, MP joint arthroplasty was performed using 12 patients with metacarpal head destruction for the reconstruction of the soft tissue described earlier, and implant (Swanson type 4, MES 8, manufactured by AVANTA 20) for the 32 MP joints. Treatment results were examined over time.

Results: Pain decreased from 40 joints before surgery to 3 joints after surgery, swelling decreased from 45 joints to 5 joints, and there was almost no

change over time. The range of motion of the joint was -10° and 70° at the time of 3 years after the surgery from the preoperative extension mean -38° , the flexion 75° , respectively, and the movable range moved to the extension side more. After 8 years after surgery, clearly the range of motion decreased, especially the lack of extension was increasing. Resurgery was performed in two of four patients who preserved the metacarpal head, and in 12 patients using implant, 6 cases showed implants breakage and dislocation. In 4 cases, the prognostic deviation in the little finger recurred, but there was no case that resurgery was performed during the follow-up period.

Discussion: Within 5 years after surgery, many patients were aware that it became easier for force to improve as the ulnar side deviation improved. Most cases are cases where the extension deficit angle clearly increases after 8 years after surgery, but there is not much restriction on flexion, and few patients want resurgery.

A-0625 Open versus arthroscopic reinsertion of the triangular fibrocartilage complex: A systematic review

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Objective: To investigate the efficacy of open versus arthroscopic reinsertion of injuries to the triangular fibrocartilage complex (TFCC) with concomitant distal radioulnar joint (DRUJ) instability.

Methods: An electronic literature search of articles published 1985–2016, in PubMed, Embase, and the Cochrane Library was carried out in May 2016. Only studies of open or arthroscopic reinsertion of TFCC – or comparisons between these surgical techniques – with sufficient follow-up were eligible for inclusion. The PRISMA checklist guided the extraction and reporting of data. The methodologic quality of the included articles was assessed with the Cochrane Collaboration's tool for assessing risk of bias. The primary outcome measure was the rate of postoperative DRUJ reinstability. The secondary outcome measures were range of motion, grip strength, residual pain, complications, and functional outcome (wrist scores; MMWS, DASH, PRWE, and Hand20). The question was whether the outcome after arthroscopic reinsertion of the TFCC is equivalent with open technique. A DRUJ reinstability rate of 15% was

considered a clinically relevant cutoff value. A rate of >80% excellent–good result was considered a clinically relevant cutoff value in terms of functional outcome.

Results: A total of 868 articles were identified by the electronic search, of which 178 were duplicates. After duplicate removal and subsequent study selection, a total of 15 topic-specific articles with relevant study design were identified. Two studies had to be excluded secondary, due to partly same cohorts. A total of 13 articles were included in this systematic review; 3 with open surgery, 7 with arthroscopic surgery, and 3 with comparison of open versus arthroscopic techniques. In total, 199 patients were operated on by open surgery and 260 by arthroscopic procedures. The included articles displayed heterogeneity regarding participants, diagnostic methods, and study design. The quality assessment displayed a high or unclear risk of bias in the majority of the studies. All included studies were LoE III–IV, according to the rating system by Oxford Centre for Evidence-Based Medicine. The median rate of reinstability of DRUJ in the studies in total was 11% (range 0–24) in open TFCC reinsertion and 7% (range 0–29) in arthroscopic TFCC reinsertion – a not statistically significant difference. In total, three articles in terms of open surgery and two in terms of arthroscopic surgery did not reach the predetermined cutoff value for the primary outcome measure (DRUJ reinstability). One paper in terms of open surgery and three in terms of arthroscopic surgery did not reach the predetermined cutoff value for the secondary outcome measure (> 80% excellent–good results). Open surgery tends to lead to higher complication rate of ECU tendinitis and neuroma but less postoperative residual pain than arthroscopic surgery. There was no significant difference in obtained postoperative range of motion, grip strength, or functional outcome scores between studies of open or arthroscopic TFCC repair.

Conclusion: This systematic review shows equal results between open and arthroscopic reinsertion of the TFCC, in terms of the rate of DRUJ reinstability and functional outcome scores.

Level of Evidence: Systematic review of Level III–IV therapeutic studies.

A-0627 Short nail matrix remnant resurfacing with dorsal de-epithelized VY-plasty

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Objectives: Fingertip injuries are relatively common in home and work-related injuries. They may occur as a result of accidents involving heavy machinery, industrial equipment or even simple kitchen tools. A ‘dorsal-unfavourable’ defect with substantial loss of nail matrix will affect the length of nail growth. We describe a simple, reproducible technique by de-epithelizing the part of the local flap that covers the dorsal defect, to allow improvement in the length of nail growth.

Methods: This was a retrospective review of a six patients with dorsal-unfavourable defects, who underwent the procedure to achieve distal nail bed growth. All patients underwent the same modification of the VY-plasty. Postoperatively, patients attended clinic sessions regularly and had hand therapy sessions to assist with mobilization of the joint and desensitization.

Results: Average length of follow-up was 7.5 months. All flaps survived with no complications. The average additional nail bed growth was 3.3mm.

Conclusions: In patients with distal nail bed loss, simple de-epithelization of an advancement flap can allow for nail bed growth without the need for nail bed grafting or more complex microsurgical procedures.

A-0629 Treatment of osteoarthritis of the trapeziometacarpal joint with interposition of synthetic materials: A review of the literature

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Objective: One of the treatment options for osteoarthritis of the trapeziometacarpal joint is interposition arthroplasty with synthetic materials. A literature review was done to find out which materials have been implanted and if there were any complications.

Methods: A search was done in PubMed and EMBASE up to October 2016. Articles were selected reporting outcomes of trapeziometacarpal arthroplasty with synthetic materials.

Results: Silicone has been used since the 1960s. However, problems including siliconitis, osteolysis, and breakage of the implants have been reported. Nevertheless, in some studies with long follow-up, a low percentage of complications were reported. Silicone implants have not been abandoned, and the Tendon Tie-in implant, a new design, has been introduced on the market. Interposition with a ceramic sphere was not very successful because of complications such as subsidence, dislocation, and trapezium

fractures. Pyrocarbon implants are available in different shapes. The Pyroshere has a round shape and the Pi2 is an oval implant. Dislocation, especially after complete resection of the trapezium, has been reported. The Pyrodisk has a hole in the center allowing stabilization with a tendon graft. The Pyrocardan is indicated in early stages of trapeziometacarpal joint arthritis. Interposition with polytetrafluoroethylene (Gore-Tex) implants has the disadvantage of foreign body reaction with bone resorption in a high percentage of cases. Polypropylene (Marlex) has also been used as an interposition material, but only in one study with a small number of patients and short follow-up. More studies have been published about interposition with polyethylene terephthalate (Dacron) implants. In up to 70% of cases, foreign body reactions with osteolysis have been reported. Initially, good results were reported with degradable polycaprolactone polyurethaneurea (Artelon) implants, but at longer follow-up several implants had to be removed, mostly because of foreign body reaction. Polylactic acid (Arex, RegJoint) implants are degradable, and it was expected that they would not have the disadvantages of Dacron implants. Unfortunately, foreign body reactions also have been reported. With polyvinyl alcohol hydrogel (Cartiva) implants, no foreign body reactions have been reported yet, but follow-up is still short.

Conclusion: Surgeons should be aware that using soft synthetic interposition materials may be associated with foreign body reactions. Ceramic spheres and pyrocarbon implants may subluxate or dislocate.

A-0636 Seamless hand trauma referral in the digital age

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Introduction: The digital age has revolutionized the delivery of health-care across the globe. Electronic patient records, digital radiology, and electronic referral systems are but a few data systems that have been adopted by the National Health Service (NHS). This adoption has not been without caution as information governance and data protection always remain an utmost priority in an NHS setting. To run an efficient referral pathway, to respond to referrals in a timely manner, and to capture high-quality data from the referral pathway, it is prudent to embrace a secure robust electronic referral system.

Materials and methods: The Information Technology Department at Queen Elizabeth Hospital Birmingham have developed an electronic referral management system that has been adapted with input from the Hand Surgery service to provide a bespoke solution for managing referral information and patient pathways. This replaced the traditional telephone contact with the on-call hand surgery team. The system alerts the on-call doctors via an alert put through to their mobile phone to which they can respond immediately with a written management plan. All communications are recorded and linked to the electronic patient record system. Activity patterns on the referral system were collated and analyzed. An electronic survey of junior doctors using the system was performed. Descriptive statistical methods were used to summarize data.

Results: Since the implementation of the Electronic referral system in January 2016, we have received an average of 200 referrals per month. Over 90% of the referrals are responded to within 30 min. The quickest response was found to be under 2 min. Interestingly, we found that the number of referrals were similar across the 7 days with a slight dip during midweek. Average least number of referrals per hour was during the 10 pm to 9 am period. We have also noted that the management plan can be reviewed and updated promptly by the senior members of the on-call team. The ease of access to relevant information allows the Hand Coordinators, who plan the trauma theatre list, to easily accommodate for patients requiring urgent surgery upon reviewing their clinical case prior to the patient presenting to the hospital.

Conclusion: The quality and accuracy of clinical information on the referrals have improved the referral process significantly. Junior doctors, the first point of contact for referrals, have felt that less of their time is taken up with communication, thus allowing them to focus on clinical duties. Junior doctor morale has improved since the introduction of the electronic system, and they feel supported by the presence of a communications record. Monitoring

referral activity helps to restructure personnel availability on on-call shifts appropriately and provide a more efficient service. Our experience has now been adopted by the Plastic Surgery and Burns Department and is to be rolled out on other centers nationally.

A-0647 Effectiveness of the botulinum toxin type A applied in the palmaris longus in patients with idiopathic carpal tunnel syndrome

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The etiology of carpal tunnel syndrome (CTS) is a subject of intense controversy. It has been related to biologic, genetic, anatomic, and mechanical factors. However, the increase in the intracarpal pressure is recognized as an important part of the pathophysiology, and the action of the palmaris longus has been considered a strong risk factor; despite being a wrist flexor weak muscle, it is capable of changing the geometry of carpal tunnel and increase the hydrostatic pressure.

Purpose: Evaluate the clinical effect of the botulinum toxin type A (BTX-A) applied in the palmaris longus in patients with idiopathic CTS.

Methods: A prospective, comparative, randomized study was done in 11 patients with diagnosis of idiopathic CTS, 7 patients with both hands affected and 4 patients with one hand affected (18 hands); each patient was examined for the presence of palmaris longus. In the experimental group (10 hands), 25 UI of BTX-A was applied in 0.25 ml of sterile solution in the motor point of palmaris longus and the control group 0.25 ml of sterile solution. Both groups entered a program of 10 sessions of physical therapy. The changes were evaluated according Boston questionnaire and Michigan hand questionnaire before injection of BTX-A and 8 and 16 weeks after treatment.

Results: In the experimental group, a significant difference in the symptoms was observed in 7 of 10 patients ($p < .0001$), and functional status show significant differences ($p < .001$).

Conclusions: Botulinum toxin type A was administered in the motor point of the palmaris longus to inhibit its muscular action, and this way neutralize its effect in pressure carpal tunnel, that effect could explain the improvement in the clinical symptoms; however, long-term studies are missing to determine much better the effectiveness of this alternative treatment.

A-0655 A new test for the evaluation of shoulder elevation in children with obstetrical brachial plexus injury: Preliminary kinematic analysis of the “Stick Test”

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Objective: Shoulder elevation is a common indicator of shoulder function following brachial plexus injury. During active arm elevation, shoulder muscles play important role in optimizing thoracohumeral and scapulohumeral arthrokinematics. Since the muscles of the shoulder joint connect and cross multiple joints, neighborhood joint configuration may also affect shoulder motion. Therefore, assessment of joint interactions on shoulder motion may provide additional information for preoperative planning and rehabilitation design. The purpose of this study was to test the influence of elbow extension positioning – defined as “Stick Test” in thoracohumeral elevation using three-dimensional kinematic analyses.

Methods: Prospectively, seven children (age, 6.14 ± 1.86 years) with upper root injury were included in the study. Instrumentation with a magnetic tracking device was used to measure humerothoracic elevation in the scapular plane (elevation: 15°, 30°, 45°, 60°, 75°, 90°, 120°; lowering: 120°, 90°, 75°, 60°, 45°, 30°, 15°) with two conditions. In the first condition, the participant performed shoulder elevation as usual. In the second condition, participant performed shoulder elevation with a custom-made immobilizing splint used to position the elbow in extension. Analysis of variance models were used to make comparisons between conditions.

Results: The average shoulder abduction was $96.42^\circ \pm 13.13^\circ$ (range: 80°–120°), and external rotation was $77.14^\circ \pm 10.74^\circ$ (range: 60°–90°). Thoracohumeral elevation in the scapular plane was increased 27° ($SD = 17.83$, $p = .028$). Scapular internal rotation was significantly increased during 30° lowering ($p = .018$). Scapular upward rotation and posterior tilt were significantly increased during 15° lowering ($p = .043$).

Conclusions: The Stick Test might provide more realistic information of range of motion of the shoulder elevation by testing the effects of elbow positioning. The results indicated that elbow joint position influences the shoulder joint elevation, since positioning the elbow in extension increases the range of shoulder elevation. Extended elbow position

might increase external rotation at glenohumeral joint, which is a necessary function to clear the greater tuberosity from the coracoacromial arch to allow for maximum shoulder abduction. Further kinetic and kinematic studies are warranted to define underlying mechanisms.

A-0658 High-resolution ultrasound diagnosis in hand conditions: The Immersion technique and its applications

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Objectives: To describe the high-resolution ultrasonography technique used for diagnosis of hand conditions. This method includes the immersion in water to improve the sound interface using high-frequency transducers and show the applications in particular cases.

Methods: The technique of water immersion is described for diagnostic ultrasonography of the hand. Cases from the past 3 years were reviewed, where this approach was applied, and the study conclusions were compared to the final diagnosis obtained after surgical intervention.

Results: Cases of nail bed lesions and masses, traumatic and inflammatory conditions of the tendons, vascular lesions, foreign bodies, tumors, and ligament injuries illustrate the utility and precision of this technique when compared to the surgical findings.

Conclusion: The immersion technique made the ultrasound examination easier and precise specifically in anatomical areas that are challenging for traditional ultrasound evaluation. As cutaneous and superficial conditions of the hand and assessment of the nail bed apparatus. In tendinous injuries, it enables a dynamic assessment in real time without the interference of the transducer position, since the water interface allows it to be applied at a longer distance, with no ionizing radiation and low cost.

A-0660 Application of epineural sheath jacket prevents neuroma formation in the rat sciatic nerve model

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Objective: Data of modern war conflicts, natural disasters, and traffic accidents show an increased number of patients suffering from severe peripheral nerve injuries. It is estimated that up to 25% of patients after limb amputation develop painful neuromas. This study investigates the efficacy of epineural sheath jacket (ESJ) as a novel technique to prevent neuroma formation in the rat sciatic nerve model.

Methods: Eighteen Lewis rats were divided into three experimental groups ($n = 6$): Group I – nerve stump without protection (positive control), Group II – nerve stump buried into the adjacent muscle (gold standard of neuroma management), and Group III – nerve stump protected by ESJ. The ESJ was created from a dissected 20 mm mid-segment of sciatic nerve by removal of the fascicles and ligation of its distal end. Next, the ESJ was applied over the proximal sciatic nerve stump as a cap. The presence of neuropathic pain was assessed weekly up to 24 weeks postsurgery by autotomy, pinprick test, and Tinel sign. At 24 weeks, macroscopic evaluation, histomorphometry, and neural/connective tissue ratio (N/C) studies were performed. Retrograde labeling (RNL) of sensory neurons was used to evaluate in Dorsal Root Ganglions (DRGs) viability.

Results: ESJ significantly reduced neuroma formation, which was associated with decreased Tinel's sign response (16.7%, $p < .05$) compared to the nerve stump control. Moreover, ESJ reduced axonal sprouting, bulb-shape nerve ending formation, and perineural adhesions as confirmed by macroscopic evaluation. Histological evaluation confirmed that nerve stumps protected with the ESJ showed less fibrosis and presented well-organized axonal structure. N/C ratio and RNL analysis revealed significantly improved results in the ESJ group compared to the control nerve stump group ($p = .032$ and $p = .042$, respectively).

Conclusion: The protective effect of ESJ against neuroma formation was confirmed by behavioral and histological analysis showing outcomes comparable to the muscle burying technique – the gold standard of neuroma management. ESJ inhibits neuroma development by creating a physical barrier for nerve fascicle outgrowth and additionally limits

inflammation, fibrosis, and scar formation around the nerve stump. The surgical technique for ESJ creation is straightforward and can be easily transferred to the clinic by applying the same surgical principles of ESJ construction from the human cadaver donor nerves. ESJ may become an off-the-shelf product, readily available for both the civilian and military patients.

A-0661 Responsiveness of the Patient-Rated Wrist Evaluation (PRWE), Quick DASH, and EuroQol 5D (EQ-5D) Index questionnaires for outcome measurement in distal radius fractures

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Objective: The purpose of this study was to assess the responsiveness of the Spanish version of the Patient-Rated Wrist Evaluation (PRWE) questionnaire for measuring outcomes in distal radius fractures (DRF).

Methods: In this classic cohort study, 40 patients with DRF, treated with closed reduction and cast, completed the standard Spanish versions of the PRWE, 11-item disabilities of the arm, shoulder and hand (QuickDASH) scale, and the EQ-5D Index at baseline (questionnaires inquired about status the week before fracture) and at 8, 9, 12, and 13 weeks after fracture. Responsiveness of each scale was analyzed with the effect size (ES) and the standardized response mean (SRM) in the intervals baseline–8 weeks, 8–9 weeks, 9–12 weeks, and 12–13 weeks. The ES was calculated as the mean change in scores between two measurement times divided by the standard deviation (SD) of the scores at the first measurement and the SRM was calculated as the mean change in scores between two measurement times divided by the SD of the score change.

Results: The ES and SRM were:

- (1) For the change between baseline and 8 weeks: PRWE 2.3 and 2.0, QuickDASH 2.4 and 2.1, and EQ-5D Index 1.3 and 1.1, respectively.

- (2) For the change between 8 weeks and 9 weeks: PRWE 0.33 and 0.71, QuickDASH 0.38 and 0.70, and EQ-5D 0.18 and 0.39, respectively.
- (3) For the change between 9 weeks and 12 week: PRWE 1.0 and 1.6, QuickDASH 1.0 and 1.5 and EQ-5D 0.50 and 0.58, respectively.
- (4) For the change between 12 weeks and 13 weeks: PRWE 0.19 and 0.49, and QuickDASH 0.23 and 0.62, respectively.

Conclusions: The responsiveness of the Spanish version of the PRWE in detecting changes in clinical importance was very high and equal to that of the Quick-DASH. The responsiveness of the EQ-5D as a measure of health-related quality of life was good.

A-0662 Surgical management of windblown hand

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Objective: Windblown hand is a rare congenital anomaly characterized by flexion contracture at the metacarpophalangeal joint with ulnar deviation. In most parts of cases, this pathology associated with congenital clasped thumb. Some patients have wrist extension contractures. The aim of this research was to describe all variants in treatment of windblown fingers used by us.

Methods: From 2005 to 2016, we treated 84 children with windblown hand (106 hands). All patients were with distal arthrogryposis. The age of patients was from 5 months to 16 years. We used clinical and X-ray examination.

Results: According severity of fingers and wrist deformities we carried out several variants of treatment:

1. Intrinsic muscles transfers from ulnar to radial surface of the finger.
2. Intrinsic muscles transfers from ulnar to radial surface of the finger with Z- plastic on the palmar surface of finger.
3. Intrinsic muscles transfers from ulnar to radial surface of the finger in combination with corrective osteotomy of the methacarpal.
4. Intrinsic muscles transfers from ulnar to radial surface of the finger in combination with wrist arthrotomy and extensor carpi radialis longus et brevis Z-lengthening.

Conclusions: The outcome results were estimated in 85 cases (65 hands [76.5%] – good results, 17 hands [20%] – satisfactory, and 3 hands [3.5%] – poor). In one (1.2%) case, we have seen fingers radial deviation

after Intrinsic muscles transfers. The worst results had patients with wrist extension contracture and adolescents. Early treatment patients with windblown fingers help to restore hand function and improve the result of treatment.

A-0663 Why do people with no disability attend a hand clinic and what happens to them?

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A large Norwegian Population study of the Quick-DASH gave an average score of <4 for fit healthy 20- to 29-year-olds who can be presumed to have no significant upper limb disability. A score of zero is of course no disability by definition. However, a survey of 1,500 elective patients revealed just under 10% who had a Quick DASH of ≤ 4 . As these patients are by definition essentially normal with no disability, we reviewed the case notes of all those with a score of 0 to assess why they had attended and what pathology was not being captured by Quick-DASH. Overall, approximately 45% of consultations resulted in a surgical procedure with Dupuytren's and carpal tunnel syndrome being the most common. There were 12 of 72 previously undiagnosed swellings including ganglions, mucous cysts, and tenosynovitis. Mucous cysts were routinely treated with surgery, and the ganglions were reassured and discharged apart from one which was aspirated in clinic. 25% of the patients had a diagnosis of Dupuytren's disease. These patients split 33% being discharged and 66% having interventional treatment. One case of SCC of the hand was diagnosed. There have been suggestions that the quick-DASH or other PROMS could be used to define a level of disability below which medical care would not be offered. Based on this survey of patients with no disability, we believe that this would fail to adequately care for a significant number of patients. The failure to pick up such a significant number of patients with CYS is particularly worrying. In conclusion, we believe that the Quick DASH is insufficiently sensitive as a tool for either screening or routine assessment of outcome after all types of hand surgery, and we have abandoned its use in our unit.

A-0664 An alternative salvage option before staged tendon prosthesis operations in zone-II Flexor tendon ruptures due to the adhesions: Tendon dressing method

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Purpose: Flexor tendon ruptures in Zone-II of hand are usually managed by staged tendon reconstruction operations. To give a second chance to ruptured tendon before any reconstruction procedure, an alternative intermediate stage before a staged tendon reconstruction as a salvage procedure was used allowing the secondary repair of the tendon to produce a pseudo-sheath around a repaired tendon and reduce the formation of adhesion. It was called "tendon dressing method," and functional results of this method were compared to the results of peri-tendinous hyaluronic acid-injected patients which is another antiadhesion barrier.

Methods: A retrospective analysis of 49 patients who were operated for flexor tendon ruptures was performed. After the secondary repair of the flexor tendon, a medical grade silicone layer was inserted over the repair area in the tendon dressing group while peritendinous hyaluronic acid injection was performed in the control group. In the tendon dressing group, the silicone layer was removed at the 60th postoperative day under local anesthesia. Both active ranges of motion of all finger joints and the Disabilities of Arm, Shoulder and Hand (quick-DASH) scores and capsule thickness in the tendon dressing method group were statistically analyzed after physical therapy in two groups.

Results: Full wound recovery was obtained in all patients. Tendon dressing method provided significantly better results in terms of range of motion and quick-DASH scores when compared to hyaluronic acid-injected group. It also provided 1.12 ± 0.14 mm of average sheath thickness around tendons.

Conclusions: Tendon dressing method has promising results as a salvage procedure before any tendon reconstruction method successfully in patients who have enough tendon excursions.

A-0665 Comparative study of K-wires Kapanji procedure and plate osteosynthesis for proximal extra-articular fractures of the first metacarpal

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Introduction: Several osteosynthesis procedures are currently practiced for extra-articular proximal fractures of the first metacarpal. We studied two

procedures: plate osteosynthesis and Kapanji K-wires procedure.

Materials and Method: We retrospectively included patients who had surgical procedure in Purpan Hospital, Toulouse, France, from January 2014 to June 2016. Inclusion criteria were extra-articular fractures of the first metacarpal. The A group had plate and screw osteosynthesis and the B group had Kapanji percutaneous K-wires osteosynthesis. Kapanji score, malunion rate, time before professional recovery, and complications rate were statistically analyzed with Student *t* test.

Results: We identified 613 osteosynthesis of the hand and 47 patients had extra-articular fracture of the first metacarpal. Twelve patients had other types of procedure like Iselin intermetacarpal pinning or arthrorisis of the trapezometacarpal joint. We included 27 patients in the A group (plate) and 20 for the group B (K-wires) with 6 months follow-up or more. Mean age was 28 for group A and 18 for group B ($p = .002$). Mean Kapanji score was 9.4 for group A and 9.3 for group B ($p = 0.43$). Early surgical recovery for dismantling occurred in one (3.7%) patient for group A and in two (10%) patients for group B ($p = .19$). Flexum malunion rate was 7.4% in group A and 10% in group B ($p = .39$). Mean time before professional recovery was 2.0 months for group A and 1.8 months for group B ($p = .29$)

Conclusion: Plate osteosynthesis and Kapanji osteosynthesis seem to have both good functional outcome with the same complication rate in patients with extra-articular fracture of the first metacarpal. However, we could not measure the surgical time of plating procedure, but it seems shorter to us.

A-0666 Inpatient rehabilitation for upper limb war injuries in Syrian patients

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Objective: The Galilee Medical Center is located in northern Israel and provides care for patients with complex injuries who cannot receive appropriate treatment in Syria. We wish to report our experience in treating and rehabilitating upper extremity war injuries in this unique population.

Methods: We searched for all Syrian patients with an upper limb injury who received occupational therapy treatment in the December 2014–July 2016 period. We identified 36 males and 2 females, at an average age of 25 ± 9 years. Demographic parameters and the diagnoses were collected from the medical charts. Both the surgical treatment and the specific occupational therapy interventions were reviewed.

Results: The etiology was blast injury in 19 patients, gunshot wound in 17, and a MVA in 2. There were 35 nerve injuries, 28 upper extremity fractures, 7 vascular injuries, and 4 traumatic amputations. The average length of admission was 54 (7–186) days. The patients underwent 135 upper limb surgical interventions. The occupational therapy intervention addressed edema by limb elevation and pressure dressings. Active and passive exercises and serial splinting were employed to improve range of motion. Accessory devices were adapted to improve basic daily performance such as eating and dressing. Specific treatment challenges were identified in this group. Due to the difficulties in crossing the border, all the treatment had to be provided during a single, prolonged hospitalization. Patients underwent complex interventions facing language barriers and without any family support. Not being familiar with the Israeli Health Care System, its limitations in general and mainly the inherent waiting times and delays were not always met with understanding. The Arabic-speaking members of our team helped bridge and overcome the cultural barriers. Despite our best efforts, five patients chose to leave before we completed the medical treatment and against our advice.

Conclusions: The occupation therapy treatment focused on improving function. In addition to the difficulties encountered treating patients with severe trauma, in Syrian patients, we had to provide all reasonable treatment during a single admission, since they were unable to return for a follow-up. To complete the rehabilitation program, we provided detailed instructions at discharge. Arabic-speaking medical team members were essential in facilitating the occupational therapy intervention.

A-0671 A randomized controlled trial comparing fascial manipulation with traditional physiotherapy for the treatment of trigger finger

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Introduction: Traditional physiotherapy modalities such as physical agents in conjunction with manipulations and gliding exercises are commonly used for the treatment of trigger fingers. Fascial manipulation is a manual therapy method which uses techniques of deep kneading of muscular fascia at specific points, termed centers of coordination (cc) and centers of fusion. The purpose of this study was to investigate the efficiency of the technique and to compare it with traditional physiotherapy.

Methods: Eligible patients with trigger finger were randomized in one of two treatment groups, either fascial manipulation (Group A) or traditional physiotherapy (Group B). The initial assessment included the Quinell staging, the measurement of the grip and pinch power, a Quick DASH questionnaire, and a VAS chart. The assessment was repeated at 6 weeks by an assessor, blinded to the protocol. A mail survey was conducted 6 months from the end of the treatment.

Results: Thirty-four patients were allocated to either to Group A (19 patients) or to Group B (15 patients). Analyzing both groups, the grip strength increased from 20 ± 9 kg to 23 ± 11 kg ($p < .02$) and the pinch from 2.5 ± 1.2 kg to 2.8 ± 1.5 kg ($p < .05$). The DASH and VAS scores at baseline, end of treatment, and 6 months were 27 ± 16 , 19 ± 13 , and 15 ± 23 ($p < .01$) and 5.3 ± 1.9 , 3.7 ± 2.2 , and 3.7 ± 2.2 ($p < .01$), respectively. At 6 months, 18 (53%) patients had no or minimal symptoms, 6 (17%) had symptoms not requiring an intervention, and 9 (26%) underwent an additional treatment. There were no significant differences in outcome between the two treatment groups.

Conclusions: Physiotherapy is an efficient treatment for trigger finger. Seventy-five percent of the patients did not require an additional treatment for a 6-month period. Fascial manipulation was found to be as effective as traditional physiotherapy.

