

A-0001 Effect of distal radius volar plate position on contact pressure between the flexor pollicis longus tendon and the distal plate edge

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Purpose: Some clinical studies suggested that distal radius plates placed distal to the watershed line have the potential to impinge on the traversing flexor tendons. However, the validity of this theory remains unclear. The purpose of this study is to evaluate the quantitative effect of volar plate position on flexor pollicis longus (FPL) tendon friction by measuring the contact pressure between the FPL tendon and the distal edge of the locking.

Methods: We used seven fresh cadaveric upper extremities without wrist osteoarthritis or any deformity. External loads of 1.5 kgf and 3.0 kgf were applied to the FPL tendon to simulate the pinch function of the thumb. The distal radius volar plate was applied to these cadaveric specimens in various positions relative to the watershed line. Contact pressure between the distal plate edge and the FPL tendon was measured using a thin flexible pressure sensor and was compared among

various positions of the volar plate for wrist extension angles of 0°, 30°, and 60°, and ulnar deviation angles of 0° and 20°. We simulated an anatomically healed distal radius fracture with volar plate