A-0672 Arthroscopic distal hemitrapeziectomy versus open distal hemitrapeziectomy without interposition in osteoarthritis of the first CMC joint: Preliminary results of a randomized controlled trial

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Introduction: A variety of treatment modalities are available for osteoarthritis of the CMC I joint. Until today, no technique seems to be superior over the other. To date, trapeziectomy is considered the most popular treatment with the least complications. Complete removal of the trapezium, however, is a potential for collapse of the first metacarpal, which may result in permanent and serious reduction of postoperative function. Distal hemitrapeziectomy does not have these drawbacks. Over the past years, there is increasing experience in arthroscopic techniques, including treatment of thumb base arthritis. Arthroscopic techniques offer the potential benefit of tissue preservation and

earlier recovery. The objective of this study is to compare arthroscopic hemitrapeziectomy with open hemitrapeziectomy without tendon interposition in a multicenter randomized controlled clinical trial.

Material and Methods: Since 2014, we are performing a multicenter randomized controlled trial in The Hand and Wrist center of the Haga Hospital, The Hague and in the Fransiscus Gasthuis, Rotterdam, the Netherlands. All patients with Eaton and Littler grade 2 or 3, seen on the outpatient's clinic, in which conservative therapy is not effective. After their permission of participating the study, and with informed consent, patients are randomized to either open or arthroscopic distal hemitrapeziectomy. Patients are asked to fill in the PRWHE, and hand measurements were done in preoperative setting and at 3, 6, 12, and 24 months postoperative.

Results: We compared the different groups (open and arthroscopic) at the different time points. At the early results, we saw that the operation time for the open technique was 26 min and 39 min for the arthroscopic technique. The PRWHE ($n = 60$) showed preoperative a total of 60 in the open group (pain 36 and function 24) and 57 in the arthroscopic group (pain 30 and function 27). At 6 months, we saw a PRWHE ($n = 43$) of the open group of 14.4 (pain 15.8, function 28) and of the arthroscopic group 10.8 (pain 16, function 22). At 6 months, satisfaction was 3.5 and 3.2 for the arthroscopic and open group, respectively, on a 5-point scale (0 = *worse*, 5 = *excellent*) for both the groups. Of the patients in the arthroscopic group, 88% would undergo the operation again and 70% of the open group. Radiologically, no serious deviation or collapse occurred in neither group. Apart from transient numbness in the skin area of the dorsal radial cutaneous nerve, no complications were observed.

Conclusion: These are the preliminary results of our RCT arthroscopic versus open distal hemitrapeziectomy, showing positive outcomes. The preliminary results show a slight patient preference for the arthroscopic hemitrapeziectomy. At this moment, we have a total of 60 patients included in the study, 32 patients with a follow-up of more than 1 year. Our goal is to enroll 100 patients, 50 per group. At the time of the congress, we will present the results of at least 50 patients with a minimum of 1-year follow-up.

A-0673 Short-term result of a pyrocarbon implant in the STT joint for osteoarthritis

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Objective: The aim of the study is to present short-term results of a Scaphoid Trapezium Pyrocarbon

Implant (STPI) in the scaphoid-trapezium-trapezoid (STT) joint in patients with osteoarthritis.

Methods: The study is prospective. In this method for treatment of symptomatic STT osteoarthritis, a pyrocarbon disk is used as a spacer in the STT joint. Minimal resection of the distal pole of the scaphoid bone is performed. Postoperatively a cast is used for 4 weeks. Rehabilitation consists of unloaded exercises during three weeks followed by 3 weeks with gradually loading. Heavy load is allowed 12 weeks postoperatively. All patients were evaluated preoperatively, 6, 12, and 26 weeks postoperatively and then yearly with ROM, grip strength, pinch, key-pinch, VAS scores for pain, Quick-DASH, PRWE, and patients satisfaction. X-Ray performed preoperatively, 3 months postoperatively, and thereafter yearly. Twenty-one patients were operated on, 8 men and 13 women. Median age was 62 years (51–78). The arthroplasty was performed on the dominant hand in 11 patients and the nondominant hand in 10 patients.

Results: Median follow-up was 13 months (range 3–28). Extension/flexion of the wrist was preoperatively 50°/61° and at follow-up 55/65 and radial/ulnar flexion preoperatively 13/40 and at follow-up 1/45. Radial abduction/palmar abduction of the CM1 joint was preoperatively 402°/43° and at follow-up 40/42. Opposition of thumb and grip strength was not affected by the procedure, 0 cm, respectively, 23 kg. Pinch/key-pinch (kg) preoperatively: 5.3/4.5 and at follow-up: 5.5/5.7. VAS pain (mm of 100) was preoperatively at rest/activity 48/70 and at follow-up 11/33 ($p < .01$). Radiographic migration of the implant was seen in 7 patients and dislocation in one. Quick DASH improved from 49 preoperatively to 34 ($p < .01$) at latest follow-up. PRWE changed from 61 preoperatively to 23 ($p < 0.01$) at follow-up. Satisfaction (mm of 100) was preoperatively 20 and at follow-up 74 ($p < .05$).

No infections were encountered but four implants (19%) were revised.

Conclusions: Short-term results with this STPI pyrocarbon implant in the STT joint are promising concerning pain, PROM and patient satisfaction improved significantly, but revision rate is high.

Keywords: Scaphoid Trapezium Pyrocarbon Implant, STT arthritis

A-0675 Restoration of 6-cm long nerve defects with epineural sheath conduit in a large animal model

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Objective: Repair of long nerve defects (>3cm) in patients suffering from multilevel traumas is a challenging task due to the significant limitations of the availability of autologous nerve tissue. The best alternative to a nerve autograft that can successfully imitate normal nerve architecture without the limitations of length is the nerve allograft. However, allografts present a lower success rate due to tissue immunogenicity and require the use of immunosuppressive protocols to prevent allograft rejection. Thus, there is an urgent need to test new strategies for restoration of long nerve defects. The aim of this study was to test the feasibility of autologous epineural sheath conduit (ESC) in restoration of 6-cm long median nerve defect in a sheep model.

Methods: Eight outbred sheep were divided into three experimental groups: Group 1 – no repair of the defect ($n = 4$ nerves/group), Group 2 – autograft controls ($n = 6$ nerves/group), and Group 3 – autogenic ESC filled with saline ($n = 6$ nerves/group). To spare animals, both forelimbs of each sheep were tested. Following dissection of 6-cm long median nerve segment, the ESC was constructed under operating microscope by fascicles removal. Prior to median nerve repair, ESC was tested for the presence of neurogenic and immunogenic factors including: GFAP, NGF, S-100, HLA I, CD31, collagen I, vimentin, and laminin B2 using immunofluorescent staining. At 6 months postrepair, neurosensory recovery was assessed by nerve conduction velocity (NCV) and somatosensory-evoked potential (SSEP) measurements. Nerve samples were stained with Toluidine blue and histomorphometry measurements were performed to confirm axonal growth and median nerve regeneration.

Results: The anatomical course of sheep median nerve was examined. ESC showed high expression of collagen I and laminin B responsible for guidance of axonal growth. At 6 months postrepair, the shape and integrity of the ESC was preserved. ESC was well vascularized, and there was limited amount of tissue adhesions comparable to the autograft control. The NCV and SSEP assessments confirmed the presence of neurosensory responses in ESC. Smaller diameter fascicles were observed in ESC conduits when compared to autograft controls. At 6 months postrepair, the samples of nerves submitted to Toluidine blue staining confirmed presence of the regenerating myelinated axons in the distal part of ESC conduits.

Conclusion: The feasibility of ESC in restoration of 6-cm long nerve defects in a sheep model was confirmed by

axonal regeneration, immunohistochemical assays and neurosensory assessments. ESC is a novel and promising bioconstruct of naturally occurring epineural sheath, which has a potential for successful regeneration of long nerve defects and as such can be included into the armamentarium of peripheral nerve surgery.

A-0677 Long-term results of the ball and socked arthroplasty of the CMC joint are comparable to those of hip prostheses

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Keywords: long-term results, CMC arthritis, total arthroplasties, thumb implants

Objectives: The purpose of this paper is to present the results of long-term follow-up (more than 10 years) of 155 total ball and socked, noncemented, and nonconstrained total arthroplasties (TA) for CMC joint osteoarthritis treatment.

Methods: From May 1999 to June 2006 155 consecutive TA has been performed in 134 patients (126 women and 8 men) to treat advanced osteoarthritis of CMC joint [(Eaton and Littler stages III (137) and IV (18)]. Mean age: 58.6 years; 84 (54.2%) were right thumbs. The indications for surgery were failure of conservative treatment, with severe pain, loss of pinch strength, and reduced thumb motion that restricted activities of daily tasks. The implants in this series were 153 Arpe prostheses and two Ivory. The average follow-up time was 10.8 years ($SD = 1.1$ years, range 9.8–16.6 years). Clinical Assessments: Range of motion (IFSSH, 2012), thumb opposition (Kapandji, 1986), pinch strength (B&L engineering), and radiological: PA and oblique X-ray at 3 months, 5 years, and 10 years. Objective test: Pain visual analogic scale (VAS 0–10), and DASH questionnaire (Rosales et al., 2002). Statistical studies: Kaplan–Meier analysis estimated survival curves and logistic regression in order to identify risk factors related to the outcomes. Although it is a type IV study, it was planned prospectively. We consider two types of implants: functional TA those with little or no pain, range of movement over 90%, and thumb opposition over 8 of Kapandji, and without noticeable radiographic changes (dislocation, instability, and loosening). They can comfortably handle objects (bottles, cans, boxes, scissors, etc.), and Failed TA those who meet one major criterion or two minor criteria. Major criteria: Dislocation, loosening of the components with malposition and instability; $VAS \geq 5$; $DASH \geq 40$. Minor criteria: Loosening, without malposition or

instability; subluxation of the components; VAS 3 or 4; DASH 30–40.

Results: Seven patients (8 TA) have not completed the follow up to 10 years, remaining a total of 147 TA for the study; 136 have had a personal assessment, and 10 patients (11 TA) have been reviewed by phone. Kaplan-Meier analysis has been 94.1 [95% CI [2.8%–12.3%]]. 136 (92.5%) implants are functional TA, and 11 (7.5%) are failed TA. Of these, four (2.7%) have been removed, and done LRTI; other four (2.7%) remain dislocated at last follow-up, and 3 (2.1%) had two minor criteria. Excluding the removed prostheses, nine (6.1%) implants have had to be surgically revised, obtaining that six of them were functional after the surgical review intervention.

Conclusions: The total joint arthroplasties of CMC joint of the thumb noncemented and nonconstrained have proven to be efficacious in improving the movement, strength, and in eliminating the pain. The implants have proven to be durable with time (similar to hip or Knee implants).

A-0678 Does the anatomy of the radial sigmoid notch have influence on the long-term outcome of ulnar shortening osteotomy

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Objective: There are several outcome studies with long-term follow-up after ulnar shortening osteotomy (USO) for ulnar impaction syndrome, but to our knowledge there are none regarding the anatomy of the sigmoid notch. We retrospectively investigated if the shape of sigmoid notch has influence on development of osteoarthritis of the distal radioulnar joint and on the clinical outcome.

Methods: We retrospectively reviewed 31 patients who had undergone ulnar shortening osteotomy for idiopathic ($n = 22$) as well as posttraumatic ($n = 9$) ulnar impaction syndrome after a mean follow-up of $96.7 (\pm 43.6)$ months. Patients were divided into three groups depending on the shape of the sigmoid notch as suggested by Tolat (I: articular surface parallel to the ulnar center line ($n = 19$); II: articulation angle opens proximally ($n = 4$); III articulation angle opens distally ($n = 8$)). The Mayo Wrist Score (MWS) was measured, and patients were asked to answer the QuickDASH questionnaire. The clinical and radiographic parameters of the distal radioulnar joint (DRUJ) were assessed.

Results: The majority of the patients after an average shortening of $3.58 (\pm 1)$ mm reported about a satisfying or very satisfying result, only 3 (9.6%) patients (all of them in the Tolat I group) had non- or less-satisfying results. The average MWS was $78.0 (\pm 25.1)$ in the Tolat I group, $77.5 (\pm 15.5)$ in the Tolat II group and $85.6 (\pm 13.2)$ in the Tolat III group. Nine patients had radiological signs of an osteoarthritis in the DRUJ (five in the Tolat I group, one in the Tolat II group and two in the Tolat III group). Of these patients all had either satisfying (1) or very satisfying results (8), without clinical symptoms and a MWS averaging $82.5 (\pm 11.6)$, quick-DASH $16.2 (\pm 20.5)$, DASH $13.3 (\pm 16.7)$.

Conclusion: Despite radiological alterations in the distal radioulnar joint in nearly a third of all patients, the overall clinical outcomes of USO are satisfactory. The anatomy of the sigmoid notch seems to have no influence on the outcome of USO.

A-0679 Closing the loop: using outcome measurements for key insight in the quality of care of hand and wrist surgery

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Objective: Although the registration of outcomes is often introduced to improve the quality of care, most often the difficulty in collecting the needed data outweighs the added value of the registration. To overcome this discrepancy, we set out to develop a feedback system that could provide patients and doctors with outcome information that can be directly used to improve the quality of care.

Methods: For this, we used our online outcome database, named Pulse, which contains answers to more than half a million questionnaires filled in by patients, hand surgeons, and hand therapists. For more than 100 treatments commonly performed within our clinics, we identified four to six end point parameters in the domains of pain, hand function, outcome satisfaction, return to work, hand force, and goniometry. For these parameters, we calculated statistics of central tendency and variability across the different phases of the health-care process (before and after 6 weeks, 3, 6, and 12 months surgery). Additionally, we calculated separate statistics for each surgeon ($N = 16$) and clinic ($N = 12$).

Results: This norm data were imported in Pulse and visualized in three different locations within the user interface. First, the surgeon dashboard, only accessible to hand surgeons, where a surgeon can compare, for every treatment, his or her outcomes with a colleague. Second, the patient results page, where a

therapist or surgeon can compare the outcomes of an individual patient to the norm of all patients that came before and received the same treatment. And third, the personal patient page: my results, where similar information is shown so a patient can follow his or her results during the entire treatment process.

Conclusion: The three modes of feedback of outcome information have successfully been implemented, and therapists and surgeons are being taught how to make optimal use of the available information. Access to specific pages in Pulse are now monitored to see how often patient, doctors, and therapist make use of these norm data. The future goal of the project is aimed at evaluating the positive effects on both the quality of care, medical performance of individual doctors, and compliance on the outcome questionnaires.

Level of evidence: Prognostic, Level 2

A-0684 Meaning of microsurgical techniques in the treatment of children with electric burns

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Objective: Tissue damage involved with electric injury can be so deep and serious that after necrectomy it might become impossible to apply traditional techniques of skin grafting. The use of vascularized tissue complexes allows to restore, the full-value cutaneous covering as well as, when necessary, the muscular tissue and the bone tissue.

Methods: 23 children with electric burns in early stages and 27 children with after effects of electric burns have been operated on since 2008. All patients have undergone auto-transplantations of vascularized tissue complexes. Thirteen of the operated children (at early period) had low-voltage electric injuries and 10 had high-voltage electric injuries. The variants for use of vascularized auto-transplants in treating children with extensive tissue injuries can be divided into 3 groups according to the aim to be achieved: (1) skin-fascia grafts such as Littler graft, radial graft, graft from the basin of 1 TMA (Kite-flap), and thoracodorsal graft have been used; (2) skin-fascia muscle grafts such as thoracodorsal graft with the inclusion of a transplant with musculus latissimus dorsi have been used; (3) composite tissue complexes with a bone fragment such as a tissue complex on the basis of the musculus latissimus dorsi with a rib fragment or a fragment of the lateral side of scapula.

Results: The data obtained from the analysis of treatment results prove that the microsurgical transplantation of tissue complexes have very good prospects

and is indispensable when treating children patients with heavy injuries involved with electric burns of upper extremities. Long-term results of treatment were studied from 1 to 8 years. The maximum treatment effect in minimum time obtained using perfused tissues with the vascular pedicle. However, there is a risk of transfer grafts data. In three cases, we have had serious complications and graft necrosis due to circulatory disorders.

Conclusion: The use of perfused tissue complexes for defect's covering provides a much better aesthetic and functional effect, compared with conventional plastic techniques. Especially, these methods are necessary for deep and extensive electric burns, if damaged to be anatomical structures.

A-0685 Is open DRUJ reposition in pure neglected DRUJ dislocations the best, can we treat it by indirect manner?

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Objectives: Neglected DRUJ dislocation is a rare condition appearing in forced rotational injuries of the forearm. It causes pain and major functional problem to the patient due to fixed malposition of the forearm bones. Increased soft tissue tension, acute carpal tunnel compression, and rotation limitation are the result. Treatment of choice is open reposition, removal of interposed tissue, soft tissue reconstruction, and temporary transfixation of forearm bones. Anyway, this does not give reliable end result in all, and function limitation persists. Authors are presenting results of five patients treated by indirect DRUJ distraction, reposition, and temporary transfixation of forearm bones followed by physiotherapy and gradually increased load after removal of transfixing pins. They describe surgical technique used, present results and discuss complications.

Methods: Five patients were treated for neglected DRUJ dislocation between 2014 and 2016. Delay from injury was 46–129 days. In all forced hyperpronation or hypersupination, injury was the cause of dislocation due to dash board injury in three and fall of heavy object to the wrist in two patients. Three had fixed dorsal and 2 had fixed palmar dislocation of the radius. Instant pain, increased tension in arm, and major functional deficit were the main complaints. Two patients had median nerve irritation. In all cases, indirect DRUJ distraction of the joint followed by reposition and temporary K-wire transfixation of the forearm bones was performed. After 6 weeks, wires were removed and physiotherapy with gradual mobilization of the joint was performed. In one patient due

to full blown median nerve palsy carpal tunnel release was performed at the same time as DRUJ reposition. All patients were followed at 6, 12, and 24 weeks after reposition. Clinical result, X-ray, range of motion, VAS, and DASH were evaluated at the end of treatment.

Results: All patients healed uneventfully. Deformity was fully reconstructed with stable congruent DRUJ in all. Forearm rotation returned to normal in 3, and over 80% of contralateral side in 2 patients. Pain dropped from 7 to 0.6. Median nerve irritation disappeared immediately after reposition in one patient and full blown palsy regenerated to "residual" impairment within 6 months. In 4 cases, minor degenerative changes persisted on X-ray after a year.

Conclusion: Neglected pure DRUJ dislocation is a very rare condition resulting from rotational injury that limits the patient by pain, motion limitation, and possible median nerve irritation. In many cases, it is a cause of CRPS condition. Unlike in open reposition indirect distraction – reposition gives better end result in this small series with comparison to authors previously operated cases. Surgical approach without direct open approach to the DRUJ heals with less scarring. The risk of redislocation and DRUJ instability was the main concern, but all of DRUJ joints were congruent and stable at the end of treatment.

A-0686 Confirmation of the engraftment and safety of cryopreserved human cord blood derived ex-vivo created dichimeric cells in the NSG mouse model: A preliminary study

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Objective: Cellular therapies are considered as the most promising approach for tolerance induction in Vascularized Composite Allograft (VCA) transplantation. Thus, we have developed a new supportive therapy of ex vivo fused human cord blood-derived dichimeric cells (DCC) to prolong VCA survival. The aim of this study was to establish cryopreservation conditions for long-term storage of DCC and evaluate the viability, phenotype, and safety of cryopreserved DCC in the NSG mouse model.

Methods: Sixteen fusions of mononuclear cells isolated from human umbilical cord blood (UCB) were performed. UCB from two unrelated donors were separately stained with PKH26 and PKH67 dyes. Fused with polyethylene glycol, double (PKH26/ PKH67)-stained DCC were sorted and cryopreserved in a liquid

nitrogen for 6 months using fetal bovine serum with 10% DMSO, CryoStor®CS10 or StemSpan H3000 medium supplemented with 5% DMSO and 25µg/ml trehalose. Viability (Trypan Blue, LIVE/DEAD staining), apoptosis (Annexin V), proliferation (colony forming unit), and changes in the DCC phenotype (CD45, CD3, CD4, CD25, CD34, CD90) were assessed. The safety of cryopreserved DCC with the highest viability was tested in the NSG mouse model. Sixteen animals divided into 4 groups received intramuscular (IM) or intraosseous (IO.) injection of 0.5×10^6 of cryopreserved: Group 1 – UCB (IM. delivery), Group 2 – UCB (IO. delivery), Group 3 – DCC (IM. delivery), and Group 4 – DCC (IO. delivery). Mice were observed for 90 days for changes in weight, activity, posture, and hair loss. Three times per week mice were evaluated by palpation and at 90 days by magnetic resonance imaging (MRI). The presence of DCC in the peripheral blood of the recipient was determined by HLA class I staining at 90 days after cell delivery. Lymphoid organs, lungs, and liver were harvested at 90 days and assessed using H&E staining for the presence of tumor-like growth.

Results: The highest viability of DCC was achieved using CryoStor®CS10 cryo-solution and lowest using standard fetal bovine serum with 10% DMSO (15% ± 5% of dead cells vs. 50% ± 15%). The DCC phenotype and proliferative properties following cryopreservation were maintained. Following IO delivery, DCCs (<1%) were observed at day 90 in the peripheral blood of the recipients. No DCC-derived tumor-like growth was detected.

Conclusions: The maintenance of DCC phenotype characteristics and safety following long-term storage were confirmed, thus allowing for the future DCC application as the "off-the-shelf" product. The unique concept of DCC, presenting phenotype characteristics of transplant donor and recipient, is a new promising approach for tolerance induction and prolonging solid organ and VCA survival.

A-0687 False-positive prevalence in the Finkelstein and Eichhoff's test in healthy population

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Introduction: Finkelstein's test has been used historically as diagnostic for De Quervain's Tenosynovitis; however, there are no publications that show its operative characteristics in the diagnosis. In the clinical practice, occasionally healthy patients show a positive Finkelstein's test. It is found in healthy population and

suggests a high prevalence of false-positive results. There is a historical confusion in the literature regarding the accomplishment of the test since there are two different ways to evaluate it, the initially described one by Finkelstein and a maneuver that in its original description corresponds to Eichoff.

Objectives: To quantify the prevalence of positive results in the Finkelstein and Eichoff's test in healthy individuals, without signs or symptoms of De Quervain's Tenosynovitis.

Methods: The test was done in a group of 100 healthy subjects, aged between 18 and 65 years, without precedents of chronic pain radius styloid, wrist fractures, wrist traumatism that has needed immobilization, overuse disease in the upper extremity, pain to the mobilization of the thumb. Tests were done in a standardized way using a device to evaluate the ulnar deviation of the wrist, ulnar deviation of the wrist with Finkelstein's test, ulnar deviation of the wrist with Eichoff's maneuver, positive tests and grade of pain were registered.

Results: A total of 100 patients were included (200 tests), 49% male and 51% women. The population was stratified by age-groups as follows: 18–25, 26–35, 36–45, 46–55, and 56–65 years.

The average of active ulnar deviation was 55° (SD 11°) and passive of 56° (SD 8°). The Finkelstein test did not change the value of ulnar deviation active or passive. When Eichoff's test was done the mean of active ulnar deviation diminished in 2 degrees (Mean 53°, SD 12°) and passive in 3° (mean 53°, SD 11°). The Finkelstein's test was positive in 15% of observations [IC95% 10.4–20.1]. The Eichoff's test was positive in 28% of the cases [IC95% 22.4–35.3]. In 4 cases (0.4%) the Eichoff and Finkelstein's test were positives bilaterally. The pain evaluation in the visual analog scale for Finkelstein was lower or equal to 5 (mean 2.4, SD 1.3) and for Eichoff all were lower or equal to 6 (mean 2.4 and SD 1.4).

Conclusions: Finkelstein and Eichoff test can be positive in a significant group of nonsymptomatic patients. There were more healthy patients that had Eichoff than Finkelstein positive test. Both tests show low pain levels. In the future, there should be interesting to evaluate the operative characteristics of both tests for De Quervain's Tenosynovitis.

A-0689 Successful replantation of the fingers after prolonged cryopreservation with long-term follow-up: Report 2 cases

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Objective: We report our experience and results of long-term follow-up of two fingers with an unique preservation procedure before replantation in more selective timing 5 or 81 days after initial trauma.

Methods: Two patients with clean, uncontaminated severed fingers were chosen for such surgery. With a tissue cryopreservation solution, the fingers were preserved in the liquid nitrogen (–196°C) by conventional freezing procedures; two patients had left index fingers totally amputated at the level of middle phalanx. The distal severed parts of the fingers were stored in liquid nitrogen for 81 days and 5 days, respectively, and taken out for replantation surgery. The bony surfaces of the severed fingers were completely debrided, and the blood vessels, nerves, and tendons were dissected in the stump of fingers and the severed fingers. The fingers were across fixed with Kirschner wires, while extensor and flexor tendons were repaired, digital nerves were anastomosed, subcutaneous superficial vein of the forearm were used to bridge two proper digital arteries and three dorsal superficial veins, skin was sutured. The severed fingers survived 2 weeks postoperative after removal of stitches. Remove the Kirschner wires 6 weeks postoperatively and started fingers functional exercises thereafter.

Result: Two replanted fingers survived without events. No vascular crisis occurred after surgery in both fingers. The severed finger which had been cryopreserved for 81 days exhibited close to normal appearance 4 weeks after replantation. The fingers regained some sensory function 3 months after the replantation, but the finger was slightly atrophic. Angiographic examination showed the arteries of the replanted fingers perfused well. The tip of the replanted finger had a moving 2-point discrimination of 8 mm 6 months after replantation. Finger did not have further atrophy and functioned well in daily use during the subsequent 13 years follow-up. The severed finger which was stored for 5 days before replantation had slightly atrophic changes as well. The fingertip has 5 mm of moving 2-point discrimination 6 months after replantation. Finger size was close to normal, and the finger functioned well in daily use in the subsequent 12 years follow-up.

Conclusion: We presented long-term follow-up results of two replanted fingers after prolonged cold preservation for 5 to 81 days before replantation with 12 to 13 years of follow-up. We conclude that prolonged cryopreservation of the served finger parts are feasible, and good long-term outcomes can be expected. We suggest such a preservation method can be used for those cases which cannot be replanted immediately.

A-0690 Use of activities to increase upper extremity skills in children with non-Hodgkin lymphoma

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Objective: The treatment results in childhood non-Hodgkin lymphoma are much improved due to the use of intensive combination chemotherapy. However, the adverse and side effects of treatment may be causing functional loss in children. In literature, the focus was more given in cognitive abilities and gross motor functions. Although children have many problems in hand functioning, there are few studies focusing on upper extremity skills. These skills can be lost very quickly, and they are vital for daily living and also for academic achievement. This study aimed to investigate the effect of activity use on upper extremity function in pediatric non-Hodgkin lymphoma.

Methods: Sixteen children (min: 9 years to max:16 years) were included in the study. They were diagnosed with non-Hodgkin lymphoma and staying at hospital for chemotherapy. Upper extremity (fine motor skills) were evaluated with response speed and upper extremity speed and dexterity subtests of the Bruininks–Oseretsky Motor Proficiency Test (BOMPT). Purdue peg board test was used for evaluating dexterity. Intervention was planned for six sessions because of the duration of hospital stay. The effect of treatment was analyzed with Wilcoxon signed-rank test as statistical analysis.

Results: Average score in fine motor skills was 36.40 ± 4.56 (min: 30–max: 42 points) before intervention and was 46.80 ± 3.83 (min: 41–max:5 0 points) after intervention. The difference between these measurements were statistically significant ($p < .05$). Purdue pegboard test score was also increased, and this increase was statistically significant ($p < .01$).

Conclusion: This study showed significant increase in short term intervention using activities to increase upper extremity skills. Pediatric cancer patients have a motivational loss, and good hand functioning may have a vital role to gain their child roles back. Even in a short time, use of activities in treatment program had positive results. It is advised to focus on fine motor skills of children with cancer.

A-0700 The Turkish version of the Movement Imagery Questionnaire-3: Its cultural adaptation and psychometric properties

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Objective: Motor imagery is the mental representation of movement without any body movement. It is an effective rehabilitation strategy in the treatment of chronic pain, reflex sympathetic dystrophy, and phantom pain. However, there are only limited assessment methods to evaluate movement imagery to demonstrate the effectiveness of the treatment. Motor imagery questionnaires are one of the most preferred methods. The aim of the study was to perform the cultural adaptation of the Movement Imagery Questionnaire-3 (MIQ-3) into Turkish and to evaluate its test-retest reliability in Turkish-speaking population.

Method: 185 healthy subjects (139 females and 46 males; aged between 18–45 years) were included in the study. MIQ-3 is a 12-item questionnaire to assess three strategies: internal visual, external visual, and kinaesthetic imagery. The test-retest, interrater reliability and the internal consistency of the internal visual, external visual, and kinaesthetic items of the questionnaire were tested. The questionnaire was applied with 1-week interval for all these participants to evaluate the test-retest reliability. For applying the test, all questionnaire and descriptions about items were clarified. After explanation in detail, participants completed the questionnaire independently, and the researcher clarified questions if requested.

Results: The Cronbach α coefficient was satisfactory (.87 for test and .86 for retest). Internal consistencies regarding each subscale were following as: internal visual items = 0.73–0.68; external visual items = 0.74–0.72, and kinaesthetic items = 0.79–0.73.

Intraclass correlation coefficient for each item ranges from 0.84 to 0.95 [95% confidence interval]. In terms of criterion validity, there was a moderate correlation between item and total correlations, ranges from 0.50 to 0.90 ($p < .001$).

Conclusion: Motor imagery constitutes key targets in upper extremity rehabilitation. The Turkish version of MIQ-3 is found to be a reliable instrument in Turkish-speaking population to measure ability of movement imagery.

A-0701 Brachial plexus tumours: Experience from a tertiary referral peripheral nerve centre

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Objective: Primary neurogenic tumours are uncommon and anatomical location within the brachial plexus is rare. Plexus tumours may present as incidental findings on imaging, following investigation for sensory and motor symptoms in the arm, with neuropathic pain or due to local mass effects. Extrinsic tumours may cause compression at the level of the thoracic outlet and features are specific to the interscalene, costoclavicular and subpectoral spaces. We report our experience and review the literature.

Methods: The Centre for Nerve Injury and Paralysis was established in 2010 and has treated 1,844 patients to date. A prospectively completed database has identified 13 cases of plexus tumours assessed during this period. We reviewed the case files, imaging, operative records and histology for these patients and describe a structured approach to diagnosis and management.

Results: Thirteen patients were identified with a primary diagnosis of brachial plexus tumour. Four patients had symptoms of thoracic outlet compression with histological diagnosis of atypical lipoma (3: 1 interscalene, 1 costoclavicular, and 1 subpectoral) and hibernoma (1). There were two malignant tumours (one unresectable neurofibrosarcoma in a patient with NF2; and one synovial sarcoma treated with partial plexus resection, acute reconstruction and distal nerve transfer). The primary nerve sheath tumours included 6 schwannomata (5 sporadic isolated tumours; 1 in a patient with underlying NF Type 2), and all patients underwent surgical resection. There was one plexiform neurofibroma (in a patient with NF2). The anatomical sites for the schwannomata were upper trunk (1) C8 root (1), posterior cord (1),

proximal radial nerve (1), medial cord (1) and proximal ulnar nerve (1). The three lipomata underwent surgical resection with resolution of compressive neurological symptoms. The hibernoma patient is under surveillance and clinical review. All the primary nerve tumour patients had sensory (8) and motor symptoms (7) at presentations. Ten patients underwent surgical resection. Five of the schwannomata patients had temporary neurological sensory symptoms with good motor recovery. One patient had severe posterior cord dysfunction and axonopathy necessitating salvage of high radial tendon transfers.

Conclusion: Diagnosis of these lesions is challenging, and it must be borne in mind that they can masquerade as central or peripheral compressive pathologies. Resection appears to be the treatment of choice in the tumours that are amenable to it. Diagnostic imaging plays a vital role in pre-operative planning and assessment. Post-operative outcomes are ultimately related to the characteristics, pathological features and invasiveness of the tumours.

A-0703 Hand and wrist reconstruction in sclerodermic patients: A systematic review

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Objective: Hand reconstructive surgery in systemic sclerosis has long time been considered a taboo due to the frequent global stiffness and menaced wound healing associated with digital ischemia and skin tightness. We assumed that orthopedic operations to sclerodermic hands or wrists could be safely performed without significant complications affecting the therapeutic result. The purpose of this study was to review the current literature in relation to the beneficial outcome and morbidity after performing joint reconstruction in hands of sclerodermic patients.

Methods: Studies were identified through systematic review of the available literature in the Pubmed database up to November 15, 2016. Pubmed was searched using a set of search terms, which described systemic sclerosis, bone and joint surgery, and hand or wrist surgery. Only studies including joint reconstruction in hands or wrists of sclerodermic patients who were related to the functional outcomes and morbidity after surgery were selected. Reviews were excluded. Studies relevant to soft tissue reconstruction in sclerodermic hands or wrists, such as digital sympathectomy, autologous adipose-derived stromal vascular fraction, vascular reconstruction, or management of finger ulcers were also excluded.

Relevant data were determined prior to reading the selected articles.

Results: A total of 124 unique articles were identified in PubMed: 23 titles selected for abstract review; 16 abstracts did not meet the inclusion criteria or did not evaluate our predefined end point and were excluded; 7 articles were fully read and 2 more articles were considered irrelevant and excluded; and finally, 5 studies were deemed eligible for our systematic review. The cases where a systematic follow-up wasn't performed, because of death or loss of the patients, were not included. Forty sclerodermic patients with a total of 138 joint reconstruction procedures in hand were found. The operations concerned metacarpophalangeal and interphalangeal arthroplasty, joint replacement or fusion, Kapandji procedures, and ostectomy of the finger and removal of the hardware. No cases of wrist reconstruction were found. A low complications rate in terms of infection or digital ischemia after surgery was mentioned to all studies. In most of the cases, wound healing was uneventful, and only in some cases it was described slow. In cases of joint fusion, bone healing was successfully achieved. The functional outcome was reliable in all the cases.

Conclusions: The outcomes of hand surgery related to joint reconstruction in systemic sclerosis were found to be reliable and related to low morbidity. Moreover, the hand function has constantly improved after surgery. Results from future studies will unquestionably contribute to further establishment of knowledge about the therapeutic outcome after surgery in these suboptimal conditions of the sclerodermic hand.

A-0719 Treatment of scaphoid–trapezium–trapezoid arthritis

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Objective: The aim of this study is to show medium-term results in scaphotrapeziotrapezoid (STT) joint osteoarthritis treatment performing resurfacing arthroplasty with scaphoid anchorage.

Material and method: An observational, descriptive, and prospective study was performed. Ten patients with isolated STT joint osteoarthritis were studied between 2013 and 2015. Mean follow-up time is 26.3 months. Clinical results, functional, and subjective scores were reviewed.

Results: Patients are satisfied, getting an average of 2.1 (0–3) on the VAS score and 16.2 (2.1–27.86) in the

DASH questionnaire beginning to work in the first 3 months postsurgery. Recovery range of motion compared to contralateral wrist is 96.05% in extension, 95.31% in flexion, 86.82% in ulnar inclination, and 90.81% in radial inclination. The average handgrip strength of the wrist is 94.6% and pinch strength is 95.2% compared to the contralateral side. There are no intraoperative complications or alterations in postoperative carpal alignment.

Conclusion: Resurfacing arthroplasty is proposed as a good and newfangled alternative in isolated SST joint arthritis. To achieve a proper balance between the strength and mobility of the wrist, without causing carpal destabilization, it is important to obtain satisfactory clinical and functional results.

A-0724 Prevention of nail bed injuries will help meet the millennium development goals

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Objective: The purpose of this study was to estimate the total health-care costs and productivity costs of nail bed injuries. Injuries unintentional or intentional constitute a major public health problem causing many cases of disability and also a big cost burden to health budgets worldwide. In order to develop effective prevention strategies, most countries need better information about these injuries. In particular, data about the number and types of injuries and the circumstances in which those injuries occur is needed. Fingertip injuries caused by jamming doors are associated with a very high total health care costs.

Methods: Retrospective study of more than 3,500 nail bed injuries at a large plastic surgery department was conducted. The injuries were defined, categorized, and analyzed. Methods of repair were described. Results at follow-up clinic appointments were also reviewed; 90% of the repaired nail beds were graded good to excellent. Poorer results occurred with crush or avulsion injuries, with injuries of both nail bed and nail fold, and with associated infection. We were analyzed demographics of patients, mechanism of injury, method of treatment; use of anaesthesia; radiologic findings; and outcomes at follow-up clinic appointments.

Result: Ninety percent of the repaired nail beds were graded as good to excellent. Poorer results occurred with crush or avulsion injuries, with injuries of both nail bed and nail fold, and with associated infection. Nail bed injuries are the commonest pediatric hand

injuries presenting to the emergency department. If managed correctly, the patient recovers quickly and complications are rare.

Conclusions: Tens of millions of children require hospital care for nonfatal injuries, and unfortunately many of these are left with some form of disability, often with lifelong consequences. In order to develop effective prevention strategies, most countries need better information about these injuries. To reduce costs in the health-care system, we need to improve the quality and efficiency to make further cost reductions and at the same time provide the best care for children.

A-0730 Long-term outcome of distal radius vascularized bone grafts for scaphoid nonunion reconstruction

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Objective: To assess functional outcome and patient satisfaction 10–15 years following scaphoid reconstruction using Zaidenberg and Khulmann vascularized bone grafts.

Method: A review notes and radiographs of patients who underwent these procedures between 2001 and 2006 by a single hand surgeon. A telephone interview was conducted to assess current symptoms, if any, functional outcome by means of a Michigan Hand Questionnaire, and patient satisfaction.

Results: Thirty-six patients underwent surgery during this period of time. A Khulmann bone graft based on the volar carpal artery was performed in 23 cases. A Zaidenberg graft based on the 1.2 intercompartmental supraretinacular branch of the radial artery was used in 13 cases. The choice of graft was based on the anatomical location of the nonunion. The mean age at the time of surgery was 25 years. Fourteen percent of patients were smokers, and 11% stopped smoking perioperatively. Surgical reconstruction was performed at a mean of 19 months after injury. All the cases had radiographic evidence of bony union at their last clinic review at one year. Michigan Hand Score ranged between 78% and 100%. Patients who underwent delayed reconstruction had lower scores. The majority of patients reported good patient satisfaction and that they would recommend surgery.

Conclusions: Between 10 and 15 years following surgical reconstruction of scaphoid nonunion using vascularized bone grafts from the distal radius, patients had good outcome scores and were satisfied with their treatment. Despite intraoperative restoration of

scaphoid anatomy, carpal alignment, and bony union, delayed patient presentation and surgical reconstruction were associated with poorer functional outcome scores.

A-0735 Long-term clinical and radiological results after treatment of basal joint osteoarthritis by Swanson's trapezium implant arthroplasty

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Objective: Goal of the presented study was the evaluation of clinical and radiological long-term results after treatment of the first carpometacarpal joint by trapezium resection and implantation of a Swanson silicone prosthesis. Up to now, only a few long-term data for this surgical technique exist.

Methods: The results of 100 trapezium resections in 72 patients with subsequent joint replacement by a Swanson silicone prosthesis have been followed up over 8.6 years on average. The range of motion, the grip strength, tip, and key pinch were measured. The pain was evaluated using a 10-point rating scale. Activities of daily living were measured with the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. Also, a patient satisfaction questionnaire was completed at follow-up. In follow-up X-ray controls, subluxations of the silicone implants as well as bony abnormalities were evaluated.

Results: The postoperative range of motion of the trapeziometacarpal joint in radial abduction was 52° and palmar abduction 39°. The grip strength measured by Jamar dynamometer (second handle position) was satisfactory after surgery (16.5 kg, 80% of the contralateral side). The tip pinch was 3.3 kg (70% of the opposite side), and the key pinch was 3.5 kg (71% of the contralateral side). The DASH score was satisfactory with 22.5 points after surgery as well as postoperative pain (2.4 points). The majority of patients were satisfied or very satisfied after the surgical treatment. In X-ray controls, subluxations of the silicone implants were detected in 54 (61.4%) cases as well as bony abnormalities in 41 (46.6%) cases. However, there was no correlation between the radiological findings and patient satisfaction.

Conclusion: Trapezium resection and joint replacement with a silicone prosthesis achieves good clinical results. Yet, there are a high number of radiographic subluxations of the prosthesis and bone abnormalities. As other treatment options with similar clinical results exist, we have abandoned this method.

A-0739 Abductor pollicis longus compared to flexor carpi radialis ligamentoplasty in treatment of advanced degenerative arthritis of the first carpometacarpal joint

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Objective: To compare results of different surgical techniques in treatment of advanced stages of degenerative arthritis of first carpometacarpal joint

Methods: In total, 41 patients were operated (36 females and 5 males). Average age at time of surgery was 56.5 years. Distally based tendon strips of m. abductor pollicis longus (APL) and m. flexor carpi radialis (FCR) tendons were used in 23 and 18 cases, respectively. All patients showed advanced stage of degenerative arthritis (stage II–IV). The operative technique was chosen randomly. After surgery, the same postoperative protocol was applied to all patients (4 weeks of internal fixation with K-wire plus 2 weeks of plaster splint). Postoperatively, all patients went through program of physical therapy for an average of 6 weeks. First control visit was 3 months after surgery and final 1.5 years after surgery. The parameters measured were grind test, thumb abduction and palmar abduction range of motion, VAS (visual analog scale), quick-DASH (disability of arm, shoulder and hand), TSR (trapezium space ratio) and key, and pinch and grip strength (measured using Jamar dynamometer).

Results: Bilateral involvement was more frequent than unilateral for both groups of patients (52% and 56% for APL and FCR, respectively). Nondominant hand was more frequently involved in cases with unilateral involvement (61% and 56% for APL and FCR). Eaton-littler Rtg stage was 2.9 in average for both groups. In average, patients noticed pain 3.3 and 2.7 years before surgery. Grind test was positive in all patients (100%). Preoperative VAS and DASH values were 59.4 (APL) and 51.1 (FCR) and 36.5 (APL) and 32.5 (FCR). Preoperative key, pinch, and grip strength was 4.2, 3.2, and 18.6 kg (APL) and 4.5, 2.8, and 17.5 kg (FCR). TSR was 0.267 (APL) and 0.256 (FCR). Thumb abduction and palmar abduction were 61° and 55° (APL) and 63° and 49° (FCR). We noticed statistically significant improvement in all measured parameters pre- and postoperatively: VAS (59.4–21.7), DASH (36.5–21.4), key (4.2–7.0 kg), pinch (3.2–5.0 kg) and grip (18.6–26.4) strength, TSR (0.267–0.217), grind test negative (100%–0%), thumb abduction (61°–70°) and palmar abduction (55°–65°) improved. Similar results were obtained when FCR technique was used: VAS (51.1–13.5), DASH (32.5–17.4), key (4.5–6.4 kg),

pinch (2.8–4.5 kg) and grip (17.5–25.4 kg) strength, TSR (0.256–0.198), grind test negative (100%–0%), thumb abduction (63°–69°) and palmar abduction (49°–58°) improved. After comparing all parameters between two groups (APL and FCR technique), we found no statistically significant difference.

Conclusion: We can conclude that both used operative techniques are efficient in therapy of advanced degenerative osteoarthritis of first carpometacarpal joint. There are no significant differences in postoperative outcome between the two techniques and both can be used as operative procedures of choice with similar outcomes.

A-0744 Isolated scaphoidectomy and midcarpal tenodesis in SLAC wrist II

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Objective: Traditional surgical indications in SLAC wrist II are scaphoidectomy and capitulate arthrodesis or four corners arthrodesis or proximal row carpectomy. Traditional treatments fuse midcarpal joint or remove all the proximal row even if midcarpal or radiolunate joint are in good conditions. Why to treat midcarpal or radiolunate joint if cartilage degeneration in SLAC II wrists involve only radioscaphoid and scaphocapitate surface? To reduce midcarpal dislocation after removing scaphoid Heras-Palau, and other authors recently described a tenodesis with strp of FRC.

In this retrospective study, the authors describe their experience about isolated scaphoidectomy and midcarpal tenodesis in SLAC II wrists.

Methods: From January 2013 to December 2016, 8 SLAC II wrists were treated. All cases were evaluated pre- and postoperatively with X-Rays, MMWS, PRWHE, and DASH scores with an average follow-up of 22 months (min 6–max 40).

Results: All patients reported relief from pain, small improvement in ROM, and improvement strength. At the follow-up, there was an average reduction in pain from 7.33 to 2.9 VAS. There was an improvement in grip strength from 31% to 75% of controlateral side; 85% of the patients were satisfied with the results and were able to return to the precedent activities. Improvement in DASH was from 67 to 21 and in PRWHE was from 96 to 34. Radiographic controls revealed in two cases asymptomatic mid carpal radial subluxation. No degenerative changes in midcarpal joint occurred.

Conclusions: This preliminary results shows that midcarpal tenodesis can be a good possibility to treat SLAC II wrists preserving radiocarpal and midcarpal

cinematic, avoiding hardware and mechanical complications of arthrodesis and allowing the possibility of other more invasive next treatments.

A-0746 A financial analysis of processed nerve allograft utilization in a public sector peripheral nerve injury service

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Background: Processed nerve allograft provides an alternative reconstruction option for nerve gaps and avoids the donor morbidity associated with autologous nerve harvest. The results of a registry analysis are promising, and allograft uptake may increase as a result. This study assesses the potential financial impact of allograft introduction to a large tertiary referral peripheral nerve injury service and explores the wider implications for the National Health Service, a publicly funded health-care system.

Materials and Methods: A prospective database of nerve injuries at our institution was searched and identified 86 nerve grafts in 78 patients between January 2001 and June 2016. Autologous nerve grafting was performed in 70 patients with 35 sural nerve grafts, 43 upper limb donor sensory nerve grafts, and 8 allografts. The length of gap on the injured nerve requiring nerve graft was documented in 53 (68%) patients. The mean gap reconstructed was 4.25 cm (range 1–14 cm). The senior author reviewed the nerve gap and identified the size and length of allograft required for bridging the gap in 53 cases, and the most economical combination of allograft lengths and diameters was calculated by the lead author to minimize intergraft neurotomy.

Results: The mean cost per case for processed nerve allograft is £3,500 (range £1,395–£15,875). Estimated cost per annum for the west Midlands Peripheral Nerve Injury Service would be £61,000 for use of processed nerve allograft in all nonbrachial plexus reconstructions. Review of the national NHS Hospital Episode Statistics data (HES) for England for all nerve graft codes identified mean annual nerve graft cases of 304 (range 228–368) over a 6-year period to 2015. Although these numbers are likely to be low due coding errors and coding hierarchy reporting processes, a conservative estimate of processed nerve allograft costs to NHS England for a similar spectrum of nerve injuries and gaps to our internal review would be approximately £1,064 million.

Conclusions: Processed nerve allograft provides an elegant solution to the management of nerve gaps and evidence for efficacy is growing with the results of a registry. There are individual and institution benefits from introduction of nerve allograft, and these must be carefully weighed against the added costs. A strategy for implementation is discussed.

muscles are proposed; fiber counts of donor and recipient nerves also endorse for donor choice.

A-0748 Nerve transfers and neurotizations in the palm: Alternative and novel approaches

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Objective: In proximal median and ulnar nerve lesions, babysitting through distal nerve transfers has proven effective in protecting distal effectors from hypotrophy. The aim of this study is to investigate the shortest and easiest ways to connect donor nerves to recipient ones or to perform direct muscular neurotizations from donor nerves in palmar region.

Methods: Anatomical dissections in palmar as well as in dorsal regions of 12 fresh frozen hands are performed in order to identify accesses, ways, and layers to best place grafts and sutures; samples from donor and recipient trunks are taken to compare fiber count compatibility.

Results: Data from anatomical dissections are reported, identifying accesses (even unconsidered approaches), for instance dorsal, measurements of nerve graft needed length, best sites for a safer and more protected coaptation, or direct muscular neurotization as well as quantitative morphology of donor trunks, whether sensory or motor.

Conclusions. New alternative routes for easier and safer fiber transfer to recipient nerves or effector

A-0753 The pronator syndrome: Diagnosis and treatment

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Objective: The term pronator syndrome (PS) was used for the first time by Seyffarth in 1951 to describe a noncommon compressive neuropathy of the median nerve in the proximal forearm. In the most of cases, compression on the median nerve can take place between the two heads of the pronator teres muscle (PTM) or under the fibrous arch of the flexor digitorum superficialis muscle (FDS). The PS can be confused with the carpal tunnel syndrome (CTS), the anterior interosseous nerve syndrome, the epicondylitis, and the C6 root irritation. The Magnetic Resonance (MR) and electromyography (EMG) does not always help in the diagnosis, which is mainly based on clinical history and physical examination. The dynamic ultrasound (US) can be an important diagnostic test in expert hands. The treatment of choice is surgical.

Methods: From January 2003 to November 2015, we diagnosed 32 cases of PS, 5 males and 27 females, mean age 40.5 years (min 31–max 70). Fifteen patients were performing manual works with upper limb overuse. The EMG was performed on all patients. The diagnosis was based on symptoms and clinical tests and in 13 cases also with the dynamic ultrasound help. The patients were treated conservatively (neurotrophic drugs, physiotherapy, and rest) for 2 months. Thirty of 32 patients underwent surgical decompression of the median nerve in the forearm. All patients were subjected to postoperative rehabilitation treatment. The quick-DASH and VAS scores at rest and during the daily activities, paresthesias, and fatigability of the upper limb at time 0 (preoperative), at 1 and 3 months postoperative, were evaluated. Data were evaluated by the *t*-test.

Results: For two patients, the improvement in symptoms was obtained with the conservative treatment. The most frequent causes of compression have been the thickening of the fibrous arch of the FDS (25/30) and hypertrophy of the PTM (18/30). The Quick-DASH

and VAS scores showed a significant difference between 0 and 3 months in all patients: There was an improvement in upper limb function, the disappearance of numbness and pain both at rest than during activities. The dynamic US identified the site of compression of the median nerve in 13 of 13 cases.

Conclusions: The difficulty of a certain diagnosis of PS can lead to a later treatment or incongruous, resulting in the appearance of motor symptoms and partial recovery. In our experience, the history of repetitive manual activities, clinical examination, and the use of dynamic ultrasound have proven as key elements for early detection and targeted surgical decompression, ensuring a quick and lasting improvement.

Evidence level: IV

A-0755 Comparison of pain in healthy weight and obese patients with distal radius fracture

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Objective: Obesity may play a causative role in post-operative inflammation. Adipose tissue secretes a number of inflammatory proteins, including tumor necrosis factor α and interleukin 6 (IL-6). It was reported that IL-6 level is exaggerated in obese patients after surgery. This potential for obesity may cause increased pain levels when it is compared to individuals with healthy weight following trauma or surgery. The aim of the present study is to compare the pain levels of healthy weight and overweighted patients with distal radius fracture.

Method: Forty-six patients who have distal radius fracture were participated in this study. Patients were divided into two subgroups according to their body mass index (BMI) as "healthy weighted" BMI < 25, (mean age: 38.05 \pm 13.61 years, 10 male and 10 female) and "overweighted" BMI \geq 25 (mean age: 51.60 \pm 11.93 years, 9 male and 17 female). Pain intensity at rest, during activity, and at night was evaluated with Visual Analogue Scale. Beck Anxiety Inventory, Beck Depression Inventory, and DASH Outcome Measure was evaluated. Correlation between measurements and grouping factor were analyzed with Spearman's correlation coefficient in

nonparametric conditions. For further analysis, Mann–Whitney *U* test was conducted. Fracture types were classified according to Fernandez Classification.

Results: Pain intensity at rest, during activity, and at night was 2.96 ± 3.07 , 4.96 ± 3.00 , and 1.58 ± 3.12 points, respectively. A positive moderate statistically significant correlation was found between pain intensity at rest, during activity and BMI ($p = .003$, $r = .46$; $p < .001$, $r = .48$). Statistically significant difference was found between two groups in pain intensity at rest and during activity ($p = .04$, $p = .02$). There is no significant correlation between grouping factor and severity of trauma ($p = .323$). Dash scores of overweighted patients were mean 51.09, min–max 3.30–100; healthy weighted patients mean 41.71, min–max 0.80–88.33. Beck anxiety scores of overweighted patients were mean 15.87, min–max 2–29; healthy weighted patients mean 9.59, min–max 1.50–23. Beck Depression scores of overweighted patients were mean 10.22, min–max 4–17; healthy weighted patients mean 14.08, min–max 2–35.

Conclusion: Pain levels of overweighted patients were higher than patients with healthy weight. Increased pain state may cause pain-related conditions including complex regional pain syndrome. Therefore, designing a rehabilitation program including pain management strategies may provide additional benefits in obese patients.

Keywords: pain, anxiety, depression, obesity, distal radius fracture, rehabilitation

A-0756 Recovery pattern of functional outcomes in patients with distal radius fracture with accompanying ulna styloid fracture

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Objective: Ulna styloid fractures can occur in association with distal radius fractures. This combination can have a significant impact on the treatment and prognosis. Untreated ulnar styloid fracture proposed to be associated with poor wrist functional outcomes. The aim of this study is to determine the recovery patterns of functional outcomes in isolated distal radius fracture and distal radius fractures with accompanying ulna styloid fracture.

Method: A total of 53 patients with distal radius fractures, who did not have distal radio-ulnar instability, were recruited after nonsurgical treatment intervention within 1 week following immobilization period. Patients were assigned into two groups: group 1, patients with isolated distal radius fractures (age 44.91 ± 10.55 years; male:6, female:16); group 2, patients with distal radius fracture with accompanying ulna styloid fracture (age, 48.32 ± 15.7 years; male:15, female:16). Patients were assessed at 1, 3, and 6 months. Assessments included pain, wrist, and forearm range of motion using goniometer, grip strength data using Jamar Handgrip Dynamometer, DASH, and SF-36. Differences between the 2 groups were analyzed with Independent Samples test.

Results: Statistically significant differences between two groups were found in regard to DASH scores at first month (mean difference 20.80 ± 9.69 ; $p = .04$) supination (mean difference 19.96 ± 6.45 ; $p = .006$) and flexion ranges (mean difference 21.21 ± 7.35 ; $p = .009$) and grip strength (mean difference 7.55 ± 2.66 ; $p = .011$) at third month.

Conclusion: Patients with distal radius fracture with accompanying ulna styloid fracture showed reduced ROM (supination and wrist flexion), grip strength, and functionality in comparison with the isolated distal radius fractures at 3 months. Poor outcomes may be related to the fracture itself or to the coincidental soft tissue injuries. However, the recovery rate is slower at 3 months, and recovery patterns of two groups were similar at 6 months. These data can be useful to clinicians, patients, and health-care systems who need to plan for the future strategies.

Keywords: Ulnar styloid, distal radius fracture, rehabilitation, recovery, functional outcome

A-0759 Survival analysis of the Elektra 1st CMCJ arthroplasty following a change in implant design

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Objective: Joint arthroplasty at the carpometacarpal joint (CMCJ) of the thumb has had limited success due to loosening of the cup in the trapezium and subsequent dislocation of the implant. The design of the Elektra implant (Small Bone Solutions) has been modified to rectify this by changing the cup from a “screw-fit” design to a “press-fit.” This study is a survival analysis of the previous screw-fit and newer press-fit designs, to see if the change has been successful in reducing revision operations for cup loosening.

Methods: A retrospective survival analysis was performed on 95 screw-fit Elektra implants and 48 press-fit Elektra implants. Implant failure was defined as revision surgery of the implant, which was usually removal of the cup and trapeziumectomy. Hospital records, electronic X-rays, and patient phone calls were used to identify all revision procedures in both the groups.

Results: The 95 screw-fit implants had an average follow-up of 9 years (range 6 years 11 months to 12 years) over which time 40 (42%) required revision. The 48 press-fit implants had an average follow-up of 2 years 6 months (range 5 months to 5 years 9 months) over which time 6 (13%) had required revision. Kaplan Meier survival curves and statistical analyses using Mantel-Cox, generalized Wilcoxon, and Tarone-Ware tests were performed to show that the press-fit design was not significantly better in terms of survivorship than the older screw-fit design.

Conclusions: So far, the new press fit cups have a better survival curve than the older screw fit design. At this early stage of follow up this has not shown statistical significance, but they show promise for the future and we will continue to monitor their performance.

A-0761 Isotonic evaluation of tennis elbow operative treatment

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Objective: Tennis elbow is the most common upper limb entezopathy. Despite the fact that different methods of nonoperative treatment are applied such as pharmacology, steroid injections, and physical therapy, it is still major problem for orthopedic surgeons and therapists. After unsuccessful nonoperative treatment, the operative techniques should be considered. The aim of the study was to evaluate forearm biomechanical parameters after tennis elbow surgery.

Methods: Twenty patients (15W and 5M) with unilateral tennis elbow after surgery were examined with Biodex System 4Pro isotonic protocol. The protocol consists of three trials (0.5/1/0.5 Nm) with 12 repetitive movements of wrist flexion and extension. To examine the muscles condition, the grip strength was measured with Biometric Hand Grip Dynamometer. To assess patient's condition, the Quick-Dash Questionnaire was taken.

Results: To assess wrist extensors and flexors, biomechanical parameters were examined: total work,

average power, peak velocity and average peak velocity. There were no significant differences between operated and nonoperated limb. The wrist extensors total work was $6.2 \text{ J} \pm 5.3$ for operated and $6.3 \text{ J} \pm 4.9$ for nonoperated limb. The average power of wrist extensors was $2 \text{ W} \pm 1.9$ for operated, and $2.1 \text{ W} \pm 2.1$ for healthy limb. The wrist extensors average peak velocity was $186^\circ/\text{sec} \pm 29.1$ and $195.2^\circ/\text{sec} \pm 33.4$. The average global grip strength for operated limb was 27.3 ± 12.7 and for nonoperated 28.7 ± 11.6 – there were no significant differences between examined limbs ($p = 1$).

Conclusions: Tennis elbow operative treatment is a reliable method of patients cure. Forearm muscles biomechanical parameters are retrieving their function comparable to healthy side. Tennis elbow operative treatment leads to patients work return, everyday living functions, and work improvement.

A-0762 The Prevalence of agenesis of the palmaris longus muscle: A meta-analysis

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Objectives: The palmaris longus muscle (PLM) is a small superficial muscle of the anterior forearm and is widely used as a source of grafts for reconstructive surgeries of the hand. The high variability including agenesis of this muscle has been widely described. The aim of this meta-analysis was to determine the true prevalence of agenesis of the PLM.

Methods: In order to identify articles eligible for inclusion in our meta-analysis, an extensive search was conducted through the following electronic databases: PubMed, CNKI, Embase, ScienceDirect, Web of Science, SciELO, BIOSIS, and Google Scholar. Data on the prevalence of the agenesis of the PML, its side, and sex and geographic distribution were extracted by two independent reviewers. The extracted data were pooled into a meta-analysis with a random effects model using MetaXL version 5.0 (EpiGear International).

Results: A total of 63 studies ($n = 75,871$ upper limbs) reported data on the prevalence of agenesis of the PLM. The PLM was absent in 15.2% (95% CI: 11.5%–19.4%) of upper limbs. The absence of the PLM was observed with similar prevalence among dissected (15.1%, 95%CI: 11.4–19.1) and functionally examined (15.1%, 95% CI: 11.0–19.7) upper limbs. When observed, agenesis was found more common on left

than on the right side (51.4% vs. 48.6%). The absence of the PLM was more prevalent among female (17.7%, 95% CI: 11.5–24.8) than male (15.1%, 95% CI: 9.2–22.0) upper limbs.

Conclusion: Tendon grafts are highly important in reconstructive surgery. The PLM tendon is an important tendon which can be utilized for this purpose. However, surgeons should be aware of the high prevalence of its agenesis, and the existence of multiple functional tests which are used to detect the presence of the PLM. The awareness of high variability in the PLM is important during corticosteroids injections for treatment of carpal tunnel syndrome, where the tendon of the PLM is utilized as anatomical landmark. Moreover, physicians should bear in mind that the PLM protects the median nerve, and its agenesis can make the nerve more vulnerable to injuries.

A-0764 Nerve transfer surgery as a salvage option for severe recalcitrant motor radiculopathy

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Introduction and Aims: Although compressive cervical spine pathology falls within the remit of the spine surgeon, we have utilized upper limb nerve transfers as a salvage option in a subset of these patients to restore upper limb function where spine surgery has either failed or deemed inappropriate.

Materials and Methods: In this study, we present our experience in seven patients all of whom had motor dysfunction resulting from cervical spine pathology. Four had degenerative cervical root compression, one had a cervical cord tumor, one had a unifacet dislocation, and one resulted from an iatrogenic root injury following spine surgery. Six patients had previous cervical spine decompression, and one was deemed unsuitable for decompression due to long-standing loss of motor function.

Key results: A selection of established nerve transfers were used, tailored to each patient's neurological deficit. The mean follow-up was 15 months. All seven patients had evidence of reinnervation and restored function within the targeted muscles. There were no significant complications.

Conclusions: In cervical spine patients with long-standing upper limb paralysis without recovery following decompressive surgery, as well as those not offered surgery due to a low likelihood of recovery, targeted upper limb nerve transfers may offer an option to provide innervation to specific muscles and

restore upper limb function. Many of these patients have incomplete denervation which allows the possibility of performing late nerve transfers beyond the typically accepted time frame in acute nerve injury.

A-0765 Arthroscopic treatment of scaphoid nonunions: Is this better than open

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Introduction: In the treatment of scaphoid nonunion, the aim of arthroscopy as opposed to the conventional treatment is to reduce risk and operative duration, shorten recovery and immobilization time, and improve bone healing. Arthroscopic surgery indeed preserves vascularity as much as possible and makes the procedure safer and more accurate. This difficult wrist surgery, under development, it is performed on an outpatient basis, under regional anesthesia, the patient in supine, begins with an arthroscopic radio-carpal assessment verifying the integrity of the various ligament structures, the absence of osteoarthritis, and confirming nonunion.

Methods: Thirty patients were referred to our hospital from 2009 to 2015 with scaphoid nonunion. In Group A ($n = 16$), patients were treated with open reduction, debridement, corticospungious graft from distal radius and fixation with a compression screw. Group B ($n = 14$) was treated arthroscopically with focus debridement, distal radius graft when needed, and fixation with compression screw. Postoperatively, patients were treated in plaster for 4–6 weeks followed by splint for another 4–6 weeks. All patients underwent hand physiotherapy beginning at 6–8 weeks. All the patients were analyzed at the final follow-up using the Modified Mayo Hand score, Visual analogue scale, and radiological assessment in AP and profile.

Results: Mean age of the patients in Group A was 35 years (19–69) and M:F ratio 14:2. We lost two (12%) patients to follow-up. At a mean follow-up of 26 weeks (16–32), 13 (81%) patients achieved radiological union. All patients but three (81%) achieved good functional outcome at mean follow up of 52 weeks (32–74). In group B (Arthroscopic), mean age of the patients was 28 years (20–61) and M:F ratio 13:1. All scaphoids have a punctuate vascularization of proximal pole at surgery time. We lost 1 (6%) patient to follow-up. At a mean follow-up of 17 weeks (16–27), 12 (86%) patients achieved radiological union. All patients but 2 (86%) achieved good functional outcome at mean follow-up of 52 weeks.

Conclusion: Arthroscopic treatment of scaphoid non-unions provide better functional outcome with shorter time to reach consolidation compared with open treatment. Being a difficult technique, with a long learning curve, arthroscopic treatment of scaphoid nonunions should be provided to patients if available.

Therapeutic study: Level IV

A-0770 Evidence-based evaluation of functional outcome of spastic upper limb surgery

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Objective: The importance of correct evaluation of the functional outcome of spastic upper limb surgery is indisputable. Still, it is a question, what is the appropriate, evidence-based instrument or combination of tools. As the main goal, we present in this study our evolving current practice based throughout review of the literature and our personal experiences.

Methods: In the literature overview in our scope were the evaluation tools with high standards: excellent or acceptable test-retest and inter-/intra-rater reliability, internal consistency, criterion, construct, and face validity and recommended by professional association. On this foundation, we tried to develop an appropriate evaluation system for our spastic upper limb surgical reconstruction program in the National Institute of Medical Rehabilitation (Hungary).

The start of the present regime and also the current study is) 01/01/2014, and we terminated the data collection on 01/08/2016. 28 patients (11 stroke, 12 TBI, 2 CP, 3 other) have been operated during that period. Each patient has been evaluated 3 times, preoperative, on the 6-month and the 12-month follow-up. The main elements of the evaluation were as follows: physical examination (spontaneous position, active-passive ROM of the joints), video recording, House score, quick-DASH test and as functional tools grip force, key pinch force, modified Box and Block, modified 9 Hole Peg. As a last development, the last three patients were examined by ARAT and Frenchay Arm Test, and we also registered thumb ab-adduction and long fingers palmarflexion and release with Zebris CMS70P ultrasonography device. On the 12 months follow-up, we also asked the patients if she or he would have the same surgery again.

Results: In our group 12 months after the surgery, we have found the following average changes: House improved with 2.3, and quick-DASH mended with 20.64. Regarding the key pinch and grip force, there

were 22 persons who were unable release the fingers from the palm preoperatively; hence, no original data were recorded. Finally, they have reached average 1.2 kg key pinch and grip force below the lower limit (1 kg) of the dynamometer. In the other subgroup of six patients who were able to product strong, spastic grip and key pinch before the surgery, key pinch has been decreased with 0.9 kg, and the final grip force was below 1 kg. Usually progress has been recorded in modified Box and Blocks and 9 Hole Peg tests. All but 2 patients would have chosen the same surgical procedure again.

Conclusions: There are quite a few internationally accepted high standard instruments, but the practice in main centers is diverse. Following a successful surgery, a typical spastic hand is capable of good grasp-release and key pinch but usually unable to perform delicate tasks. Extensive, sophisticated tools are usually too hard for the mean spastic patient to complete with reliable result. Simple, easily executable tests could serve more creditable appraisal; however, sometimes they are not specific enough to display the changes. Valid evaluation can be reached with combination of quantitative-semiquantitative and functional instruments.

A-0772 Treatment of long finger hyperextension injuries in children participating in ball game activities: The development of a clinical decision guide

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Objectives: Hyperextension injuries of the long fingers are common in the paediatric population. However, exact guidelines regarding their diagnosis and treatment do not exist. The objective of this 5-year prospective study was to develop a clinical decision guide for the diagnosis and treatment of these injuries which improves diagnostic accuracy while reducing unnecessary and cost-intensive investigations.

Methods: Three-hundred consecutive patients under 16 years of age were included in the study. Patients were eligible for study participation when presenting with acute long finger hyperextension injuries acquired during ball game activities. To establish high- and low-risk parameters for severe finger injuries, a standardized clinical examination was conducted. Additionally, anterior-posterior and lateral radiographs of the injured finger were taken. Four

standardized clinical variables (location of pain, swelling and bruising, stability, and mobility) were assessed and recorded in medical charts by emergency physicians before radiography. The radiographs were assessed by a board-certified paediatric radiologist and by a senior paediatric orthopaedic surgeon in order to confirm or exclude a bone or joint lesion. All bony lesions present on a radiograph were compiled, and their risk to cause late complications was analysed. Furthermore, the predictive value of the clinical examination in the identification of low-risk injuries was assessed.

Results: Sixty-seven percent of children consulting for a finger trauma due to hyperextension did not have a fracture. No child with a low-risk clinical examination (no instability and only moderate restriction of mobility) of the injured finger had a subsequent high-risk diagnosis (relevant intra-articular fracture, instability). Among 64 clinical high-risk diagnoses, only 11 significant fractures were found.

Conclusions: In the present study, we were able to show that treatment decisions after hyperextension finger injuries can be based on a clinical evaluation when using a standardized evaluation protocol. With our clinical decision guide, the likelihood of missing significant high-risk injury is very low, and thus the majority of radiographs currently taken can be avoided. Once the method is fully validated, clinicians will be able to apply it without endangering patient health, substantially reduce treatment costs, and improve patient flow in the emergency department.

A-0773 Arthroscopic assessment of surgically treated wrist fractures improves diagnosis and treatment

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Fracture of the wrist is a very common pathology in our hospitals. Currently, the most endorsed treatment for these fractures is osteosynthesis with a volar plate. In some centers, arthroscopy is added as an adjuvant treatment, but there is no scientific evidence for a clear improvement in the results. Adding arthroscopy to the surgery of wrist fractures has a great sanitary and economic impact (prolongs the time of surgery, requires trained personnel, offering in return a better prognosis functional recovery). That's the reason why we present a descriptive retrospective study of 164 cases of distal radius fracture surgery by means of volar plate osteosynthesis and

wrist arthroscopy between January 2011 and October 2015. Wrist fractures were considered surgical according to La Fontaine's criteria. We assessed the presence of associated injuries confirmed by arthroscopy and the arthroscopic treatment as well as the functional outcome obtained according to the DASH an PRWE scales and the occurrence of complications (infection, joint stiffness, Complex regional pain syndrome, tendon injuries, and compartment syndrome). Of the 164 cases included in this study, 71.4% were women. The mean age was 57 years (range 20–84) and 91% of them had high functional demand. Of all patients, 93% had intra-articular fragments, appreciating step in 36.4%. Arthroscopic reduction in steps was necessary in 10% of them (not seen by fluoroscopy). Between the associated lesions we found scaphoid fracture in 4%; 18% scapholunate injury and / or lunotriquetral grades III and IV classification Geissler of which 19 patients had acute lesions treated with k-wires; 50% triangular fibrocartilage complex injury, of which 30 patients needed treatment (above elbow splint or phoveal implant) and 14% chondral lesions (only debridement). We treated and modified postoperative treatment because of the arthroscopic findings in 32% of the patients. Complex regional pain syndrome appeared in 11 (7%) cases of which 6 were solved within 6 months. A subsequent arthroscopic arthrolysis was necessary in 2 cases. In summary, 32% of the patients treated with arthroscopy plus open osteosynthesis of distal radius fracture, modified their preoperative diagnosis, and the further treatment. Anatomic reduction in the articular surface is the primary goal treating these fractures for prevention of posttraumatic arthritis. In the study of Edwards, a 33% of joint steps/gaps were not seen by fluoroscopy. In our study, a 11% of the steps were seen arthroscopically. Our study has limitations because is descriptive and doesn't compare the results with the open technique without arthroscopy. It would also be advisable a prospective study to evaluate the relationship between time of surgery and postoperative regional dystrophy/stiffness because in our study the majority of the patients with this complication were operated at the beginning of the study, so we suspect a learning curve association. Finally, its not clear the appropriate treatment of soft tissue injuries of the wrist so a prospective study should be conducted.

1.-Wrist arthroscopy helps to identify associated lesions not visible in previous studies and joint steps, thus adapting the appropriate postoperative treatment.

2.-Despite increased surgical time, we consider it advisable in the articular fractures.

A-0778 Lunate fossa resection arthroplasty for old Kienbock disease

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Kienbock disease is relatively rare condition that has usually good prognosis with or without treatment. Sometimes (especially in neglected cases), we faced with patients with obvious degenerative changes in lunate fossa and pain. There are different options for this problem from resection of the lunate to different types of limited and complete wrist fusion. We started to treat these patients with a simple resection arthroplasty of lunate fossa and evaluated their final results in a 12–39 months follow-up. Six patients, five male and one female, with wrist pain and known diagnosis of previous Kienbock disease underwent lunate fossa resection arthroplasty. Inclusion criteria were disabling pain resisted to medication and splinting; plain radiography showed degenerative changes in lunate fossa without generalized osteoarthritis. The technique was a simple resection of 2–3 mm thickness of the degenerative lunate fossa with a cutting burr via trans-4 portal as working portal. The patients' age was from 36 to 45 years. Two patients had previous radial shortening 4 and 5 years before index surgery, three patients have had refused surgical treatment, and the pain had been increased before index surgery, and one patient had come with advanced stage of the disease without previous history of the diagnosis and treatment. Total mean arc of range of motion of the wrist increased from 42° to 58°. Mean VAS score decreased from 6.3 to 2.1. Quick DASH score decreased from 45 to 22. Four patients satisfied from decreasing wrist pain, one patient showed no pain relief and one patient underwent total wrist arthrodesis. The rationale of lunate fossa resection arthroplasty are: 1- scaphoid fossa spares even in late stages of Kienbock disease; 2- well-known good results of arthroscopic resection arthroplasty at first CMC rhizarthrosis which has the same radiologic findings; and 3- acceptable indication of radius styloidectomy in isolated degenerative changes of this articular surface. Reasons against this technique are: 1 - the majority of the force in radiocarpal joint crosses from lunate fossa; 2 - the differences between simple debridement and complete resection is hard to judged; and 3 - degenerative changes could be accelerates with changing the carpal biomechanic after this procedure. We suggest this simple technique in patients with neglected or failed previous treated Kienbock disease with degenerative changes in lunate fossa and sparing other perilunate articular surfaces before trying for any type of carpal arthrodesis.

A-0779 Olecranon osteotomy with hinge external fixator for complex cases of old unreduced elbow dislocations

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Background: Old unreduced elbow dislocation is a rare condition. The treatment of this problem is difficult. For good results, we need a stable fixation and early range of motion after a perfect reduction. Elbow hinge external fixator is the device of choice for stable fixation and early range of motion. Open reduction may be achieved by a direct posterior approach or medial and/or lateral approach. In complicated cases such as long-standing dislocations, heterotopic ossifications or intraarticular malunions, to achieve a perfect reduction is difficult. In such cases, we use an olecranon osteotomy.

Objective: We reviewed our patients who had a combination of olecranon osteotomy and elbow hinge external fixator to find out its complications and results.

Method and patients: Between January 2007 and December 2012, we had 7 patients with complex elbow dislocations, underwent open reduction with olecranon osteotomy and hinge external fixator insertion. Three were with intra-articular malunion, two with more than 6 months dislocation, and two with extensive heterotopic ossifications. In semilateral position, the patient underwent olecranon osteotomy, olecranon fossa was cleaned, heterotopic ossification was removed, and the malunion was reduced. External fixator was applied. Olecranon was fixed with tension band and wiring. Active and passive motion began the day after operation. Fixator was removed after 8 weeks.

Results: Range of motion of all our patients improved. The final elbow range of motion was 70°–110° (98°). Elbow Mayo score was 60–95(82) at final follow-up. There was no any complication for olecranon osteotomy site and all of them showed union at 3 months.

Conclusion: Olecranon osteotomy is a safe procedure in combination with hinge external fixator insertion and makes the treatment of complex old unreduced elbow dislocations easier.

A-0781 Endoscopic Anatomy of the Carpal Canal

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Objective: In February 2016, we published a prospective study on the first 50 cases of the suprapretilacular endoscopic carpal tunnel release. Since this time,

we have performed 1023 supraretinacular endoscopic carpal tunnel releases. The purpose of this paper is to share with you new patterns of carpal canal anatomy and improvements in this technique.

Methods: All supraretinacular endoscopic carpal tunnel releases were recorded on video, and any interesting anatomical variation or problems encountered were documented on a database.

Results: Videos will show recurrent motor branches traversing abnormal muscles, the transverse carpal ligament, cross communication between the ulnar nerve and the median nerve, and aberrant blood vessels and muscles. Of the 1,023 cases, there were 218 anatomical variations of the motor branch. There were 46 vascular anomalies and 94 cross-communications between the median and ulnar nerve. It was found that 39 (3%) of the 1,023 variations were at risk of iatrogenic damage. The mean operating time for a simple supraretinacular endoscopic carpal tunnel release was 4 min.

Conclusion: Supraretinacular endoscopic carpal tunnel release is a simple procedure when there are no anatomical variations. This presentation will demonstrate how the flexor tendons, nerves and carpal canal can be explored and how anatomical variations appear when visualized using a supraretinacular endoscopic carpal tunnel release technique.

A-0782 Dry arthroscopic repair of the foveal insertion of the triangular fibrocartilage

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Objective This presentation will demonstrate how to visualize the foveal insertion of the triangular fibrocartilage using arthroscopic techniques, how to debride the soft tissue to see the foveal insertion and how to arthroscopically assess the peripheral and foveal insertion of the triangular fibrocartilage.

Methods: Seventy-one cases of symptomatic painful distal radioulnar instability underwent surgery to stabilize the distal radioulnar joint using a dry arthroscopic technique between 2012 and 2016. In all cases, there was a tear in the foveal insertion of the triangular fibrocartilage or the foveal insertion was intact but incompetent. None of these instabilities was attributed to malunion of the radius or the ulna. The decision whether to arthroscopically repair the fovea or repair the fovea with a tendon graft was made based on the anatomic defect at the time of arthroscopy.

Results: Of the 71 cases, 68 (96%) were stabilized with resolution of ulnar-sided wrist pain and the creation of a stable distal radioulnar joint. Of the 71 surgeries, 3 did not result in a stable distal radioulnar joint. These three cases required a second operation to achieve a stable pain-free distal radioulnar joint. Two cases were successfully stabilized using a distally based slip of the extensor carpi ulnaris passed through a bone tunnel in the distal ulnar using an arthroscopic technique. One case was successfully stabilized using arthroscopic palmaris longus graft to reconstruct the foveal insertion. Approximately 80% of cases achieved full flexion and full extension of the wrist. 20% of the cases achieved a functional range of flexion and extension (defined as a range of flexion or extension ranging from 35° to 59°). 87% of cases and a full range of pronation, 11% had a functional range of pronation (defined as between 50° and 79°). One (2%) case had a restricted range of pronation (defined as between 0° and 49°). 83% of cases had a full range of supination. 17% of cases had a functional range of supination (defined as between 50° and 79°)

Conclusions: To our knowledge, there has been no documentation of the routine use of dry arthroscopic techniques to repair the triangular fibrocartilage. The ability to visualize the foveal insertion using dry arthroscopic techniques enables the pathology to be identified and the repair to be specific to the triangular fibrocartilage injury. Using dry arthroscopic techniques not only makes the procedure easier but provides information as to whether the TFCC can be arthroscopically directly repaired or whether a tendon graft is required to augment the repair.

A-0783 How to make the Sauve-Kapandji procedure work

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Objectives: The Sauve-Kapandji procedure has fallen into disrepute because of problems caused by painful instability and impingement in the forearm. This paper documents that the routine use of an interposition ulnar head and stem prosthesis inserted into the surgically created pseudo-arthritis solves this problem.

Methods: Between 2000 and 2016, 28 procedures using a ceramic titanium distal radial ulnar implant as a routine part of the Sauve-Kapandji were performed. Pronation, supination, 2-point, 3-point, key strength, Jamar grip strength, and visual analogue

scale were assessed postoperatively. Measurements were compared to the contralateral unaffected side to determine the functional value of this procedure.

Results: Of the 28 cases, 17 (61%) had a full range of supination. Four (14%) cases had in excess of 70° supination. Two (7%) cases had limited supination of 30° and 40°, respectively. Twenty (71%) cases had full pronation, 1 case (3.5%) had near-full pronation (in excess of 70°), and 1 (3.5%) case had limited pronation measuring 40°. There was no significant difference between 2-point, 3-point, and key power between the affected side and contralateral side. There was a 16% reduction in Jamar grip strength in the operated side. The average visual analogue scale (VAS) scored 0.4 at rest and 3.1 on use. Only 1 case required revision surgery. A larger ceramic head was inserted and the forearm was stabilized with a palmaris longus graft augmented with tendon graft substitute. In some cases, the excised distal ulnar shaft metaphysis was used as a vascularized bone graft pedicled on the pronator quadratus to augment the distal radioulnar joint fusion. This was especially useful when the bone defect was in the region of the sigmoid fossa. It maintained the width of the wrist, which improved cosmetic appearance and avoided having to harvest additional bone graft to achieve a distal radioulnar joint fusion. There have been no cases of significant erosion of the ulnar head into the distal radial metaphysis, including in rheumatoid patients.

Conclusions: The advantage of using a distal ulnar implant inserted into the pseudo-arthritis of the Sauve-Kapandji procedure is that it solves the problem of painful radioulnar impingement, which is often associated with the Sauve-Kapandji procedure, resolves the clicking that can be associated with Sauve-Kapandji procedure, and solves the palmar dorsal instability of the radius in relation to the distal stump of the ulna which can cause mechanical pain, weakness and secondary problems with impingement of the extensor tendons. The Sauve-Kapandji procedure has fallen into disrepute because of painful unstable impingement. Our experience is that the routine use of a standard ceramic ulnar head inserted into the pseudo-arthritis of the Sauve-Kapandji procedure once again makes this procedure a reliable and useful technique and one that should be considered before total joint replacement.

A-0785 Flexor digitorum superficialis tenodesis for treatment of flexible swan neck deformity of fingers: A randomized, double-blind clinical trial to compare two surgical techniques

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Objective: To compare two surgical techniques for fixation of a slipped flexor superficialis tendon during the flexor digitorum superficialis tenodesis procedure (as described by Curtis) and to correct swan neck deformity (SND) of the finger.

Methods: A two-arm randomized controlled trial design with two treatments: tenodesis with a bone anchor (treatment) and tenodesis with suturing the tendon directly to the A2 pulley (control). The outcome measures were the postoperative and the intraoperative (difference pre-post) extension of the proximal interphalangeal joint. We calculated the rate of SND recurrence (extension >0°), the relative risk of treatment versus control, and performed a two-sample *t*-test analysis.

Results: The mean postoperative extension was 7.75° (intraoperative 8.75°) in the treatment group and 0.60° (intraoperative 13.60°) in the control group. The overall SND recurrence rate was 61.5% (8/13), 62.5% (5/8) in the treatment group and 60% (3/5) in the control group. The relative risk was not significantly different than one, and the traditional comparative two-sample *t*-test did not reach significance. The nonsuperiority test of treatment versus control was significant at 0.05 level with an equivalence margin 6.37° in terms of postoperative extension, and 4.93° in terms of intraoperative.

Conclusions: This study cannot conclude that one technique is better than the other one but only that, if the bone anchor technique is superior to the A2 pulley technique, it gives a mean postoperative extension no smaller than 6.37 less (or a mean intraoperative no larger than 4.93° more) than the one obtained with the current technique (A2 pulley). Further studies, with a larger sample size, will be able to reduce the equivalence margin or even to indicate which is the best technique.

A-0789 In Office Trigger Finger Release

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Objective: Delivery of health care is rapidly evolving. An emphasis on value rather than volume has driven many of the changes. In an attempt to increase the value of the services delivered to the patient, payor, and the surgeon, we have adopted an in-office/point-of-service

approach for the treatment of trigger finger. Contract negotiation combined with simplified surgical devices have allowed an increase in surgeon payment, with improved patient satisfaction. The combined efficiency for both the surgeon and the patient affords time and financial savings. This point-of-service experience has been embraced by the major insurance carrier in the state in which this study was undertaken. Results of 423 office-based trigger finger releases are presented from 2 surgeons at 2 separate facilities.

Materials and Methods: 423 trigger finger releases were performed on 379 patients under local anesthesia in the surgeon's office. There were 243 females and 136 males in the group. 82 patients were diabetic. All triggers were released through a mini incision. 205 patients had wounds closed with a single stitch; the remaining wounds were left open. All patients were allowed full motion and unrestricted use within the limits of pain at 2 days postprocedure. Trigger fingers were graded as 1: pain without mechanical locking; 2: mechanical locking that can be overcome with active flexion; 3: mechanical locking requiring passive force to achieve finger extension; and 4: grade 3 with fixed flexion contracture. The majority of triggers were grades 2 and 3. All patients except those with diabetes were offered up to two steroid injections. All patients were offered surgery in the operating room or the office. The decision for the in-office procedure was determined by the patient. Follow-up was an office appointment or by phone. DASH scores were recorded pre and postprocedure.

Results: All trigger fingers were successfully released. All wounds healed without infection. Six patients developed an inflammatory response between 2 and 4 weeks requiring outpatient therapy. DASH scores improved on average from 66 before the procedure to 5 postprocedure. The majority of the patients returned to full unrestricted use within 7 days. The insurance carrier supported the in-office approach.

Conclusions: Cost reduction with improved patient satisfaction can be reliably achieved by performing simple procedures in a more cost-efficient location. Patients, payors, and surgeons can benefit from point-of-service care.

A-0793 The use of the core hand exercise app: The future of exercise prescription

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Introduction and Aims: The Core Hand App (CHA) was developed in 2013 to improve patient satisfaction and compliance with home exercise programs (HEP). The CHA includes exercises in video format from

which the therapist can use to prescribe a HEP. From May 2015 to February 2016, the therapy department completed a patient satisfaction audit regarding use of the CHA.

Material and Methods: All patients with an iPhone/pad, meeting the inclusion criteria were recruited to the study. Participants had their specific HEP downloaded on their device, and this was reviewed at each appt. A telephone satisfaction survey was carried out 6 weeks following initial CHA download.

Key results:

- 112 patients met the inclusions criteria and were recruited.
- Feedback was gained from 69 of those patients.
- Four patients didn't use the APP.
- 65 sets of data were analyzed.
- 88% of patients rated the CHA as a "very user friendly" tool, with only 2% reporting the app was "not user friendly at all."
- 89% participants rated the CHA as "very useful" with only 2% rating it as not useful at all.

Conclusion: Most patients rated the App as being "Very User friendly" and "Very Useful." Results suggest that patients are satisfied with using the CHA as an alternative method of exercise prescription. The majority of patients using smart phones had Android operating systems and were excluded from the study, as the current service is only available to Apple systems demonstrating one limitation of the audit. We are now developing the CHA on the android platform and this will be available later in 2016. Our aim is to enable other hand therapy departments to be able to access the Core Hand App for use in their own practice and we will soon be making this available via the purchase of an annual license.

A-0796 Improving regeneration after nerve-transplantation: The impact of hypoxically preconditioned stem/precursor cells in a rat model

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Objectives: Incomplete nerve regeneration after autologous nerve grafting remains a significant problem in clinical routine. The application of autologous stem cells was hypothesized to improve nerve regeneration, yet to date this approach did not meet all of the expectations. In an attempt to improve the regenerative potential of autologous stem cells, we hypoxically preconditioned the cells before they were applied in a sciatic nerve defect model in rats.

Methods: On day 0, adipose-derived stem cells were isolated from the inguinal fat pad of 36 wistar rats using the ARC centrifuge (Ingeneron). Cells were preconditioned in 2% of oxygen in a standard hypoxia incubator for 3 days. On day 3, right before implantation, cells were suspended in liquid fibrin glue (Artiss/Baxter), which was then cast into a solid nerve conduit of 25 mm in length, 2 mm in diameter, and 2 mm of wall thickness. The cell-containing conduits were then applied around a 20-mm autologous nerve graft in a sciatic nerve defect model covering both coaptation sites. In this model, a 20-mm segment of the sciatic nerve was cut out and reversely coapted under the microscope. While the experimental group ($n = 9$) received 2x10EXP6 hypoxically preconditioned cells, the control groups received either the fibrin conduit alone ($n = 9$), the conduit containing nonpreconditioned stem cells ($n = 9$), or no conduit at all ($n = 9$). During the trial period of 16 weeks, we conducted weekly walking-track and static foot print analyses yielding the sciatic function index (SFI), which is an excellent indicator of sciatic nerve function. After 16 weeks, the animals were sacrificed and the gastrocnemius muscle weight was determined bilaterally. Subsequently, morphometric evaluation including histology, axon counts and measurement of axonal thickness was carried out at 5 defined areas of the sciatic nerve.

Results: Our functional analysis showed a significantly improved SFI in all groups treated with a fibrin conduit when compared to the control group that did neither receive conduit nor cells. The group that received hypoxically preconditioned cells produced the best results, followed by the nonpreconditioning group, which in turn yielded better results than the fibrin conduit group without cells. These results were reflected in a significantly increased gastrocnemius muscle's weight ($p < .05$). On histology, conduit-treated animals showed a higher fraction of large axons, while at the same time presenting lower levels of nerve tissue fibrosis in all 5 segments of the operated side. The proportion of large axons as a fraction of the total number of axons was significantly higher in the distal one-third of the nerve grafts ($p < .05$) in the conduit groups when compared to the control. Correspondingly, the fraction of small axons was significantly higher in the distal half of nerve grafts in control group.

Conclusions: In this study, we demonstrated that hypoxic preconditioning of adipose-derived stem cells had a positive influence on functional nerve regeneration in an autologous nerve transplantation model. Interestingly, all groups with fibrin glue conduits significantly improved functional nerve regeneration, indicating that fibrin glue itself is beneficial in this context.

Keywords: stem cells, peripheral nerve regeneration, rat model

A-0799 Occupation-based hand therapy: Hype or hope?

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Background / Objective: Occupation-based hand therapy balances the value of occupation as a therapeutic mean and the value of maintaining sound biomechanical principles. Evidence for occupation-based interventions (OBIs) in the field of hand therapy is just beginning to emerge; and moreover, this evidence suggests that OBI are at least as effective as function-based interventions (FBIs). However, hand therapists are still facing barriers to the use of occupation in hand therapy. Therefore, this presentation aims (a) to give an overview of the current evidence of occupation-based hand therapy literature and (b) to discuss the benefits of and challenges to the use of occupation in hand therapy based on the available literature.

Methods: A literature search has been conducted from 2004 to 2016 for research articles with "occupation-based" AND "hand therapy" as search terms in title, abstract, or key words. The following databases have been screened: Pubmed, the Cochrane Library, and OTseeker. Reference lists from the available literature have been checked thereafter for additional articles. The search resulted in 21 hits including multiple study designs.

Results: The existing literature indicates that OBI in hand therapy might be effective, not only in terms of improvement in hand function but also as an increased interest of the client toward this treatment. Randomized controlled trials comparing OBI versus FBI for hand-injured clients favored the combination of OBI and FBI to FBI alone. For hand therapists, perceived benefits of the use of OBI are, for example, meaningful therapeutic experiences and a holistic approach to treatment. Barriers to occupation-based hand therapy are time constraints, lack of credibility of OBI, or the limitations imposed by the client's medical condition.

Conclusion: The current evidence shows that occupation-based hand therapy might not only be a hype but becomes an inherent part of today's clinical practice. The current evidence points out to the duality of the therapeutic focus – the combination of OBI and FBI – which seems to be most effective in treating hand injured clients. Nevertheless, future studies

should focus on the effectiveness of OBI to overcome the challenges to occupation-based practice in hand therapy.

A-0800 Surgical considerations for patients with cubital tunnel syndrome: By investigating outcomes from revision surgery

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Objectives: The aim of this study was to figure out surgical considerations of patients with cubital tunnel syndrome (CTS) by investigating the clinical outcomes and operative findings of patients with revision surgeries for CTS.

Materials and Methods: A total of 21 subjects (male 15, female 6, mean age 60.9 ± 7.7 years) with CTS who had underwent revision surgery for CTS were selected. In situ decompressions were performed in all 21 participants at the initial surgery. Additionally, anterior transposition in 9 subjects, medial epicondylectomy in one subject, and both anterior transposition and medial epicondylectomy in 2 subjects each were conducted at the initial surgery. After surgery, 14 participants complained of persistent ulnar symptoms and 7 participants suffered from recurrent ulnar symptoms. Revision surgery was determined after 22.8 ± 16.9 months from initial surgery. In situ decompression were done in all 21 subjects, and 2 subjects had Guyon canal decompression and 4 subjects got medical epicondylectomy additionally at the revision surgery. The McGowan's grade system and grip and pinch power were used to determine the surgical outcomes after 1 year from revision surgery.

Results: Ulnar nerve compression was major cause of revision surgery in all participants, and there were two main reasons for nerve compression in above cases. First, severe adhesions between ulnar nerve and surrounding tissues were observed in 11 cases. Second, previous incomplete releases of distal structures of cubital tunnel including fascia of flexor carpi ulnaris and deep flexor pronator aponeurosis were detected in 7 cases, and 2 cases showed both two reasons. The mean grip ($p < .001$) and pinch power ($p < .001$) were significantly increased after revision surgery. The mean McGowan grade was significantly improved after revision surgery ($p = .013$).

Conclusions: The primary goals of revision surgery for CTS were further decompression of surrounding

structures of ulnar nerve which had not been resolved in previous surgery. The sufficient decompression would be critical factor for successful surgical outcomes. From abovementioned results, two points could be derived. First of all, surgeons should consider anatomical variations in each patient by clinical examinations and advanced imaging before initial surgery. Second, further rehabilitation efforts should be considered after surgery for prevention of adhesion of surgical sites. Thus, careful patients' evaluation before initial operation and adequate rehabilitation treatment could lessen the patients discomfort and prevent revision surgeries for CTS patients.

A-0804 The efficacy of tele-rehabilitation intervention compared with traditional therapy after ORIF of elbow fractures

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The Objective of this pilot study was to examine the efficacy of tele-rehabilitation intervention using a computerized system (MediTouch) following open reduction internal fixation (ORIF) of elbow fractures. The main advantages of a tele-rehabilitation program are the ability of intensive home practice, increased interest, and motivation during the exercises and reduced number of visits to the hand therapy clinic. We hypothesized that the tele-rehabilitation program will be efficient as the traditional rehabilitation program.

Methods: Eighteen participants (7 males and 11 females) were recruited from the hand surgery unit in Sheba medical center, age range 19–73 (mean 45.28 ± 17.86 years). Inclusion criteria: post-ORIF of elbow fractures or elbow arthrolysis surgery, stable for mobilization. Exclusion criteria: rheumatology, neurological, or orthopedic conditions, such as injuries to the ligaments or nerves. The subjects were matched into study and control groups ($n = 9$ in each group) according to age and fracture type. The intervention for both groups included 1 month of rehabilitation sessions in an outpatient hand clinic and a home program. The subjects in the study group received two tele-rehabilitation sessions and one face-to-face session per week in the clinic. The control group received three treatments per week in the clinic. All subjects were evaluated before and after the intervention by the following tools: the Jebsen-Taylor Hand Function Test, The Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), The

Patient-Rated Elbow Evaluation (PREE), range of motion measurements, grip strength measured using a dynamometer, and a questionnaire which evaluated their level of satisfaction from the program. Our hypothesis was tested by evaluating the differences between pre- and postintervention and comparing the differences between the groups in range of motion, function, and satisfaction level using the Mann-Whitney *U* test.

Results: No statistical significant differences were found between the study and control groups in all measured parameters. Nonetheless, the subjects in the study group ranked their functioning level after 1 month with a higher score in the PREE questionnaire compared to the subjects in the control group. No differences were found in the satisfaction rate from the practice program in both groups, but the subjects in the study group reported a higher level of enjoyment.

Conclusion: Tele-rehabilitation is a legitimate form of treatment for individuals following elbow fractures since it yields results that are similar to face-to-face rehabilitation. However, tele-rehabilitation is advantageous by allowing the patient to independently exercise in his or her free time without the need to attend to the clinic.

A-0805 Biomechanical comparison of a new loop suture technique with conventional methods in flexor tendon repair: In vitro study

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Objective: Many suture techniques were developed to counteract postoperative active forces after flexor tendon repair, but the ideal suture technique has not yet been achieved. It was aimed to compare a new suture technique with other methods in chicken tendon.

Methods: 100 flexor digitorum superficialis tendons of Leghorn chickens were dissected and cut. Tendons were randomly divided into four groups. Group 1 tendons were repaired with 4-strand double modified Kessler technique, Group 2 tendons with 4-strand grasping cruciate technique, Group 3 tendons with 4-strand Tsuge loop suture technique, and Group 4 tendons with 4-strand new loop suture technique. 4/0 round polyester sutures were used for Groups 1 and 2 and 4/0 loop polyester sutures for Groups 3 and 4. All repairs were done by the same surgeon and only

cor sutures were evaluated. For biomechanical tests, Elista electromechanical load tensile tester was used. The repaired tendons were subjected to an initial tension of 0.5 Newton and pulled in separate directions at a rate of 0.2 mm/sec. The tests were terminated, and the most recent applied forces were recorded when there was a 2-mm gap between tendons or suture lacerated the tendon or when there was sudden breakage in tendon.

Results: The tendons in Group 4 were statistically better than the other groups ($p < .05$). There were no significant difference between Groups 1 and 2 ($p > .05$) and were in second place. Tendons in Group 3 gave statistically the worst tension force results in all groups ($p < .05$).

Conclusions: Studies with chicken tendons are the closest to human tendon studies. In this technique, suture is much more stable and with only 2 passes of the needle, 4 stranded sutures can be obtained so that the injured tendons are given less additional damage. The new 4-strand loop suture technique which gives the best results is a good candidate for a new flexor tendon repair method.

A-0809 Autologus chondrocyte implant in the treatment of thumb CMC joint osteoarthritis

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Objective: Degenerative thumb CMC joint osteoarthritis is a common disease in middle-aged woman. Nevertheless, synovitis and initial cartilage damage starts earlier and then progressive degenerative arthritis develops leading to joint narrowing with progressive exposure of subchondral bone, osteophyte formation, subluxation, and deformity involving also the surrounding joints. The aim of this study is to evaluate the outcome of the patients treated with autologus chondrocyte transplantation at thumb CMC joint often associated with dorsal ligaments reconstruction.

Materials and Methods: Ten cases of thumb carpometacarpal thumb osteoarthritis, stages II and early III, were treated by arthroplasty with the implant of autologus chondrocyte transplantation by open or arthroscopic technique. Preoperatively, all patients had persistent pain reluctant to different kinds of nonoperative treatments for at least 6 months. Mean preoperative pinch was 3.2 kg. All patients had a limitation of abduction and flexion at maximal degrees. Ethic committee approval of our institute had been

obtained. Fragments of 3–4 mm of cartilage were harvested under arthroscopy or by open technique from the wrist or elbow joint. Cartilage cells were sent to laboratory to grow on a collagenous biphasic matrix (Novocart). After 3 weeks, it has been possible to implant the chondrocyte augmented scaffold in thumb CMC joint using fibring glue or freeze them to have the second operation later. Ten CMC joint in 8 patients, all females, aged 42–68 years (mean 53 years) have been treated. Dominant hand was treated in 6 cases, and 2 patients had bilateral operation. In 8 cases, the patients were operated by open technique, and dorsoradiale or dorsooblique ligament reconstruction was associated stabilize the CMC joint. Patient were reviewed at a mean follow up 6.5 years (ranging from 5 to 9 years)

Results: Impairing pain disappeared in all patients and full range of motion was obtained in all cases . Mean pinch increased to 6.5 kg, and grip also increased in all cases. No complications occurred postoperatively. One patient was lost at follow-up and another patient, who did not have ligament stabilization, was converted to arthroplasty after 6 years for reappearance of pain.

Conclusions: The results obtained are encouraging, and implanted cartilage has lasted in the majority of cases up to 5–9 years. Tissue reconstruction is developing and could be an optimal solution to restore normal cartilage in young patients in order to postpone more aggressive procedures to an older age. In cases of instability, it is necessary to associate a ligament stabilization procedure to avoid subsequent damage to implanted cartilage. A longer follow-up and a greater number of cases are necessary to definitively establish the usefulness of this procedure which has the advantage of being completely biological but has high costs.

A-0816 The effects of manual soft tissue techniques on the elasticity of burn scars: Preliminary results of a comparative study

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Background and Objective: Hypertrophic burn scars remain a problematic challenge for both patients and health-care providers. In many cases, they are a source of morbidity presenting with lifestyle-limiting problems such as pruritus, pain, burning, stiffness, and even contractures and can severely limit a burn survivor's level of function, including work and recreational activities. Scar massage has become increasingly popular in the last 20 years, and despite the lack of evidence, massage should theoretically be effective. One hypothesis to support its use is that mechanical disruption of fibrotic tissue increases the pliability of the scar. Mechanical forces induce changes in the expression of extracellular matrix proteins and proteases, and massage may alter the structural and signaling environment. Manual soft tissue techniques are part of the techniques described under the general term "scar massage." To date, there are no reports of improvement in scar elasticity, measured with objective assessment tools. The aim of this study was to investigate the effects of manual soft tissue techniques on the elasticity of burn scars, measured with subjective and objective assessment tools.

Method: A single-blind, single-center, comparative study was carried out on 40 patients. The control group received standard of care comprising mobility exercises, pressure garment, silicone, and hydration as prescribed by the physician. Additionally, the intervention group also received manual soft tissue techniques. Elasticity of the scar tissue was measured subjectively by means of the Patient and Observer Scar Assessment Scale (POSAS), filled in by the patient as well as the observer. Objectively, the scar was assessed for elasticity with the DermaLab USB elasticity probe. The measurements were performed at baseline, after 1 month, 3 months, 6 months, and 1 year. Demographic data are presented with means and standard deviations. Friedman's Two-Way Analysis of Variance by Ranks was used to analyze the data over time, and Wilcoxon Signed-Rank test was used to compare the results after 1 year to baseline.

Results: To date, the preliminary results of 20 patients are presented. The intervention group consisted of 12 patients with a mean age of 45.5 years ($\pm 13.6y$) and a mean time after wound healing of 4.6 months ($\pm 1.8m$). In the control group, patients were on average 39.6 years ($\pm 12.8y$) old with a mean time after wound healing of 4.1 months ($\pm 1.7m$). In the intervention group, we observed a significant improvement over time for POSAS elasticity assessed by the patient ($p < .0005$, $d = 2.08$) as well as the observer ($p < .0005$, $d = 1.75$), as opposed to the

control group where no significant improvement was seen. For the objective elasticity measurements, there was no significant improvement over time for either of the groups, but the intervention group showed a significant improvement of elasticity after 1 year compared to baseline ($p = .017$, $d = 1.04$), which was not seen in the control-group.

Conclusion: These preliminary results point toward a trend that manual soft tissue techniques could give added value to the conservative treatment of burn scars. A larger sample size and randomization of the patients are necessary to confirm this trend.

A-0817 Needle aponeurotomy versus open fasciotomy in the mirror of evidence based data

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Objective: In our practice, needle aponeurotomy is indicated for patients with severe Dupuytren's contracture (Tubiana III- IV) as a first step procedure before open fasciotomy. Due to the high satisfaction rate of the patients, the second operation is often denied. Based on this, our goal was to find evidences to compare the two procedures.

Methods: Publications from the last 5 years were searched using PubMed and evaluated according to PRISMA questionnaire.

Results: Our search gave 34 articles for "needle aponeurotomy" and 66 for "Dupuytren's fasciotomy." Overall, 25 publications were dealing directly with the two methods, and only 3 articles were highly valuable (II-III). Altogether 372 patients were involved in the studies mostly with mild contractures (Tubiana grade I-II). They were assigned into two groups according to the technique: percutaneous needle aponeurotomy and open fasciotomy. One trial supplemented aponeurotomy with lipofilling. Total extension deficit was measured throughout the follow-ups in each study, and no significant difference was found. For patients with percutaneous needle aponeurotomy, the rate for short-term complications, for example, nerve damage, septic problems, was significantly lower compared to the open technique (5.2% vs. 24.3%). One of the studies had a follow-up of 5 years and found that the recurrence rate in case of open fasciotomy was significantly lower than with needle aponeurotomy (20.9% vs. 84.9%). The appearance of recurrences occurred later in time for the open fasciotomy group. However, another study concluded that after 1 year, and there was no significant difference in

recurrence. As mentioned in one article, the patient satisfaction was high in both the groups, but it was significantly higher when open fasciotomy was performed. Almost half of their patients preferred percutaneous needle aponeurotomy for the second surgery in case of recurrence.

Conclusions: Needle aponeurotomy has just as good results as open fasciotomy in case of MP joint mild contractures. There is no evidence of one being superior to the other as both have advantages and disadvantages.

Remarks: Objective comparison of the results was difficult as each article used various points of views for evaluating the outcomes.

A-0818 Functional recovery after shoulder tendon transfer in patients with Duchenne-Erb's palsy, following structured rehabilitation protocol

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Objective: To observe the effect of a therapeutic exercise program followed by the patients with Duchenne-Erb's palsy who received m.latissimus dorsi (LD) and m.teres major (TM) tendon transfer.

Methods: The survey was conducted in the period between 2012 and 2016. The contingent of the study was 32 children (18 boys and 14 girls) with mean age of 6.5 years who received tendon transfers in the shoulder. Our postoperative protocol is 24 weeks long and consists of four phases. Each phase consists of several short-term goals and appropriate therapeutic exercises and techniques to achieve them. To move from one phase to the next, the patient has to cover certain criteria related to the time after the surgery, lack of pain, and performance of certain movements. The protocol consisted mainly of isometric exercises, active assisted exercises, and active exercises and progressive resistance training in the latest stage. There are also specific techniques for retraining the transferred muscles, exercises to improve synchronization between the scapula and the humerus, and the proprioception the upper limb. The methods used for functional evaluation were goniometry (active range of motion (AROM) of the abduction and external rotation (R ext) of neutral position in degrees), Active movement scale (AMS), and Modified Mallet scale.

Results: For the statistical analysis, we used Student's T-criteria for dependent samples. Preoperative observation showed low values of

abduction – average 35.3°, which is not enough for good functional performance of the upper extremity. The active external rotation is impossible because of impaired innervation of external rotators. The final measurements (at the 24th postoperative week) showed significant improvement – abduction was average 101.2° and R ext was average 56.2°. All differences are statistically significant ($p = 99.9\%$). Preoperative AMS showed average 77.5 pts., but in the 24th postoperative week was significantly improved to average 88.9 pts. Preoperative average complex score of Modified Mallet scale was 12.7 points. At 24th postoperative week, there was marked improvement in all tested movements in the scale, and as it was expected, the complex score was improved with 21.8 points ($p = 99.9\%$). These results are associated with the quality of the surgical technique, properly conducted immobilization period, proper selection of the active exercises for retraining the transferred muscles, and, not at the last place, the motivation and active participation of the patients.

Conclusions: The physiotherapeutic protocol is essential in specific surgeries like the tendon transfer. Its proper implementation in the 24-week postoperative period resulted in statistically significant increase ($P = 99.9\%$) in the active abduction and external rotation and muscle function. This determines the improvement in the important functional movements performed with upper limb and assessed with the Modified Mallet scale. Compliance, combined with individual approach and close relationship with the orthopedic surgeon provides good functional recovery of the upper limb after tendon transfer of m. LD and m.TM in patients with Duchenne-Erb's palsy.

A-0820 Ultrasound-assisted diagnosis of pediatric distal forearm and radial fractures

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Objective: Distal forearm injuries are very common in childhood. Diagnosing and reducing fractures are usually done by using X-rays or fluoroscopy. In recent years, several studies have shown that ultrasound can be used with the same efficiency as X-rays in certain pediatric fractures. The aim of our presentation is to introduce our prospective diagnostic study of pediatric wrist fractures.

Methods: Between 2010 and 2015, we have investigated 437 children with distal radial injury by point-of-care ultrasound. Sonography has been carried out by the primary care provider pediatric surgeon or resident, immediately after physical examination. Sonographic pictures were created from six standard longitudinal planes. Results were saved and compared to standard two planed X-rays, which were made according to the diagnostic protocol. Outcomes were evaluated by primary care physicians and also by a radiologist who has been blinded because he had not got information of related clinical cases.

Results: Of the 437 cases, 240 proved to be distal radial or forearm fracture radiologically. Sonographic results evaluated by the surgeons were the following: false positives: 4, false negatives: 5 (Sensitivity: 0.979, specificity: 0.98, positive predictive value: 0.98, and negative predictive value: 0.975). Results evaluated by the radiologist: false positives: 3, false negatives: 3 (sensitivity: 0.987, specificity: 0.985, positive predictive value: 0.98, and negative predictive value: 0.985).

False negative cases were all nondisplaced epiphyseolyses or torus fractures with slight clinical consequences. In cases of displaced fractures, there were no difference between the efficiency the two diagnostic methods. Children with false-positive sonographic pictures had long-lasting (more than 1 week) pain, and X-rays made in the fourth week have showed callus formation. We have made the conclusions that these were occult fractures invisible to X-rays. In these cases, ultrasound was more sensitive than conventional X-ray.

Conclusions: Pediatric distal forearm or radial fractures can be evaluated by ultrasound. Advantages of this method is the reduction in radiation and simplification of the diagnostic procedure. This point of care method is cheap, reproducible and learnable with a minimal skill required for ultrasound. Regarding the clinical consequences, we suggest that pediatric wrist fractures should be examined by ultrasound first, and X-rays could be used in operative and uncertain cases.

A-0824 Prevention of extensor pollicis longus tendon injury in pediatric ESIN technique by intraoperative ultrasound

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Objective: ESIN technique is the gold standard for operative treatment of pediatric forearm fractures. The distal insertion point of the radial elastic nail is a

question of debate. Although the dorsal entry point through the tubercle of Lister is biomechanically better than the conventional lateral radial area, the potential injury of the extensor pollicis tendon means an increased risk and requires a broad surgical exposure. Intraoperative checking by high-frequency ultrasound makes the insertion very safe and allows a minimally invasive technique.

Methods: Between January and October 2016, we have performed 27 ultrasound-assisted radial elastic nailing through the Lister's tubercle. During operation, we have determined the exact place of the Lister's eminence and the extensor pollicis longus tendon. High-frequency ultrasound (20 Mhz) was used by the surgeon, and the ulnar side of the Lister's tubercle was localized from a standard transverse plane. After inserting the nail, we rechecked the situation of the nail and tendon from both the transverse and the longitudinal plane. A dynamic sonographic examination was also done by extending and flexing the thumb. After sonography, elastic nailing was performed according to the standard technique under fluoroscopy. Ultrasonographic pictures were saved and analyzed postoperatively by the surgeon and a radiologist.

Results: Lister's tubercle and extensor pollicis longus tendon in the transverse plane were well defined in all cases. Tendon movement in dynamic examination from longitudinal plane was visible in 20 cases, and 4 times the surgeon was not able to localize it due to great edema. Average time of the intraoperative ultrasonic examination was 3 min. We have not observed any injury of the extensor pollicis longus tendon postoperatively.

Conclusion: Intraoperative ultrasound of the Lister's tubercle and extensor pollicis longus tendon makes the dorsal radial minimally invasive ESIN technique a safe method. The intraoperative examination is fast, cheap, and easily learnable for a surgeon. Although we have made our observations in pediatric ESIN cases, theoretically the method can be also useful in other minimal invasive technique, where there is a potential risk of extensor pollicis longus tendon injury. Further investigations are needed to confirm our initial findings.

A-0827 Diagnosis of scapholunate ligament tear: Literature review

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In the recent literature, there are several ways described for diagnostic measures of a painful wrist. We wanted to find out what is the best investigation

method for getting diagnosis in case of scapholunate ligament tear.

Methods: An online search of the PubMed database was performed concerning the 1993–2016 period. The key words “diagnosis” and “Scapho-lunate ligament” and “examination” and “Scapho-lunate ligament” were searched. The articles were filtered for title and abstract, and the relevant articles were evaluated by the PRISMA questionnaire.

Results: Fifty-four articles can be found for the “diagnosis” and “Scapho-lunate ligament” search words and 23 more for “examination” and “Scapho-lunate ligament.” Finally, four prospective trials met our inclusion criteria. Summarizing all the selected articles, we had information about 306 examined wrists. All these cases were somewhat symptomatic, suspicious for intrinsic ligament tear. The standard radiographic images were negative in all the cases. All of them were examined arthroscopically also. The arthroscopic evaluation of the intrinsic ligaments was considered to be objective by all the articles. Arthroscopic examination found a scapholunate (SL) ligament tear in 67 cases. This is 21.8% of the examined cases. The rate of SL ligament tear of the examined wrists is varying from 11% to 100%. If the ligament lesion was found by MRI, it was proven arthroscopically also. By contrary not all arthroscopically proven ligament injuries were visible on MRI or MR arthrography (sensitivity 72%).

Conclusion: If a patient after wrist trauma remains symptomatic, the most reliable is wrist arthroscopy. In case of any doubt, this should be the investigation for a final decision. This review demonstrates that no MRI, no MR arthrography, and no special physical examination can safely predict the presence of an SL ligament rupture.

A-0831 Thumb replantation: Functional recovery beyond 15 years of experience

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Objective: The aim of this retrospective study was to analyze the results of 42 thumb replantations with special and exhaustive attention on functional outcomes.

Methods: Between 1997 and 2014 we reviewed the thumb replantations performed in our

traumatological center. The level of amputation was classified according to Biemer. We enrolled just complete traumatic amputations that underwent to replantation procedures with at least 1-year of follow-up. In each patient, we analyzed ROM, grip strength, tip pinch strength, key pinch strength and tridigital strength, static and dynamic 2-point discrimination, Semmes-Weinstein pressure aesthesiometer test, cold intolerance and thermal sensibility, and upper limb function by means DASH and GLOBE tests.

Results: In the considered period, 124 patients with traumatic amputation or subamputation of the thumb were treated. Subamputations were excluded. Complete amputations were 74, and 42 of them survived completely. The overall survival rate was 57%. The mean follow-up time was 3.25 years. The mean metacarpophalangeal joint ROM was 51°, the interphalangeal joint ROM was 14°, and the Kapandji apposition test was 8°. The pinch strength in different position ranged from 71% to 98% compared to unaffected hand. The static two-point discrimination test was positive in 20% of patients, and the dynamic two-point discrimination test was positive in 30% of patients. The recovery of sensibility was described as S3 for those patients. The Semmes-Weinstein test showed that 40% lost protective sensation. Cold intolerance affected 86% of patients. About 70% of patients can discriminate between warm and cold sensation. The mean DASH score was 11.06. The return to previous work was possible for 80% of patients.

Conclusions: The long-term results of thumb replantation confirmed satisfactory outcomes in terms of general upper limb function, handgrip and pinch strength, and social and work reintegration. Sensory recovery remained unsatisfactory, especially about cold intolerance and two-point discrimination. Nevertheless, no patients needed any kind of revision surgery as a consequence of inadequate thumb sensibility.

A-0833 Should the Oberlin procedure be considered as a viable option for biceps reinnervation in long standing partial brachial plexus injuries? Retrospective comparative study with patients operated before and after 12 months of injury

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Introduction: The treatment of brachial plexus injuries has evolved considerably over the last 2 decades with the widespread use of nerve transfers. This was particularly more evident in partial injuries, where the Oberlin procedure became the standard nerve transfer for elbow flexion recovery. Nevertheless, most of these studies only included patients operated within 12 months of injury and did not recommend a nerve transfer in more prolonged injuries due to the increased risk of poor outcomes.

Objective: to report our experience with the transfer of a motor fascicle from the ulnar or median nerve to the biceps motor branch in patients with long standing (>12 months) traumatic brachial plexus injuries and compare the results of elbow flexion recovery in these patients with patients operated earlier (<12 months).

Methods: Between January 2007 and August 2016, 56 patients with partial brachial plexus injuries were submitted to a transfer of a motor fascicle from the ulnar or median nerve to the biceps motor branch to regain elbow flexion. Thirty-eight patients had a follow-up ≥ 12 months were included in this study. They were divided in two groups according to the interval between the injury and the nerve transfer: Group 1 less than 12 months and Group 2 equal or more than 12 months. The BMRC was used to grade the elbow flexion strength recovery. Twenty-nine patients were included in Group 1. The mean age was 29.8 years (17–50 years) and all of them were male. Fifteen had a C5–C6 injury, and 14 had a C5–C7 injury. The interval between the trauma and the nerve transfer was 8.45 months in average, ranging from 4 to 11 months. Nine patients were included in Group 2. The mean age was 27.8 years (17–49 years), and all of them were male. Five had a C5–C6 injury and four had a C5–C7 injury. The interval between the trauma and the nerve transfer was 15.4 months in average, ranging from 12 to 21 months.

Results: In Group 1, 82.75% (24/29) patients regained an elbow flexion strength $\geq M3$. 55.17% (16/29) $\geq M4$, 27.58% (8/29) $\geq M3$, 6.89% (2/29) M2 and 3.44% (1/29) M0.

In Group 2, all 9 patients regained an elbow flexion strength $\geq M3$; 77.7% (7/9) achieved an excellent elbow flexion $\geq M4$. There was no statistically significant difference among the two groups regarding elbow flexion strength ($p = .698$), level of injury ($p = .841$) or donor nerve used, ulnar or median nerves ($p = .226$).

Conclusions: The Oberlin procedure should still be considered as a viable procedure for biceps reinnervation in patients presenting late (>12 months of injury) with upper or upper and middle trunk brachial plexus injuries.

A-0835 Validation of wrist lateral radiographs: A new method using the ulnar styloid as reference structure of forearm rotation (preliminary report)

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Although standard wrist lateral radiographs should be obtained with neutral forearm rotation, there have been no reports on how we can validate the forearm rotation in radiographs already taken. The standard wrist lateral view is an orthogonal projection of the wrist with the X-ray beam parallel to the humerus with the elbow flexed to 90°. We found forearm CT images of five patients with nonulnar disorder, which were taken with the elbow flexed more than 70° and the axial images of which were perpendicular to the distal ulnar shaft. Straight lines parallel to the long axis of the humerus on axial plane were drawn on axial images at the level of the ulnar head, passing the most volar/dorsal point or the ulnar head (lines V and D), center of the ulnar head (line UH), and center of the ulnar styloid process (line US). In addition, a straight line was drawn from the center of the ulnar head to the center of the ulnar styloid process (line C). To identify in which direction the ulnar styloid process is located on the axial plane of the ulnar head, the angle between the lines C and UH were measured (ulnar styloid direction angle). To identify how volarly or dorsally the ulnar styloid process should appear on the wrist lateral view, the ratio of the distance between lines V and D and the distance between lines V and US were calculated (ulnar styloid location ratio). The mean ulnar styloid direction angle was 6° dorsally. The mean ulnar styloid location ratio was 1:0.54. Our results suggest that the ulnar styloid process should appear almost midway of the ulnar head on standard wrist lateral view. By this, we may validate the forearm rotation in wrist lateral views already taken. What's tricky about the wrist radiographs is that the volar/dorsal directions of the distal ulna are the same as the ones of the radius (and the hand which rotates along with the radius) only when the forearm is in neutral rotation. As the "lateral view" in practice is the lateral view of the radius (which rotates along with the hand), the ulnar styloid process appears to be located dorsally (and not in the midway of the ulnar head) on the wrist lateral view if the forearm is supinated. Surprisingly, a number of articles previously published are presented with wrist lateral views taken with the forearm supinated, even

including studies on the ulnar variance which varies with forearm rotation.

A-0842 Prospective study of 166 patients with waist and proximal pole fractures of scaphoid fixed by Herbert screw

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Objective: In this study prospectively was investigated the healing rate and time of acute waist and proximal pole fractures of the scaphoid fixed by Herbert screw.

Methods: Between January 1, 2010, and September 31, 2016, at our Department 166 consecutive patients with waist or proximal pole fractures of the scaphoid were treated by early Herbert screw fixation. In this period, all patients were treated surgically (only more 2 cases were treated conservatively). Percutaneous retrograde Herbert screw fixation was performed in 158 cases (95.1%), and in 8 cases scaphoid proximal pole fracture was fixed by open anterograde fixation. The wrist wasn't fixed by cast after surgery. Radiological investigation was performed at 8, 16 week, and half year after surgery. At same time function of the wrist was also detected.

Results: All 166 (100%) patients were healed. Bony healing was achieved within 8 weeks in 142 patients (85.5%). Compared to the contralateral site full function of the wrist without pain was detected in 153 patients (92.1 %). Screw removal was necessary in one case.

Conclusions: Herbert screw fixation of the scaphoid waist and proximal pole fractures results early bony healing and good function.

A-0843 History of the Hungarian Hand Surgery

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Objectives: Author presents the development of the Hungarian hand surgery from the beginning until nowadays.

Methods: The development, organization, and activity of the Hungarian hand surgery during last 50 years was summarized.

Results: Hungarian hand surgery started with surgical care of the hand injuries within the departments of trauma network. Increasing of the hand cases required systematic education. It was started according Austrian and German courses by professor

Manninger, followed by professor Renner. The courses organized by Central Trauma Institute resulted, that in all trauma departments the hand injuries and diseases, later hand infections were treated by well-educated and expert hand surgeons. In 1994 was established Hungarian Society of the Hand Surgery which organized every year scientific national congress and national and FESSH courses. In 2004 in Budapest was organized the 9th world congress of IFSSH and now in 2017 FESSH Congress.

Conclusion: We hope that the hand care, education, and scientific activity of the Hungarian hand surgery is at the European level.

A-0846 An insight into the pathogenesis of radial and ulnar aplasia using fate-mapping as a novel technique in determining the embryological basis of the zeugopod

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Introduction: Radial and ulnar aplasia are congenital hand conditions of unknown origins, but we have previously demonstrated in chicken models that ectopic sonic hedgehog (SHH) activities induce not only duplication disorders such as polydactyly and ulnar dimelia but also radial deficiencies. To further shed light on the pathogenesis of these conditions, we used Cre-Lox DNA recombination technology to fate-map zeugopod (forearm) cells so as to clarify the origins of the radius/ulna.

Methods: Cre-inducible Cybow transgenic (CPX) chickens were generated using a transposon vector system. Heterozygous embryos at stage 20HH were manipulated with Affigel beads and placed in the presumptive zeugopod (HOXA11-D13) region of the limb bud to induce clones of fluorescent cells, which could be followed through subsequent radial development. After 72 h, embryos were processed for cartilage visualization using wholemount immunohistochemistry and visualized with fluorescence dissection microscopy.

Results: Cre-bead application to polarizing zone cells induced fluorescent clones within the zeugopod mesenchyme and distal ectoderm confirming that the zeugopod originates from the posterior mesenchyme of the early limb bud. From these results, a provisional fate-map for the development of the limb was created.

Conclusions: Our provisional limb fate-map shows that the zeugopod originates from a more distal and posterior aspect of the limb bud than expected. Furthermore, use of the novel CPX transgenic chicken model will allow us to fundamentally define the origin of the radius on the limb bud and track its development. The implication of this model for understanding the pathogenesis of radial aplasia as well as other congenital hand conditions will be discussed.

A-0847 Do we need to repair TFCC after distal radius fractures

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Distal radius fracture was associated with a high incidence of triangular fibrocartilage complex (TFCC) tear. However, there is still controversy on the need of repairing TFCC after distal radius fractures. This study aims to evaluate the status of TFCC after the healing of distal radius fracture and to assess the functional outcome of patients with and without TFCC repair. Fifty-two patients with an average age of 54 years old who were elected for the removal of implants after union of distal radius fractures from September 2013 to January 2016 were recruited. Concomitant wrist arthroscopy was performed. For those who were found to have TFCC tear and were noted to suffer from symptomatic distal radioulnar joint instability, repair was attempted at the same setting. Clinical assessment and functional outcomes, that is, DASH score was recorded both pre- and postarthroscopy. There were 13 extra-articular distal radius fractures, 5 partial articular fractures, and 34 intra-articular distal radius fractures. Preoperatively, 21 patients complained of ulnar wrist pain and 36 were noted to have DRUJ instabilities. Their average range of movement was: 55° extension, 50° flexion, 81° pronation, and 86° supination. Their average grip strength was 73% of their unaffected wrist, and their DASH score was 28. Seven patients had intact TFCC while 44 distal radius (86%) were noted to have TFCC tears. Twenty patients underwent TFCC repair of which 7 had the repair at the fovea and 13 had the repair at the sigmoid notch. Twenty-five patients did not have TFCC repair as they were asymptomatic. At 6 months postoperatively, for the TFCC intact group, a trend in improvement (that did not reach statistically significant) in the range of movement of wrist, power, and DASH score within the TFCC intact group was noted. For the patients

with repaired TFCC, there was a statistically improvement in the wrist grip strength at 6 months 72% (pre) versus 80% (post) $p = .039$. There was also an improvement in the DASH score of 30 versus 22 at 6 months, which did not reach statistically significant. As for the patient with unrepaired TFCC, there was a statistically significant improvement in flexion, power, and DASH at 6 months: 50° versus 56° $p = 0=.006$; 74% vs 84% $p = .002$, and DASH 24 vs 11 $p = .003$. When we compare between the three groups, 1 – patients with intact TFCC, 2 – patients with TFCC repair, and 3 – patients with unrepaired TFCC, there was no clinical significance between the range of movement and grip strength both pre- and postarthroscopy. There was no difference between the groups with their pre- and 6 months post wrist arthroscopy DASH score. Our results suggested that irrespective of the TFCC status, there was an observed improvement, in terms of range of movement, power, and DASH score postarthroscopy and implants removal. Interestingly, there was no statistically difference between the groups with and without TFCC repair

A-0848 Return to Employment After Carpal Tunnel Release Surgery (REACTS): A survey of UK clinical practice

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Objective: Carpal tunnel release (CTR) is a common elective hand surgery procedure; however, there is limited evidence suggesting when and how patients should return to work postoperatively. Reported sick leave after CTR varies from a few days to several months. The aim of our practice survey was to identify the return to work advice provided by UK hand surgeons and therapists for patients undergoing CTR and to explore whether this advice is tailored to individual patient circumstances. This abstract presents a preliminary analysis; full results will be available for the Euro Hand Congress.

Methods: Data were collected via a paper-based and e-survey. Survey questionnaires were given to delegates at the British Society for Surgery of the Hand (BSSH) and British Association of Hand Therapists (BAHT) joint conference in October 2016. Subsequent electronic mail-outs were also sent to all members.

In addition, the survey link was e-mailed to members of the Association for Surgeons in Primary Care and the Reconstructive Surgical Trials Network. Question themes included the CTR treatment pathway and follow-up, diagnostic decision-making, and return to work recommendations for different job types.

Results: Preliminary analysis of the data has been conducted. Eighty (27%) hand surgeons and 61 (48%) hand therapists completed the survey at the BSSH/BAHT conference. A further 93 surgeons and 76 therapists completed the survey online. A minority of surgeons perform endoscopic CTR, with most using an open short-incision technique for 67–100% of their cases. For bilateral presentations, opinion varied on whether to advise simultaneous or staged surgery. Nerve conduction studies were not used routinely in CTR decision-making. Postoperative follow-up varied in both time scale and the health-care professional(s) involved, and the recommended return to work times scales for desk-based, light manual, and heavy manual workers were wide-ranging.

Conclusion: The preliminary data analysis demonstrates that a range of patient pathways exist for CTR in the United Kingdom. Furthermore, the advice provided to patients returning to similar jobs is not consistent. These results reinforce the need for further targeted research to explore the clinical implications of returning to work at different time scales and to examine the return to work experience from the patients' perspectives.

A-0851 Evolution of grip and pinch strength after open carpal tunnel release: Prospective analysis of 284 operations

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Objective: Our goal was to analyze the evolution of grip and pinch strength after open carpal tunnel release in relation with the history of the condition.

Methods: In our unit, an online database for prospective data collection of different hand conditions is available. It is mandatory to fill this form for every operated patient pre- and postoperatively. The grip and pinch strength were registered, and the overall satisfaction of the patients were examined and evaluated by a visual analogue scale of 1–10 (VAS). The data were collected preoperatively, after 1 week, 6 weeks, and 3 months. Patients were divided into 3 groups according to the time passed from the presentation of the first symptoms: less than a year history (group 1), 1–3 years (group 2), and more than 3 years (group 3).

Results: There were 382 started data sheets, but because of incomplete data or severe comorbidities we had to exclude 98. We have records about 284 patients. There were 139 patients in group 1. Preoperatively, the grip strength was 16.35 kg, and the pinch strength was 5.11 in average. At 1 week, the strength values decreased to 8.37 kg and 4.34 kg, respectively, and the satisfaction was 8.85 VAS. After 6 weeks, the grip strength was 15.13 kg, and pinch strength changed to 5.57 kg with the satisfaction level of 9.18 VAS. After 3 months, they grew further to 19.66 kg and 6.13 kg with the same level of satisfaction. In group 2, we had 104 patients with the mean age of 61.6 years. Preoperatively, grip strength was 16.86 kg and the pinch was 4.93 kg. After 1 week, it changed to 8.66 kg and 4.10 kg, 6 weeks 14.07 kg and 4.79 kg, and 15.47 kg and 4.74 kg (3 months). The average satisfaction was 8.7, 7.93, and 8.94 (1w, 6w, and, 3m). We had 82 patients in group 3 with the mean age of 57.67 years. Preoperatively, their grip strength was 19.78 kg and pinch 4.73 kg and at 1 week postoperatively decreased to 9.24 kg and 3.90 kg with the satisfaction level of 9.32 VAS. At 6 weeks, the grip strength was 16.44 kg, pinch was 4.88 kg, and the level of satisfaction was 9.03 VAS. After 3 months, the values increased to 17.18 kg and 5.45 kg, with no change in satisfaction.

Conclusion: Based on our results, we conclude that grip and pinch strength progress very fast after this type of operation. By the end of the sixth postoperative weeks, the preoperative level can be reached. The time from first symptoms to the operation doesn't make any significant change in this process. At the 3 months check-up, the patients had higher values compared to the preoperative data except for group 3. It is interesting, that the patients who got used to living with a compressed median nerve, after operation cannot reach the preoperative grip strength level. This also affected the overall satisfaction of these patients. The overall satisfaction of the patients show a good correlation with the increasing grip strength after surgery but there are many other influencing factors like night pain and changes in the numbness.

A-0854 Comparison of ultrasound and fluoroscopy evaluation of dorsal screw prominence after volar distal radius plating

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Objective: To investigate the accuracy of ultrasound versus fluoroscopy imaging for detecting dorsal screw prominence following volar distal radius plating in a cadaver model.

Methods: A standardized model for volar plating of the distal radius, followed by ultrasound and fluoroscopic evaluation of screw penetration of the dorsal cortex of the distal radius, was used in 46 fresh-frozen upper limb amputation specimens. Through a FCR approach, a standard volar plate (Stryker, Mahwah, NJ) was applied to the distal radius with the distal portion placed immediately proximal to the watershed line. Each of the 3 screws in the distal row were drilled, and the plate was removed. The screw hole length was measured with a depth-gauge and was recorded. For each hole, a screw length of +4, +2, 0, -2, or -4 was assigned via a randomization chart; for each specimen, 3 screws were placed such that they were secured to the volar cortex. Each specimen was evaluated, without attempted palpation of the dorsal distal radius, by fluoroscopy (mini-OEC 6600) and by ultrasound using an 18MHz transducer (MyLabOne Musculoskeletal: Esoate North America, Indianapolis, IN). Fluoroscopy evaluation was performed independently by one resident (PGY-3), one hand surgery fellow, and one hand surgery attending. Ultrasound evaluation was performed by a second-hand surgery attending. Evaluators were blinded to screw lengths and other evaluators' results. Final screw lengths were confirmed by open dissection and measurement with digital calipers. Statistical analysis was performed to assess the accuracy of ultrasound and fluoroscopy evaluation of potential dorsal screw prominence.

Results: In general, there was poor correlation between observers using fluoroscopy for determining the prominence of individual screws relative to the dorsal cortex of the distal radius, although fluoroscopy evaluation was typically helpful in identifying the presence of a prominent screw within the group of three screws. Ultrasound evaluation, however, was more reliable in identifying the presence of a prominent screw and was more accurate in identifying which specific screw(s) of the 3 was prominent.

Conclusions: Ultrasound evaluation for potential dorsal screw penetration of the distal radius following volar plating was found to be reliable and accurate, particularly when compared to fluoroscopy assessment in this cadaver model. As unrecognized variables may exist in the traumatic condition, clinical study is warranted.

Clinical Significance: Extensor tendon injury associated with volar plating of distal radius fractures may be caused by screw prominence at the dorsal cortex. Various radiographic views have been described to assist in the detection of dorsal screw penetration; however, the accuracy of such imaging is limited due, in part, to the morphology of the distal radius and limitations of two-dimensional imaging. The use of intraoperative (or post-operative) ultrasound may provide improved accuracy for the real-time localization of dorsal hardware prominence, permitting the removal or exchange of screws and reducing the risk of extensor tendon injury.

A-0857 Treatment of chronic neuropathic pain: Clinical experience with peripheral nerve stimulation

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Introduction: Central nerve stimulation (CNS) already has proved its efficacy for treatment of chronic severe pain. The aim of our clinical study was to prove the effectiveness of peripheral nerve stimulation (PNS) for treatment of chronic neuropathic pain syndrome of the extremities.

Materials and Methods: From 2005 to 2016, 43 patients (23 female, 20 male, aged 18–67 years, mean 45a) suffering from complex regional pain syndrome (CRPS) – mainly CRPS2 (chronic neuropathic pain) – were selected for treatment with PNS. All patients had a history of microsurgical procedures to their peripheral nerves and every possible conservative treatment but without any significant pain reduction. None of the patients was able to use the extremity functionally. Pain level at the Numeric Rating Scale (NRS) was in mean 9, even at rest, requiring not only psychological treatment but also somatical intervention. Stimulation leads were implanted in 38 patients to the upper and 9 patients to the lower extremity in a position along and close to the epineurium of the peripheral nerves. After a testing phase using percutaneous leads, the electrodes were connected with an implanted stimulator.

Results: Relief from pain occurred immediately after onset of stimulation. The positive effect was directly correlated with PNS and stable over years. PNS was effective to reduce pain from NRS mean 9 to NRS mean 3 and to regain functional use of the extremity in all patients. Several complications as electrode dislocation and technical defects but also infections had to be noted.

Discussion: PNS reduced pain deriving from peripheral nerves reliable and effective. Regarding our follow-up period of 1.6 years in mean PNS produced a stable, nearby pain-free interval in all patients. Positioning of the electrodes direct to the brachial plexus and to the sciatic nerve allowed movement of upper and lower extremity to nearby normal ROM. PNS seems to represent an important technology for treatment of CRPS in carefully selected cases.

A-0858 Upper limb proprioceptive and core stability training in Ehlers-Danlos Syndrome

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Objective: Ehlers-Danlos Syndrome (EDS) is a genetic mutation which is responsible for protein coding which provides to changes in soft tissues structure. Nowadays, it is divided into 10 different types which are connected with joints, ligaments, tendons, cardiac, and skin symptoms. Patients are suffering because of high developed pain ailments, deformities, congenital anomalies of the circulatory, and digestive systems. One of the greatest problem is high muscle fatigue and imbalance which leads to the joint instability. The aim of the study was to present the method of treatment in patients with the EDS with the proprioceptive, core stability training, and Kinesiology Taping applications.

Methods: Three patients (average age 23 years, all women) with the EDS type VII suffering from a very high developed pain ailments in the shoulders area (VAS: 8) and wrists (VAS: 6). Additional symptom was the subjective impression of the instability of the shoulder joints and wrists. Patient had been treated previously with multiple steroid injections, laser therapy, light therapy, strengthening exercise, and pharmacological therapy. The therapeutic effect in patients' opinion was too short and insufficient to the pain ailments. During the 1-month therapy, the Kinesiology Taping shoulder proprioceptive application and wrist fascia application was applied. Additionally, the upper limb proprioceptive training was conducted. The training consists of the eccentric exercises, coactivation, and upper limb exercises with the unstable base.

Results: High decrease in the pain ailments was observed after first week of the therapy (VAS: 4). In the second week, the continue decrease of the pain ailments was observed. After 1 month of the therapy, the patient obtained shoulders and wrists stability improvement and high decrease in the pain ailments

(VAS: 1.5). Marfan's test was positive during the entire course of the therapy.

Conclusions: Ehlers-Danlos syndrome is complicated disease which leads to high number of problems concerned mostly with pain and joint instability. Because of the lack of soft tissue tension, the proprioceptive and core stability exercises are the therapy methods of "choice." During the training, patients' pain decreased and the stability rapidly improved. However, patients need to work out every day to remain such results.

A-0862 Evolution of daytime and nighttime numbness after open carpal tunnel release: Prospective analysis of 284 operations

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Objective: Our goal was to analyze the evolution of daytime numbness and nighttime numbness after open carpal tunnel release in relation with the history of the condition.

Methods: In our unit, an online database for prospective data collection of different hand conditions is available. It is mandatory to fill this form for every operated patient preoperatively, and a postoperative regular follow-up is recorded too. The level of daytime and nighttime numbness and the overall satisfaction of the patients were examined and evaluated by a visual analogue scale of 1–10. The data were collected preoperatively, after 1 week, 6 weeks, and 3 months. Patients were divided into three groups according to the time passed from the presentation of the first symptoms: less than a year history (group 1), 1–3 years (group 2), and more than 3 years (group 3).

Results: We have recorded 284 patients. There were 382 started datasheets, but because of incomplete data or severe comorbidities we had to exclude the rest. The three group of patients were homogeneous. The intervention was open carpal tunnel release in all the cases. There were 139 patients in group 1. Preoperatively, the level of daytime numbness was 5.94 (the next values are in VAS) and the night time numbness was 7.15 in average. At 1 week, it decreased to 2.53 and 2.71, respectively, and the satisfaction was 8.85. After 6 weeks, the daytime numbness was 2.16 and the nighttime numbness was 2.38 with the satisfaction level of 9.18. After 3 months, the values did not change significantly compared to the previous ones. In group 2, we had 104 patients. Preoperatively, their level of daytime numbness was

5.63, and the nighttime numbness was 6.87. According to the data gathered at the follow-ups, this value changed to 2 and 2.11 (1 week), 2.6 and 2.77 (6 weeks), and 2.21 and 2.34 (3 months). The average satisfaction was 8.7 after 1 week, 7.93 after 6 weeks, and 8.94 after 3 months. We had 82 patients in group 3. Preoperatively, their daytime numbness was 6.1 and nighttime numbness was 6.78. At 1 week postoperatively, they decreased to 2.39 and 2.55 with the satisfaction level of 9.32. At 6 weeks, they were 2.6 and 1.83, and the satisfaction was 9.03. After 3 months, there were no significant changes.

Conclusion: Daytime numbness and night time numbness in fingers after carpal tunnel release changes a lot within the first week and a little more in the next 5 weeks. If the symptoms have been causing complaints for the patient for 1–3 years, the numbness can decrease a bit more during the next 2 months. The remnant numbness in the fingers can lead to dissatisfaction of the patients, if they are not warned about this preoperatively. The overall satisfaction is influenced by many other factors, for example, night pain or grip and pinch strength. Based on our result, patients can be informed more specifically about the expectable changes.

A-0863 Does anatomic knowledge correlate with upper extremity surgical competency: A multicenter pilot study

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Objective: The purpose of this novel pilot study was to evaluate the correlation between the anatomic knowledge base of orthopaedic surgery residents and hand surgery fellows and their performance of common upper extremity procedures and to determine whether this knowledge could be used as an objective measure for evaluating surgical competency.

Methods: Twenty-two orthopaedic surgery residents representing 6 levels of training from two orthopaedic residency training programs and 14 hand surgery fellows representing 4 different training years participated in the study. Data collection occurred at the beginning and end of the academic year. Prior to participation in the study, expectations for the dissections were outlined in a brief video of board-certified orthopaedic hand surgeon

performing an unrelated approach to the upper extremity. Each resident was video-taped performing a carpal tunnel release (CTR) and a volar distal radius exposure (VDR) without an audience in a mock operating room. During each procedure, residents were instructed to explain, in the greatest detail possible, the pertinent surgical anatomy specific to the successful completion of the surgery. Videos were reviewed independently and in a blinded fashion by the authors using an itemized checklist created from the results of surveys sent to all hand surgery fellowship directors through the American Society for Surgery of the Hand. Points were given for correctly identifying pertinent anatomic structures. Resident milestone and case log data were obtained from the residency program director of the host institution. Associations between resident / fellow year in training, anatomical knowledge score, previous surgical experience, and ACGME Milestone scores were evaluated.

Results: There was a statistically significant improvement in anatomic knowledge measured between groups at each level of training and between the beginning and end of the fellowship year. This measurable improvement in scoring was not observed consistently with subjective grade assignment associated with summative training scores (Milestones) provided by faculty to trainees in the same time period. Improved operative efficiency and reduction in adverse tissue dissection were observed in trainees demonstrating greater anatomic knowledge.

Conclusions: This pilot study demonstrates a progression of anatomic knowledge for CTR and VDR with increasing training experience determined by objective evaluation. Comprehension of pertinent anatomy improves with experience and may be attributed to increased exposure to these procedures and relevant education during formal clinical rotations. Increasing anatomic knowledge base correlated with improved surgical competency and decreased surgical complications. Despite improvement in Milestone scores for CTR and VDR each year, variation between PGY levels were minimal and all residents scores were above 4. This observation suggests that summative assessments by faculty may not accurately reflect surgical competency and are possibly influenced by their subjective nature. Standardized, procedure-based assessment of pertinent clinical anatomy may facilitate identification of educational deficiencies, both for diagnostic and surgical skills, and may improve reliability of objective methods for competency assessment.

A-0864 Lateral Epicondylitis: Influence of injection timing on patient outcomes – does it make a difference?

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Objective: Previous studies have provided little consensus regarding the efficacy of extensor origin injection on the outcomes of treatment for lateral epicondylitis. Comparisons of injectable solutions, including corticosteroid, whole blood (WB), platelet-rich plasma (PRP), saline, and other prolotherapies, have not critically considered the influence of the timing of the injection relative to the duration and stage of tendinopathy on patient outcomes. The purpose of this study was to assess the potential influence of injection timing relative to symptom onset on the duration of symptom relief.

Methods: 179 cases of lateral epicondylitis in 171 patients (89 male and 82 female) with a mean age of 50 years (range: 27–89) were identified retrospectively as being treated with a lateral epicondylar injection between 2000 and 2015. The following information was recorded: (1) onset of symptoms; (2) diagnostic evaluation details including clinical examination and imaging; (3) interval time from onset of symptoms to injection(s); (4) type of injection(s); (5) repeat injection, as applicable; (6) duration of relief following injection; (7) adjuvant treatments including therapy and splinting; and (8) final disposition, including surgery. Chi-square tests were conducted to assess statistically significant relationships, and odds ratios (OR) were calculated to measure potential associations.

Results: 261 injections were identified in 179 patients. Injections were given at an average 4.6 months (range: 1 week to 4 years) from symptom onset. There were 115 of 261 injections given within 3 months and 60 of 261 were given between 3–6 months of symptom onset. A corticosteroid and local anesthetic solution was most common (237/261). Symptoms resolved after only one injection in 121 cases, whereas 58 cases underwent multiple injections with an average of 6.5 months between each injection. Physical therapy was prescribed in 54 cases. Surgical treatment of the common extensor tendon was performed in 21 patients at an average 17.3 months from symptom onset (range: 2–40 months). The interval from symptom onset to injection significantly influenced the duration of relief ($p = .017$): Injections within 3 months and 6 months

of symptom onset led to significantly higher rates of ≥ 6 months relief (107/175, 61%) compared with injections given after 6 months of symptoms (42/86, 49%; $p = .012$), although there was no difference in duration of relief for patients injected between 0–3 or 4–6 months following symptom onset ($p = .64$), despite a trend toward improved outcomes with earlier injection. Prescribed therapy did not significantly influence symptom relief ($p = .55$), as 56% of patients who had physical therapy either before or after injection received ≥ 6 months of relief, compared with 62% in patients who did not have prescribed therapy. Surgery was more probable in patients first receiving an injection > 6 months from symptom onset ($p = .03$, OR = 2.93).

Conclusions: An optimal injection protocol that considers timing and type of injection for lateral epicondylitis is not known. Targeted intervention strategies based on the stage of the disease process should be investigated. Despite recognized limitations in this retrospective methodology, our data suggest that earlier injection with corticosteroid may improve ultimate outcomes and support further investigation through a prospective, controlled study design.

A-0865 Is it possible to reduce the functional limitation of advanced stages of rhizarthrosis using arthroscopic treatment: Our experience

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Objective: Osteoarthritis of the trapeziometacarpal joint or rhizarthrosis provokes functional limitation because of pain and in advanced cases causes deformity. The aim of this review is to evaluate the clinical and radiological outcomes obtained after surgical treatment of rhizarthrosis, using the arthroscopic technique and compare them with the current literature.

Methods: A retrospective descriptive review was made of clinical and radiological outcomes in 26 cases with osteoarthritis of the thumb treated with arthroscopic arthroplasty between 2009 and 2016, both inclusive. In all cases operated by arthroscopic interposition, arthroplasty used were ulnar and radial portals, it was resected the articular surface of the trapezium, and was used as interposition the palmaris longus tendon, except in two cases in which

was performed without interposition. It was assessed the residual pain by VAS scale and the DASH scale was used to assess functional improvement. They mobility and strength of the thumb were evaluated and the preoperative and postoperative pinch strength using approved dynamometers. It was also registered the level of satisfaction of patients after surgery, and complications during follow-up. From the radiological point of view, they were rated the disease according to the classifications of Eaton and Menon, and the trapeziometacarpal residual space after surgery was also measured.

Results: The average follow-up time was 3.9 years (range: 1–7). It has revealed an average preoperative and postoperative VAS and DASH similar to other previously published series. In this review, in 24 cases there were no complications, and two cases had persistent residual pain at the end of follow-up. After assessing patient satisfaction with this surgical technique, it was observed that there was a high degree of satisfaction in 22 cases, a moderate degree in 2 cases, and a low degree in 2 cases. From the radiological point of view, arthroscopic arthroplasty was performed in 17 cases with advanced stages of rhizarthrosis.

Conclusion: Authors conclude that the clinical and functional improvement achieved with arthroscopic technique makes it a good choice for treating several stages of rhizarthrosis. Satisfactory results were obtained in advanced stages of osteoarthrosis of the thumb similar to other reported series

A-0866 Use of human fat grafting in the prevention of perineural adherence: Experimental study in athymic mouse

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Objective: Perineural adhesences represent a problem after surgery involving peripheral neural system. Fat grafting with adipose-derived stem cells (ASCs) with their proregenerative characteristics can be important to prevent the neural damage or to facilitate the neural regeneration. Our idea was to use the fat-grafting as an antiadherence device and test its efficacy on a postsurgical scar animal model.

Methods: 24 athymic mice were operated under magnification, and we exposed both sciatic nerves.

We randomly divided all sciatic nerves into three experimental groups: burning group in which we injured by diathermocoagulator the muscles surrounding sciatic nerve (1), burning + human adipose fat tissue (2), and control group (3). The human fat graft was harvested by abdominal wall of patients who underwent to breast reconstruction. The harvested fat was treated according to Coleman protocol. Biomechanical evaluation was performed to measure the peak force required to pull out the nerve from the muscular bed. The histological evaluation underwent by means a specific stain for collagen fibers on longitudinal slices of en bloc harvested sample of sciatic nerve and surrounding muscles.

Results: In the fat-grafted group, we registered a peak pull out force of 0.35 N (t Student 0.913). In burning group the force necessary to tear the nerve apart was markedly superior (0.46 N). In control group, we reported the minimal strength (0.31 N) to slide the nerve from the tissue. Histologically, the injured group presented an extensive fibrotic reaction that connected nerve and muscles. In treating with fat grafting group, a thin scar reaction was identifiable, and a cleavage plan between nerve and muscle was described.

Conclusions: Considering the results of this study, we can support the efficacy in animal experimental model of fat graft as an antiadherence device in peripheral nerve surgery. This solution could be employed to treat scar neuropathies in order to prevent more scar reactions. A clinical study is needed to understand the safety and efficacy of these method on patients.

Evidence level 5

A-0867 The importance of radiological results in distal radius fracture operations: Functional outcome after long-term (6.5 years) follow-up

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This follow-up study was to research long-term results of surgically treated distal radius fractures, especially the correlation between radiological and functional results. One hundred consecutive patients (mean age 55 years, 77 % female) operated due to a distal radius fracture were called for follow-up mean 6.5 years after operation. Sixty patients (63 wrists) participated. Most (59) were operated with volar locking plate with additional K-wires in 12 cases. In three wrists, fixation was with K-wires

only. Patients were evaluated both radiologically and clinically. The QDASH score and PRWE served as outcome measures. The X-rays were evaluated in AP and lateral projections. Radius shortening and possible step-off on radius articular surface were measured in mm and the dorsal inclination of distal radius in degrees. When variables were compared between two independent groups, Mann-Whitney *U* test was used. Correlations between continuous variables were analyzed using Spearman rank correlation. In 34 of 63 wrists, an exact anatomic result was achieved according to radiology (54%). There were still dorsal (or volar) tilt in radius in 13 wrists (21%, -15° to 22°), radius shortening compared to ulna in 15 wrists (24%, 1–11 mm), and step on joint surface in 11 wrists (17 %, 1–3 mm) Dorsal inclination of distal radius showed no significant correlation with PRWE (median 6 vs. 5, $p = .70$) or QDASH (median 6.8 vs 4.5, $p = .030$). Radius shortening of 1 mm or more (15 wrists) seemed to have statistically significant correlation with PRWE ($p = 0.033$) and QDASH ($p = 0.034$) in correlation analysis. Step-off on the joint surface (11 wrists) caused worse results in PRWE (17.5 vs. 4.5, $p = .025$) but not significantly in QDASH ($p = .24$, 11.4 vs 4.5). Fracture of ulnar styloid (basal or tip) had no affect with the clinical results PRWE (5.5 vs. 6.5, $p = .83$) and QDASH (6.8 vs 4.5, $p = .47$). Ten (16%) complications related to surgery were noted. Three reoperations were needed due to unsatisfactory primary reduction. In two patients, hardware had to be removed because of screw penetration into the joint. Three tendons ruptured: 2 EPL and 1 FPL. One median nerve compression was released and one hemostasis was done. Complications did have significant effect on QDASH and PRWE (median 4.5 vs. 13.6, $p = .038$, and 5 vs. 17.5 $p = .029$). In addition to previous, 16 wrists were later treated surgically: hardware removal for 6 and K- wire removal for 10. Our study showed that inaccurate radiologic results correlate with worse clinical results. However, moderate dorsal tilt does not seem to affect the clinical outcome. Complications are not rare in radius fracture surgery (10, 16%) and reoperations are common (26 in this group).

A-0868 Use of chitosan conduit enriched by fresh muscle fibers to repair nerve gaps in animal model

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Objective: After a big loss of substance of peripheral nerves, in order to connect proximal with distal stump, it is possible to use, in alternative to autologous grafting, different kinds of conduits. The chitosan conduit and the "muscle in vein" technique showed very good results in preclinical and clinical settings. We compared in this study the efficacy of empty chitosan conduit versus chitosan conduit enriched with fresh muscle fibers (MIT, "muscle in tube") to improve peripheral nerve regeneration.

Methods: The median nerve of rat was repaired by means of empty chitosan conduit or MIT (nerve gap 6 mm, conduit length 10 mm). As a control group, we used auto grafting technique.

We performed analysis at short term (7, 14, 28 days) and at long term (12 weeks) in order to register biomolecular modifications (quantitative real-time PCR and Western blot), morphological modifications (optic and electronic microscope), and functional changes (grasping test).

Results: Biomolecular analysis showed that muscle fibers produced and released Neuregulin 1, needed for regeneration and activity of Schwann cells. Also, the autograft produces Neuregulin 1, instead no production was observed in the empty conduit. Therefore, we hypothesize that muscle fibers compensate this fact releasing Neuregulin 1. Morphological analysis showed that the first myelin fibers appear in MIT after 14 days, while they are still missing in the empty chitosan tube.

Conclusions: The results of our work are very encouraging because they combine the easiness of chitosan tube implantation and the efficacy of fresh muscle fibers, as previously demonstrated by muscle in vein technique. From a clinical point of view, this procedure could be an alternative to auto grafting, that nowadays is the gold standard for nerve repair, but presents some disadvantages.

Level of Evidence: V

A-0869 Ligament plastic of the chronic scapholunate dissociation: An evidence-based assessment of the literature

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Introduction: No clear consensus exists on the best treatment for patients with chronic symptomatic scapholunate dissociation uncomplicated by

arthrosis. Although most surgeons agree that operative intervention is indicated, their preferences are divided between soft tissue and bony procedures.

Material and method: We reviewed in the PubMed and in the Medscape in the 15 years appeared articles, which dealt with the SL dissociation. We found 212 articles. Of these 91 articles mentioned the SL dissociation treatment. We reviewed only the evidence base of the ligamentoplasty technic.

Results: Approximately, all (99%) advocated surgical intervention: 45% opted for a soft tissue procedure, 36% a bony procedure, and 19% preferred to wait before making a clinically dependent choice. We have found that 38 articles described the soft tissue reconstruction and the ligamentoplasty. S-L dissociation in III and IV stages were examined and the results of the range of motion, grip strength and the painful symptoms based on VAS. Eight articles deal with the Blatt described method of surgical stabilization of the wrist with a dorsal capsulodesis. They found in 12 patients that the range of motion according to the healthy compared to the contralateral hand were 83.3%. The grip strength was 80%. The painful symptoms occurred in four patients. 17 studies involved soft-tissue scapholunate reconstructions in patients with Brunelli and modified Brunelli technique. The range of motion were 30–60% compared to the contralateral hand, the grip strength 65%, and painful symptoms were occurred in 2 patients of 13 patients. Palmer, Glickel, and Almquist reported 87 case of the patients with ECRB tenodesis. The results average were 73% the range of motion, the grip strength average was also 73% compared to the contralateral hand, and the painful symptoms average were 44 patients. Cuenod reported the bone-ligament-bone capsulodesis. He found in 3 patients 75.5% range of motion, 94.6% grip strength, and 0 patient painful symptoms compared to the contralateral hand. Lavernia's, Wintman's, and Uhl's articles described the dorsal radioscaphoid capsulodesis. They found in average by 75 patients 75% – 90% – 56% range of motion. The grip strength was in average 87% compared to the contralateral hand. The painful symptoms were found by 4 patients.

Discussion: Despite a vast amount of surgical experience and a number of reports in the literature, no consensus exists on the best operation for a chronic scapholunate dissociation. The surgeon is still faced with many choices. The purpose of this study was to try to narrow the choice and, specifically, to determine whether one avenue of management (soft tissue procedures) was superior to the other (limited wrist fusions) for chronic scapholunate dissociation

Conclusion: Based on the reviewed literature data, we found that the III – IV stages in S-L dissociation solutions the Blatt's capsulodesis and the dorsal radioscaphoid capsulodesis provided the best results. It is important to correct concurrent scapholunate deformity. Otherwise, alterations in wrist kinematics and abnormal articular surface appearing can cause definitive scapholunate advanced collapse and post-traumatic arthrosis.

A-0871 Cost-effectiveness of subcutaneous release of trigger finger in diabetic patients versus open release

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Trigger finger is a common disease among patients with diabetes mellitus. In diabetic patients, the incidence reaches about 4 times higher than in the general populations, and the clinical symptoms are more severe. Definitive treatment is release of A1 pulley (open or subcutaneous). The purpose of this study is to compare the outcomes and complications of convectional open versus percutaneous release for the recurrent trigger finger in patients with diabetes mellitus

Material and Method: Fifty-nine patients with diabetes mellitus (28 insulin-dependent and 31 non-insulin dependent) with an average age 48 years (range 28–64 years old) were treated for recurrent trigger finger between 2013 and 2016. The mean duration of symptoms before treatment was 11.4 months (range 4–21 months). All patients had failed conservative treatment. The digits were graded according to the severity of symptoms: We classified 17 (28.8%) digits as grade 2, 28 (47.4%) as grade 3 (3a in 12 cases and 3b in 16), and 14 (23.8%) as grade 4. Multiple digit involvement was in 12 patients. The patients divided in two groups: group A (27 patients) were treated by open release of A1 pulley and group B (32 patients) with percutaneous release using the tip of an 18-gauge. Postoperative patients in both groups were placed in bulky soft dressing leaving interphalangeal joints completely free for early motion.

Results: The median follow-up was 8 months (range 6–14 months). The groups were statistically similar regarding the age, sex, and dominant side involvement. The results were based upon the Visual Pain Scale (V.P.S.), Quick Dash, and Michigan Hand Outcome Questionnaire (M.H.O.Q.). In group A (at 3 weeks), the V.P.S. was 1.32, the mean Quick DASH 6.8 (varied from 4.5 to 18.2), and the mean M.H.O.Q

84% (varied from 91% to 76%). The same period in group B (at 3 weeks), the V.P.S. was 0.58, the mean Quick DASH 4.2 (varied from 3.1 to 15.9), and the mean M.H.O.Q 84% (varied from 96% to 82%). In two groups, there was no statistically difference at 3 months and 6 months, postoperatively.

Conclusions. Trigger finger is a common disease among the patients with diabetes mellitus. The goal of treatment is restoration of digit function. Both surgical methods (open or percutaneous release) in long follow-up postoperative resulted in similar therapeutic efficacy. Percutaneous surgical technique in treatment of trigger finger appears to be a safe alternative method with a low complication rate and immediate postoperative recovery.

A-0874 The development of a Hungarian wrist arthroscopy registry

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Objective: Wrist arthroscopy is a rapidly expanding field in hand surgery. The indications and surgical procedures are continuously growing. Registries facilitate to obtain evidence-based data, and they help to improve the standard of health care. To confirm the favorable clinical outcomes of several studies with wrist arthroscopy, further scientific evidence is needed. The purpose of this study is to describe the development of the Hungarian wrist arthroscopy registry.

Methods: Based on the beneficial usage of the Hungarian anterior cruciate ligament registry, the authors decided to develop a similar web-based prospective wrist arthroscopy registry. The problems with development and maintaining a large clinical registry are described. From previous registry development, it is known that careful design of outcome tool selection, logistical planning, and optimizing quality of input data are the most important when creating a clinical registry.

Results: The authors agreed upon a common data structure, questionnaires and patient-reported outcome measures to use for the evaluation of wrist arthroscopy patients. These included the Hungarian version of the QuickDASH outcome measure, the Patient-Rated Wrist Evaluation, the Mayo wrist score, and the Visual Analogue Scale. The data collection is web-based and is an ongoing prospective registration of all procedures of wrist arthroscopy performed

in Hungary. The patient receives online access to the database at hospital admission and submits the pre-operative subjective scores. The registry automatically sends out patient-reported questionnaires at 6 months, 1, 2, and 5 years postoperatively to the patients. Each surgeon performing wrist arthroscopies has access to the web-based registry. At the time of surgery, the surgeon reports both data from clinical examination, radiological parameters and perioperative data. There is a carefully structured operative chart for all wrist arthroscopy procedures performed at the hospitals.

Conclusions: We consider the development of a national wrist arthroscopy registry as a successful way of developing and maintaining a valuable clinical and scientific tool. Our short time experience shows that using the registry helps to compare and standardize our results and provides evidence based data for further studies. Our vision is to have a common international registry for wrist arthroscopy, where a huge amount of data could be obtained and international comparisons would be possible. To reach this aim, the first step is to test our registry with a smaller sample size to identify and revise the potential initial difficulties.

A-0875 Effects of Selective Nerve Transfers on the Neonatal Motor Unit

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Introduction: Despite advances in obstetric monitoring and techniques, the incidence rate of obstetric brachial plexus lesions (OBPL) has remained constant over the last decades. Although recovery occurs in the majority of cases, satisfying long-term rehabilitation cannot always be achieved. Hence, research on the reconstruction of OBPL and techniques to bridge severe proximal nerve defects remains urgent. Selective nerve transfers (SNT) promise to be a powerful tool, but the neurophysiological effects on peripheral nervous system and the motor unit have not been adequately investigated. Furthermore, the tremendous capacity of nerve regeneration and plasticity of the central nervous system in the neonate cannot be compared to studies available in the adult. Therefore, we specifically designed an experimental nerve transfer model in the forelimb of the neonatal rat.

Methods: Operating on pups within 24 h after birth need adaptations and preparations of dam, cub handling, anesthesia, operation procedures, and analgesia methods. Handling and olfactory conditioning of the dam for about 10 days prior to birthing, was performed to reduce cannibalizing and neglect of pups. Inhalational anesthetic (isoflurane) was used to anesthetize neonatal rats sufficiently. A randomized controlled trial was designed. In the experimental group, 15 male Thy-1 GFP neonates, the ulnar nerve was transferred to the musculocutaneous nerve. A standardized crush of the musculocutaneous nerve was performed in another 15 rats. In a negative control group ($n = 5$), the musculocutaneous nerve was dissected and an 8-mm nerve defect was created and 15 further rats underwent sham surgery (exposure/closure). In order, to depict the burden of surgery to the pups, and the recovery process weight was measured and a functional test (Bertelli) was performed twice a week. After 12 weeks of nerve regeneration, neurophysiological effects were explicitly assessed on each level of the motor unit by tetanic muscle force, MUNE (Motor Unit Number Estimation), retrograde labelling, axon quantification, muscle fiber typing, and neuromuscular junction staining.

Results: The nerve transfer successfully reinnervated the musculocutaneous nerve in all animals, as indicated by functional outcome, muscle force and Motoneuron Count. Compared against the crush-group equivalent regeneration was found. No aberrant reinnervation occurred from the original motor source in the negative control group. By applying the described protocol dam cannibalizing, neglecting pups was reduced and overall survival reached a satisfying level of over 88%. Initially, weight dropped significantly in all operated groups, but when pups were weaned at 3 weeks, weight has already recovered.

Conclusion: Applying this neonate model will help to attain a deeper understanding of the neurophysiological effects of SNT on newborns. As selective nerve transfers play a major role in extremity reconstruction findings of such studies further help improving clinical approaches. Additionally, neonatal plasticity can be investigated in the peripheral nerve system. Ultimately, these advances might also be used to further understand neuronal regeneration and improve treatment options in the reconstruction of OBPL.

A-0877 Dupuytren disease: Risk factors associations

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Introduction: Dupuytren disease (DD) is the most common heritable disorder affecting connective tissues. It is an inherited, benign, chronic progressive condition that results in fibrotic changes on the palmar and digital fascia and adjacent soft tissues. Dupuytren contracture is the end of DD. DD has been associated with comorbidities including hypercholesterolemia, diabetes, smoking tobacco, excessive alcohol use, epilepsy, antiepileptic medication, regional trauma, chronic heavy manual labor, and a lower-than-average body mass index. The literature is far from clear on this topic and lack of association has also been reported for each of these factors. The objective of this work is to clarify some of these associations by identifying and correlate the risk factors with DD.

Material and methods: This is a retrospective and observational study that analyze the data from the patients submitted to surgical intervention between 2010 and 2015 with the diagnosis of DD or Carpal Tunnel Syndrome (CTS). The risk factors evaluated were sex, age, comorbidities such as Carpal Tunnel Syndrome, Trigger Finger, De Quervain Disease, Synovial Cysts, Diabetes, Arterial Hypertension, Obesity, Anxiety, Depression, Thyroid Diseases, Degenerative Osteoarticular Diseases, Benign Prostatic Hyperplasia, Asthma, Dyslipidemia, Anemia, Auricular Fibrillation, Smoking, Rhinitis and American Society of Anesthesiologists (ASA) Score. To compare the means of one variable (age) for the two groups of patients, we use the Independent-samples t test. The association of the risk factors with DD was performed with the chi-square test. The data were processed in statistical software version 20.0 of SPSS (SPSS). It was considered a probability of type 1 error of 0.05 in all inferential analyzes.

Results: The incidence of DD in the 3,481 patients studied were 12.2% and the CTS were 88.4%, meaning that 0.6% had both diseases. The mean age were 61.18 years in DD and 53.05 years in CTS. Comparing the means of the variable age in the 2 groups of patients with the Independent t test show that there was a statistical difference ($t(3,479) = 12,880$; $p = .000$); 87.1% of the patients were male in DD meanwhile in CTS 82,5% were female. The inferential analyzes shows that DD is associated with sex ($p = .000$), comorbidities such as CTS ($p = .000$), Trigger Finger ($p = .004$), Diabetes ($p = .000$), Obesity ($p = .01$), Anxiety ($p=.002$), Depression ($p = .000$), Degenerative Osteoarticular Diseases ($p = .003$), Benign Prostatic Hyperplasia ($p = .000$), Dyslipidemia ($p = .000$), Auricular Fibrillation ($p = .002$) and ASA Score ($p = .000$), showing no correlation with all other risk factors studied.

Discussion and Conclusion: This study identifies as risk factors associated with DD the male sex,

comorbidities such as CTS, trigger finger, diabetes, obesity, anxiety, depression, degenerative osteoarticular diseases, benign prostatic hyperplasia, dyslipidemia, auricular fibrillation, and ASA score. The identification of this risk factors is of great value in the prediction of risk of DD, but, more investigation is necessary to explain the mechanism underlying these risk factors and to understand the correlations between them.

A-0878 Evaluation of proprioception in denervated and healthy wrist joints

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Background: The aim of this study was to investigate the conscious and unconscious proprioceptive senses after wrist denervation when compared to healthy controls.

Material and Methods: Twenty-five patients (54 ± 13; 25–78 years old) after complete denervation of the wrist according to Wilhelm and 60 healthy control (48 ± 18; range: 21–77 years old) were recruited. The range of motion as well as the active ipsilateral and contralateral joint position sense of the wrist were measured with a standard goniometer. Force sense was measured with a Jamar dynamometer using 30% of maximal force. A self-developed trapdoor, capable of suddenly tilting 40° in the frontal plane, was used to trigger the wrist reflex, whereas electromyographic signals were recorded with bipolar surface disc electrodes from the muscle bellies of the extensor carpi radialis brevis, extensor carpi ulnaris, flexor carpi radialis, and flexor carpi ulnaris muscles.

Results: No significant results were obtained neither for the joint position and force sense nor for the wrist reflexes between the two groups. Dorsal extension of the wrist decreased significantly with increased age ($p < .05$).

Conclusion: Wrist denervation does not result in a proprioceptive deficit in terms of joint position and force sense as well as wrist reflex time.

Keywords: denervation, joint position sense, proprioception, wrist

A-0880 Peripheral nerve injury repair: Neurorrhaphy or tubulization

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Objective: The gold standard for peripheral nerve injuries without defect is microsurgical suture (neurorrhaphia). Using tubes made of different materials in case of nerve defects is more and more common in the last years. Some recent presentations and studies have reported better results in primary nerve repair without defects by using tubes instead of direct nerve suture. We have reviewed the available literature for searching evidence-based data on the above-mentioned topic.

Material and methods: Search for the available publications on PubMed was performed for the last 16 years period. Comparing the data and the results of these articles, we would like to have an objective ranking of these two possible methods when dealing with peripheral nerve injuries without defects.

Results: Searching for "nerve injury" 86,548 articles, for "peripheral nerve injury" 44,946 articles, for "peripheral nerve injury suture": 4,739 articles, for "peripheral nerve injury tubulization": 5 articles were listed. All these articles deal with in vitro or animal experiments. Extending our search to all available references in total we have found three articles about using tubulization in case of primer nerve lesion without defect in human care.

The first article signed by Zhang and al. was published in 2012. They compared the conventional nerve suture and the chitin based tubulization in 30 patients. Half of them received conventional nerve suture, the other half was reconstructed by chitin-based tube. In the tube 2 mm distance between the nerve endings was preserved in order to facilitate neurotaxis. The results were evaluated according to the criteria of British Medical Research Council (BMRC).

Their results show a 20% shortening of the operation time for the tubularized nerves. There were no rejection and septic reaction in none of the groups. Combined functional regeneration was good and excellent in the tubulization group: 78.57%, compared to the neurorrhaphy group, where 28.57% good and excellent. In 2013, the same authors published a multicenter study involving 50 patients where in 25 cases traditional nerve suture and in 25 cases tubulization was used. Their result: presented 20% shortening of operation time for tubulization. Evaluation according to BMRC shows 36,19% better results in the tubulization group. Neuropathic pain decrease after one month measured by VAS was 91% in the tubulization group compared to 22,5% of the suture group. After 2 months, a 97%–54.8% diminution, and after 4 months a 100%–71% diminution, after 6 months a 100%–77.4% diminution of pain was recorded. After 6 months, the ENG-based sensory regeneration was 74.7% in tubulization group compared to 70.2% in the suture group. The motoric

regeneration was 65,2% compared to 59,6% in favor of the tubulization group.

In 2016 a German group (Neubrech et al.) reported a study project with a planned double-blind randomized multicenter study of 100 injured sensory nerves using chitin based tube. Results are foreseen in the next years.

Conclusions: Based on the available data, comparing direct nerve suture to tubulization there is an impressive advantage in favor of tubulization. If further studies show the same results, the tubulization method is expected to spread and may be replace direct nerve sutures.

A-0881 Carpal tunnel syndrome: Clustering of patients

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Introduction: The study of determinants and characteristics of the population has a long tradition in epidemiology. Those factors are indispensable for controlling diseases and promoting health. This theme has developed with a huge and growing impact and is usually materialized in three interrelated approaches: (1) mapping of diseases and their determinants, (2) the study of geographic correlations, and (3) clustering or agglomeration – temporal. The present work is focused on the clustering of patients with carpal tunnel syndrome (CTS).

Material and methods: This is a retrospective and observational study that analyzes the data from the patients submitted to surgical intervention between 2010 and 2015 with the diagnosis of CTS. The risk factors evaluated were sex, age, comorbidities such as Dupuytren Disease, trigger finger, de Quervain disease, synovial cysts, diabetes, arterial hypertension, obesity, anxiety, depression, thyroid diseases, degenerative osteoarticular diseases, benign prostatic hyperplasia, asthma, dyslipidemia, anemia, auricular fibrillation, smoking, rhinitis, and American Society of Anesthesiologists (ASA) Score. It was made the distribution of the patients by city of residence. The data were processed in statistical software version 20.0 of SPSS (SPSS). It was considered a probability of type 1 error of 0.05 in all inferential analyzes. The classification of subjects was performed with a nonhierarchical cluster analysis K-means with the Ward method using the square Euclidean distance as dissimilarity measure between subjects.

Results: 3,077 patients were studied. The mean age was 53.1 years; 82.2% of the patients were female and 17.8% were male. 45.1% of the patients reside in Santa Maria da Feira, 23.6% lived in Oliveira de Azeméis, 10.6% in Arouca, 8.5% in São João da Madeira, and 6.9% in other places, meaning that most patients lived in a industrialized area instead of rural. Following the R2 criteria, there were established 4 clusters (that explained more than 80% of total variance). The subjects' classification were refined with the K-means method. Cluster 2 and 4 were the more dissimilar. The dimension that best differentiated the clusters were auricular fibrillation ($F = 314,616$), followed by smoking ($F = 5,337$) and arterial hypertension ($F = 2,349$). Other dimensions that affected clusters were age, synovial cyst, diabetes and dyslipidemia. Cluster 1 is the biggest ($n = 1,867$) and comprise the youngest and healthy patients.

Discussion and Conclusion: This study identifies that the dimensions that best differentiated the clusters are auricular fibrillation, smoking and arterial hypertension. The biggest group are the young and healthy patients. Knowledge of the reality of each hospital unit (and the national territory as a whole) is the first step in controlling diseases and promoting health. Patient clustering is a useful tool in building best practices, better clinical information and a cornerstone for protocol implementation.

A-0885 Tissue perfusion of the hand and forearm following reduction in a supracondylar fracture in the pediatric population

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Objective: Supracondylar humeral fractures are the most common elbow fractures in children. Rigault and Lagrange have classified these fractures as type I–IV according to the fracture displacement. Completely displaced (type III and IV) fractures can be accompanied by neurovascular injuries and have an elevated complication rate. While closed reduction and surgical stabilization are generally considered the best treatment method for types II–IV supracondylar fractures, some surgeons still advocate a non-surgical treatment using the Blount method which requires elbow immobilization in elbow flexion of at least 110°. As most supracondylar fractures are

associated with significant elbow swelling, flexion of the elbow joint leads to increased pressure in the cubital fossa. This can reduce forearm perfusion and may cause or enhance neurovascular deficiencies. The aim of the present study was to evaluate forearm and hand perfusion under progressive elbow flexion in children treated with percutaneous pinning for supracondylar humeral fractures.

Methods: Forty-six consecutive cases of supracondylar fractures type II–IV treated by closed reduction and percutaneous pinning were included in the current study. Fractures were classified 17 times as type II, 16 times as type III, 13 times as type IV. Mean patient age was 6.3 years. Time between trauma and surgery was 7.8 h (mean), and mean surgical time was 30 min. At the end of surgery diameters at the flexion crease of both elbows were taken. Furthermore, using a pulse oximeter plethmograph, oxygen saturation and plethmograph wave was measured in extension and progressive elbow flexion (90–140 or maximum flexion) at the index finger of both arms. Flattening of the plethmograph wave and a decrease in oxygen saturation was recorded. Correlations of fracture type, swelling, plethmograph wave, and saturation curve in progressive elbow flexion were evaluated.

Results: Flattening of the plethmograph wave was seen in 35 of the 46 patients with progressive elbow flexion. In 10 patients (4 type II, 3 type III, and 3 type IV fractures), the wave pattern disappeared between 90° and 120° of elbow flexion, and in further 19 cases, the plethmograph wave was flat before maximal elbow flexion was achieved. Oxygen saturation levels decreased at the same time as the wave or at a slightly greater elbow flexion. Swelling documented by the increase in circumference was less in type II fractures than in type III and IV fractures. Only a weak correlation between fracture type, swelling, and reduced saturation upon progressive elbow flexion could be found.

Conclusions: Elbow flexion of more than 90° can lead to reduced peripheral perfusion after closed reduction in a supracondylar humeral fracture. While saturation values can stay in the normal range with reduced arterial inflow, the plethmograph wave pattern flattens immediately. We thus believe that the plethmograph wave is more sensitive in detecting perfusion problems. 22% of our patients presented with changes in wave pattern and reduced peripheral oxygen saturation at flexion degrees used in a nonsurgical treatment. We thus strongly recommend a precise peripheral perfusion evaluation at the degree of elbow flexion required for immobilization.

A-0886 Results of anterior shoulder release for medial rotation contracture in brachial plexus birth palsies about 17 cases

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Objective: Medial rotation contracture of shoulder is frequent evolution in brachial plexus birth palsy is the anterior release of contracted soft tissues and gives a good result to improve lateral rotation

Methods: Seventeen patients with medial rotation contracture of shoulder was operated. Ages of patients was between 12 months and 11 years. CT scan was performed for the children upto 5 years old and MRI for the children over to 5 years to study gleno humeral joint deformities The patients included in this study did not shows important deformities on gleno humeral joint. Lateral rotation was measured by upper view videos of shoulder. Preoperative medial rotation was appreciated with ability to put hand to belly and hand to back

After delto pectoral approach release included the following elements:

- coraco humeral ligament
- coraco acromial ligament
- resection of a part of coracoid process
- anterior capsulae
- high fibers of sub scapularis muscle

Thoraco brachial splinting was performed for 6 days. Rehabilitation was started immediately with mobilization of the shoulder on lateral rotation and medial rotation several times a day.

Results: Results were assessed by measure of post-operative external rotation and the ability to put hand to belly and hand to back. External rotation improved in all cases. Mean of external rotation improvement was 47°. Loss of partial medial rotation was observed in 3 cases. We took the videos of pre- and postoperative status for all the patients

Conclusion: Anterior shoulder release with immediate mobilization is good procedure to improve external rotation without important loss of medial rotation in cases without important deformities of gleno humeral joint

A-0889 Arthroscopic-assisted treatment of posttraumatic TFCC lesions in adolescents

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Objective: Posttraumatic injury of the triangular fibrocartilagineous complex (TFCC) can result in debilitating wrist problems. Although diagnosis and treatment of these lesions is well described in adults, hardly any data exist for this type of injury in young adolescents. The objective of the study was to evaluate the correlation of magnetic resonance imaging (MRI) and intraoperative findings. Furthermore, we intended to evaluate the outcome after arthroscopic and arthroscopic assisted reconstruction of the TFCC in the adolescent population.

Methods: Between 2011 and 2016, 12 patients with a mean age of 13.7 years (range 10–15 years) have consulted our department for posttraumatic ulnar-sided wrist pain. Previous trauma included distal radial fractures with or without concomitant fracture of the ulnar styloid, wrist sprains, and repetitive micro-trauma of the wrist. Clinical evaluation showed tenderness over the TFCC complex, pain on movement, and in most cases instability of the distal radio-ulnar joint (DRUJ) with episodes of sub-/dislocation in two patients. Preoperative arthro-MRIs were conducted confirming the pathology in four cases. All patients underwent diagnostic arthroscopy of the wrist. The mean age at the time of surgery was 12.9 years

Results: Arthroscopy of the wrist confirmed a TFCC lesion in all patients. In 10 cases, the injury was classified as Palmer type 1B, once as a combined type 1A/1B, and once as type 1A. All 11 patients with a type 1B injury underwent arthroscopically assisted reconstruction of the TFCC. Treatment of the type 1A injury consisted of arthroscopic shaving of the central lesion. Mean follow-up was 1 year (range 3–18 months). Postoperative clinical examination elicited stable wrists with a normal range of motion and an increase in force in all cases. Patients reported a decrease in pain level during daily activities or were entirely pain free. At the end of the treatment (11 patients), the mean Quick Dash score was 9.6 (range 0–18.2) and the Mayo scores were 6 times excellent, 4 times good, and once satisfactory.

Conclusion: TFCC lesions in the adolescent population are difficult to evaluate on an arthro-MRI, and results are often inconclusive. Diagnostic arthroscopy is thus the preferred method of diagnosis for this type of injury in the adolescent population. The arthroscopic-assisted TFCC reconstruction is a reliable technique to achieve DRUJ stability and good clinical outcomes.

A-0892 Evolution of night pain after open carpal tunnel release – Prospective analysis of 284 operations

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Objective: Our goal was to analyze the evolution of night pain after open carpal tunnel release in relation with the history of the condition.

Methods: In our unit, an online database for prospective data collection of different hand conditions is available. It is mandatory to fill this form for every operated patient preoperatively, and a postoperative regular follow-up is recorded too. The level of night pain and the overall satisfaction of the patients were examined and evaluated by a visual analogue scale of 1–10 (VAS). The data were collected preoperatively, after 1 week, 6 weeks, and 3 months. Patients were divided into 3 groups according to the time passed from the presentation of the first symptoms: less than a year history (group 1), 1–3 years (group 2), and more than 3 years (group 3).

Results: We have recorded 284 patients. There were 382 started datasheets but because of incomplete data or severe comorbidities, we had to exclude the rest. There were 139 patients in group 1 with the mean age of 57.6 years. Preoperatively, the level of night pain was 6.64 VAS in average. At 1 week, it decreased to 1.66 VAS, and the satisfaction was 8.85 VAS. After 6 weeks, it was 1.38 VAS with the satisfaction level of 9.18 VAS. After 3 months, the values did not change compared to the previous ones. In group 2, we had 104 patients with the mean age of 61.6 years. Preoperatively, their level of night pain was 6.46 VAS. According to the data gathered at the follow-ups, this value changed to 1.57 VAS (1 week), 1.77 VAS (6 weeks), and 1.53 VAS (3 months). The average satisfaction was 8.7 VAS after 1 week, 7.93 VAS after 6 weeks, and 8.94 VAS after 3 months. We had 82 patients in group 3 with the mean age of 57.67 years. Preoperatively, their night pain was 6.54 VAS. At 1 week postoperatively, it decreased to 1.36 VAS with the satisfaction level of 9.32 VAS. At 6 weeks, it was 1.30 VAS and the satisfaction was 9.03 VAS. After 3 months, there were no significant changes.

Conclusion: Based on our results, we conclude that the night pain levels decrease significantly in all groups independently from the time elapsed from the first symptom. The differences in overall satisfaction rates can be explained with other factors like numbness or grip and pinch strength or even with misunderstanding the doctor's explanation regarding the outcome of the procedure.

A-0893 The application of the Oberg Manske and Tonkin classification in daily practice: An evaluation of the classification strategy

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Introduction: Congenital upper limb anomalies (CULA) exhibit a wide spectrum of phenotypic manifestations. This variety can be observed both in severity and in extensiveness of the anomaly as well as the embryological nature. To describe the full nature of all anomalies, the Oberg, Manske, and Tonkin classification was developed. The OMT classification aims to (1) provide a classification which better fits the current concepts of the etiology, (2) allow combined documentation of all anomalies present in a single limb, and (3) to cross-reference anomalies with syndromes. The introduction of the OMT classification was succeeded by multiple validation studies regarding its clinical application. However, all studies were mainly aimed to test usability of the classification and were not consistent in the classification strategy: In some studies, anomalies were classified whereas others only used one diagnoses per arm. Therefore, the aim of this study was to evaluate the various classification strategies used with the OMT classification.

Methods: We retrospectively reviewed all patients visiting the Erasmus MC Team for Congenital Hand and Upper Limb Malformations in the Sophia Children's Hospital between December 2014 and February 2012. All congenital anomalies of both limbs individually were classified according to the OMT scheme as proposed by Tonkin et al.; furthermore, all associated anomalies were recorded. In compound hand phenotypes, every hand anomaly present was classified in order to best describe the clinical features of every patient. To evaluate which hand anomalies commonly required multiple OMT diagnoses, the mean number of diagnoses per OMT class and diagnosis was calculated. Structural supernumerary diagnosis use was identified in classification of isolated anomalies as well as syndromic patients.

Results: 736 cases were eligible for inclusion and 953 OMT diagnoses were registered. 375 cases were affected unilaterally (195 cases left handed and 180 right handed), and 361 were affected bilaterally. The average number of diagnosis for each patient was 1,30 [95% CI: 1.25–1.35]. In 20.5% of the patients ($n = 155$), a combination of OMT diagnoses was used to describe the observed anomalies. The total number of unique combinations of OMT diagnosis was 101, of which 77 combinations were used only once and 24 were used repeatedly. We illustrate that in syndactyly, additional OMT diagnoses were often used to convey differentiating characteristics, such as additional ulnar or radial polydactyly, the combination of which was more often observed in patients with a syndromal cause of the anomaly.

Conclusion: The OMT classification provides a structured framework for describing congenital hand anomalies. Furthermore, the use of a classification system is to discriminate between groups of patients that may need different surgical or nonsurgical care. We conclude that the strategy used in applying the OMT classification is of eminent importance for optimizing the discriminating features of the OMT classification.

A-0894 Identification of associated genes and diseases in patients with congenital upper limb anomalies: A novel application of the OMT classification

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Purpose: Congenital upper limb anomalies (CULA) can present as an isolated feature or as a part of a syndrome or association. As there is a wide spectrum of CULA and each of them might be related to different diseases, the structure provided by the Oberg, Manske, and Tonkin (OMT) classification 1, 2, 4, 5 could aid in formulation of a differential diagnosis in patients with CULA. Therefore, the aims of this study were to review the Human Phenotype Ontology (HPO) project database for diseases and causative genes that can be related to hand anomalies present in the OMT classification. Subsequently, we developed a methodology for differential diagnosis formulation based on the observed congenital anomalies and validated it against a currently available tool.

Methods: The HPO database was reviewed for all diseases with a known causative gene related to hand anomalies. All hand phenotypes were classified according to the OMT-classification; associated non-hand phenotypes were classified into a further 12 anatomical groups. TIBCO-Spotfire (version 7, TIBCO Spotfire Inc., CA, USA) was used to analyze the contribution of each anatomical group to a given disease and to prioritize diseases and genes based on this contribution. Results were compared with cases from the literature and to a current HPO tool, Phenomizer.

Results: In total, 514 hand phenotypes were obtained, 384 could be classified in the OMT classification, and 1,403 diseases could be related to hand anomalies present in the OMT classification. Comparison to 10 recently published case reports on hand-related

diseases reveals that the presented phenotype matched the descriptions in our data set. The differential diagnosis produced using our methodology was more accurate than Phenomizer in four of five examples.

Conclusions: The newly accepted OMT classification can be used to describe hand anomalies that can present in over 1,400 diseases. CulaPhen was developed to provide a hand phenotype-based differential diagnosis. Differential diagnosis formulation based on the proposed system outperforms systems in current use.

A-0896 Darrach procedure in acute traumatology: A maximalist treatment of the elderly care

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Introduction : Highly comminuted distal ulna fracture are difficult to treat, especially in elderly patients with osteoporosis. The optimal acute management of these fractures has been a subject of controversy. We assessed outcome after ulnar head excision on wrist trauma with the assumption that long-term outcomes would reflect good functional results.

Methods: A retrospective data analysis identified posttraumatic distal ulna fracture who had undergone the Darrach procedure. We assessed functional outcome on flexion–extension, pronosupination, grip strength (JAMAR), and pain value. We looked for clinical dynamic instability. The radiological outcomes were evaluated using pre- and postoperative X-rays to classify the fracture according to Biyani and to investigate the effect of possible ulnar impingement syndrome. Finally, we recorded any additional procedure after the acute surgery.

Results: A total of 27 patients, mean age 79 years old (range 72–90), were treated by Darrach procedure for distal ulna fracture following surgical fixation of the distal radius fracture. Thirteen patients underwent distal ulna resection through a separate dorsal ulnar incision with ECU tenodesis, and 11 patients had no stabilization procedure and pronator quadratus was used as interposition on 3 patients. According to the Biyani Classification of Fractures, there were two simple extra-articular fractures (type 1), 6 inverted T- or Y-shaped fracture (type 2), and 19 comminuted fractures (type 4). Patients displayed a mean wrist range of motion measured 36° flexion (range, 10°–70°), 37° extension (range, 10°–70°), 83° pronation (range, 70°–90°), and 64° supination (range, 40°–90°). Mean grip strength measured 62% of the contralateral uninjured side (range, 8–100%). Only 2 patients still had pain, with a mean value of 2.6, and 1 patient had distal ulna multidirectional instability

without pain. A total of five patients displayed radioulnar impingement on the last follow-up x-ray. No patient has required a secondary surgical procedure.

Conclusions: For elderly patients, acute excision of the ulnar head whatever technique, is an effective treatment for comminuted ulna fractures. The Darrach procedure provides reliably good mobilities without pain and no complications due to a simple procedure in appropriately selected patients. This trend is reinforced by recent studies on the treatment of wrist fractures in elderly people.

A-0898 The role of prophylactic antibiotics in surgical carpal tunnel release

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Goal of the study: Our aim was to look for the effectiveness of antibiotic prophylaxis in elective surgical carpal tunnel release. A systematic review was performed with the available literature.

Material and method: Pubmed and Medscape research engines were used to look for publications dealing with surgical carpal tunnel release and antibiotic prophylaxis. The data included in selected articles were summarized and compared using statistical methods.

Results: From total, only four articles, dealing with this specific issue, were found. Other articles dealing with soft tissue procedures of the hand and different antibiotic protocols were excluded from our review. The four articles analyzed 298, 3003, 1400, and 112, surgical carpal tunnel released patients, summarizing a total of 4,813 operations. From these, 2,594 (53.89%) patients received antibiotic prophylaxis, and 2,218 (46.10%) patients did not. The infection rate in case of antibiotic administration in average was 0.34%. The patients without antibiotic prophylaxis presented 0.63 % of infections. All of studied articles revealed the absence of significant difference between the group of patients who received antibiotics and those who did not. We also agree with the idea that in both groups of patients, the rate of infection was very low (below 1%), so the differences were not statistically significant.

Conclusions: The antibiotic prophylaxis does not improve the results considering septic complications in surgical carpal tunnel release.

A-0900 Proprioception-based surgical treatment of scaphoid instability

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Objective: Dynamic scaphoid instability (DSI) can be treated dynamically based on the sensory-motor response.

Method: The scapholunate interosseous ligament (SLIL) is rich in mechanoreceptors. When the SLIL is intact, the dynamic stabilizers of the wrist are recruited to assist the ligament stabilizers within the first 20 ms of the loading. Activation of the flexor carpi radialis (FCR) supinates the scaphoid and eases tension on the SLIL. Dynamic stabilization then continues by global co-contraction of muscles (20–60 ms after loading) to actively stabilize the wrist. When the SLIL is torn, it deprives the wrist of a major static stabilizer and diminishes the response of mechanoreceptors to activate the muscles. When scaphoid instability is static, contraction of FCR increases the compression forces between the scaphoid and the radius and accelerates joint destruction. However, when scaphoid instability is dynamic, the accessory stabilizers of the scaphoid are still functional. Therefore, if the dynamic stabilizers can be activated, it would be sufficient to stabilize the scaphoid when the wrist is loaded. This can be achieved by allowing direct activation of the dynamic stabilizers of the scaphoid. We designed a surgical technique that has two components and uses the FCR and ECRL: (1) Dynamic extension of the scaphoid by passing two-thirds of the ECRL through a hole in the reduced distal scaphoid. (2) Address the volar–distal scaphoid ligament (STT ligament) by anchoring the ECRL to the FCR. The portion of FCR distal to the scaphoid becomes a check-rein that tightens with contraction of the ECRL. (Dynadesis)

Results: Eighteen (19 wrists) patients reached a minimum of a 20-year (20–24 years) follow-up. All SLIL injuries were documented by arthroscopy. At follow-up, average age was 61 years (54–67), average grip strength improved from 47 to 67 pounds, the mean wrist flexion–extension arc decreased by 9°, radial deviation decreased by 2°, and ulnar deviation increased by 2°. Wrist X-rays in four views showed no radiocarpal arthritis. The drill hole remained patent in all wrists. Patients reported 83% improvement in pain level with 71% reporting no pain at all. 79% of patients had an excellent to good result as measured by a modified Mayo Wrist Scoring System. 100% of patients were satisfied with their results, would undergo the same procedure on the other wrist if needed, and would recommend the procedure to others.

Conclusion: The contribution of the forearm muscles is imperative to prevent failure of the wrist ligaments when the wrist is loaded. When the SLIL is torn, the FCR and ECRL (dynamic stabilizers) response is poor or absent, as the mechanoreceptors are not stimulated properly. When the majority of the scaphoid's stabilizing ligaments are torn (static deformity), reactivating the forearm muscles is not sufficient to

re-establish stability. However, stimulating the FCR and ECRL directly by way of the scaphoid, reestablishes their role in stabilization of the scaphoid when the scaphoid instability is dynamic.

A-0903 Absorbable adhesion barrier gel (Dynavisc®) for sciatic nerve regeneration of the mouse compared with carbon nanotubes: Enriched biomaterials

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Objective. The purpose of our study was to evaluate the biocompatibility and efficacy of Absorbable adhesion barrier gel (Dynavisc®) compared with carbon nanotubes-based poly(L-lactic acid) (PLLA) biomaterials and simple neurotomy for nerve regeneration. The principal goal was to assess whether or not the gel interfered with the regrowth process.

Materials and Methods. Three different scaffolding films (a continuous one and two 3D-printed mesh films) have been employed as a structural support to the otherwise impalpable and electrostatic MWCNTs and PLLA nanofibers. The sciatic nerves of 10 animals were either transected or compressed. After having been treated either with DYNAVISCTM gel or via mere epineurial suture, mice were monitored for 60 days, while their anatomical and functional statuses were being evaluated by various tests. A histological examination has been obtained at the end of our study.

Results. The two "dynavisc-mice" (no.8 and 9) performed clinically better than the other animals treated with simple neurotomy, and dynavisc showed not to interfere with the regeneration process. No adhesions and interpositions have been revealed histologically.

Conclusions. The encouraging results of our experiment confirmed the dynavisc effectiveness not only in tendon surgery. We adopted these results in order to improve our daily nerve surgery. The fact, histologically confirmed, of not interfering with axons regeneration should encourage the use of anti-adhesion strategies in nerve repair surgery. The next protocol is going to include rats, providing a bigger scale model and stronger evidences.

A-0904 In vitro and in vivo study of a bioengineered scaffold with carbon nanotubes for nerve regeneration

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Objective: The growing interest for nanotechnologies and their attractive features have pushed research groups to take further steps on a nanoscale and, thus, to prepare more sophisticated scaffolds that accomplish the task of finely interacting with cells and macromolecules. Based on an in-depth review of current biomaterials and nanotechnologies and prompted by the promising results, we obtained in various in vitro studies through a novel MWCNT-PhMO_PLLA (4-methoxyphenyl-functionalized-multi-walled-carbon nanotubes- and PLLA-nanofibers)-based scaffold, and we tested this material for the first time in vivo on a murine injured sciatic nerve model. The aim of the study was to evaluate its effectiveness, compared to some of the more commonly employed materials and methods.

Materials and methods: In this in vivo application, we employed three different scaffolding films (a continuous one and two 3D-printed mesh-films) as a structural support to the otherwise impalpable and electrostatic MWCNTs and PLLA nanofibers. The sciatic nerves of 10 animals were either transected or compressed. After having been treated either with our materials, Neurawrap™, DYNAVISCTM gel, or via mere epineurial suture, mice were monitored for 60 days, while their anatomical and functional statuses were being evaluated by various tests.

Results: The three "CNT-mice" (no. 2, 5, 7) performed better than the other animals at the tests, suggesting that the combination of our functionalized CNTs and PLLA fibers was superior to the other treatments. However, mouse no.7, that received a wide-mesh CNT/PLLA implant, was, by far, the one that showed the best results.

Conclusions: The encouraging results of our experiment confirmed the scaffold effectiveness, already showed by the in vitro studies as well as the suitability of the three supporting films. Moreover, we obtained useful information to define the steps of future research and experimentation. The next protocol is going to include rats, providing a bigger scale model for the scaffold implantation. Furthermore, we are going to observe the material's biocompatibility and other histological features, which are of primary importance for the expected future clinical trials. In parallel, we are going to design a novel conduit based on the same technologies, aimed at supporting nerve regeneration across large nerve gaps.

A-0907 First human hand transplantation for total hand agenesis: Early report

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The encouraging results of previous upper limb transplantations performed by Pathmanathan (2000) and Zucker (2006) between ischiopagus twins as well as excellent long-term outcome of the first Polish arm transplantation performed in a patient who had lost his arm 29 years earlier due to traumatic amputation (at an age of 18 months) made the authors believe that clinical application of transplantation for correction of congenital limb anomalies is feasible. Keeping in mind good results of the above-mentioned procedures, the authors performed the first-hand transplantation in a patient with congenital hand agenesis. The operation was performed on December 15, 2016. The transplant recipient is a 32-year-old male born without left hand, with the left upper extremity terminating at the level of the wrist. The donor was a 46-year-old brain-dead male. Two surgical teams simultaneously dissected the donor's limb and the recipient's stump to identify anatomical structures. The fact that dissection of both the stump and the graft was more complicated in comparison to dissection in posttraumatic cases (due to hypoplasia of the distal portion of the recipient's limb) and the transplant procurement in a distant city significantly extended the total ischemia time, which was 12 hours. Stump dissection revealed that vessels and nerves were underdeveloped or atrophic and reached the level of mid-forearm, the number of active muscles was very limited. The differences in size and diameter of corresponding anatomical structures in the transplant and the stump were so significant that it was necessary to perform the anastomoses of particular structures at different levels - for example the bones were fixated at the level of radius and ulna epiphyses, the nerves at the level of mid-forearm and the arteries proximally to antecubital fossa. The initial postoperative course was uneventful. No surgical complications were observed, except for slightly delayed wound healing. Immunosuppressive therapy consisted of Basilixi mab, tacrolimus, mycophenolic acid, and prednisone. Maintenance therapy included tacrolimus, mycophenolic acid, and steroids. Immunosuppression was well tolerated. Deep skin biopsy revealed histological signs of moderate cutaneous rejection episode 4 weeks after surgery, but without clinical manifestation. The histological findings resolved after transient increase in immunosuppression, including ATG infusion. The presence of immediate, postoperative motor function and its continuous improvement is more than satisfactory taking into consideration the congenital etiology of the

patient's disability as well as the limited number and quality of motor units providing finger and wrist motion. Moreover, the extremity excellently matched the contralateral hand for size, color, and skin texture. If no chronic rejection develops, the long-term functional prognosis of the graft should be similar to this reported in large series of previous allotransplantations performed in posttraumatic patients. However, the short time of postoperative observation (1.5 months) makes it impossible to evaluate the sensory recovery and cortical integration of the limb at the present moment.

A-0970 Dorsal metacarpal artery perforator flap

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Objective: Reverse dorsal metacarpal artery island flap is a common procedure performed in the reconstruction of the soft tissue of the hand, except for the tip of the finger. Rather than elevating the flap and the artery through reverse dorsal metacarpal artery island flap procedure, elevating only the island flap via the use of a perforator in the dorsal metacarpal artery perforator flap is a simpler and more useful procedure. The purpose of this study is to evaluate the result of the dorsal metacarpal artery perforator flap procedure.

Methods: Dorsal metacarpal artery perforator flap was performed in 37 patients, composed of 29 males and 8 females, from November 2012 through October 2016. The mean age of the patients was 47, and the average follow-up period was 5.3 months. Of the 38 cases, 35 cases presented soft tissue defect due to trauma and 3 cases due to burning. In 16 of the cases, the subcutaneous tunnel was created for the pedicle to pass through, and in 22 of the cases, the pedicle was left exposed with wet dressing and 2 weeks later, pedicle division was performed.

Results: The mean flap size was 4.3×2.5 cm. Primary closure (mean flap size 4.1×2 cm) was performed at the donor site in 17 cases, and full thickness skin graft (mean flap size 4.2×2.8 cm) was performed at the donor site in 21 cases. It involved 3 cases of perforator of 1st dorsal metacarpal artery, 18 cases of second dorsal metacarpal artery, 13 cases of third metacarpal artery, 4 cases of fourth metacarpal artery. Five cases of partial necrosis, and 1 case of total necrosis were observed, and 15 cases included additional procedure of flap defatting.

Conclusions: Scars remained, but donor site morbidity was minimal. It is also a useful procedure in producing adequate length of the pedicle for reconstructing not just the dorsal side of the hand but also the thumb or the first web space of the hand.

A-0971 Habitually overnight immobilization as a single therapy significantly improves the clinical symptoms, functionality of hand and the life quality of patients with CMC osteoarthritis

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Objective: To evaluate the effectiveness of habitual overnight immobilization with a new, POP-like circular stable and re-adjustable orthosis in CMC osteoarthritis.

Methods: Twenty-seven patients (36 – 81 years) with symptomatic CMC osteoarthritis (X-ray class II-III) have been involved into this prospective cohort clinical study (in average 6 weeks long). The study period includes 3 assessments (at start, and 3 and 6 weeks later in average). Overnight-use of a POP-like circular stable (immobilizing), well-fitting wrist and saddle joint orthosis was the only allowed therapy. Visual analog scale was used for assessments of pain, physical tasks to check the capability of hand functions (adduction-, sphere grasp-, keeping a bottle at screw stopper- and opening a screw stopper tasks). For assessing changes in the life-quality of the patients quick DASH questionnaire was used and questions were put on occurring of morning stiffness and on set-up of continuous activities-disturbing pain during days. Variance and correlation analysis and non-parametric tests were applied for statistical evaluations.

Results: Pain: Nightly occurring pain was reported by 21 patients at beginning and only 4 at end of study (VAS means: 40,2 and 9,9, respectively).

Without orthosis (during days), pain in rest and during activities became significantly reduced (VAS score means 35.1 vs. 17.3 and 66.6 vs. 36.7, respectively). Pain-free or improved status has been reported by 8 vs.25 and 0 vs. 24 patients, respectively.

Pain became significantly reduced during all four functional tasks. The statistical analysis of the pooled VAS scores (108 assessments per visit) reflects the time-dependent effects (start, first and second control: 54.1 to 40.0 and 29.0, respectively).

Functional tests: The improvement in functional capability of hand functions is clearly reflected in

increased number of patients able to perform functional tasks (adduction: 12 to 20, sphere grasp: 13 to 24, bottle grasp at the cup: 11 to 22, and (open a screw stopper of a bottle: 6 to 18).

Life-quality: Seventeen patients reported on morning stiffness at start and 7 at end of study. At beginning out of 26, the activity-disturbing pain occurred by 13 patients in the morning, while in 13 cases only afternoon. At end 11 patients did not experience such pain at all, 12 only afternoon and only 2 in the morning.

The quick DASH questionnaire was filled out by 17 patients. All patients declared him- or herself

definitely disturbed in the daily activities before start, and only six at the end of study.

Conclusion: Habitual overnight immobilization with POP-like stable circular orthosis without any additional therapy significantly reduced the clinical symptoms, improved the performance in the functional tasks and the life-quality of the patients with CMC osteoarthritis. The effects improved statistically parallel with the duration of the therapy.

Evidence level: II.

¹Chrisofix support restricted to free samples, co-authorship activity only after concluding the statistical analysis.



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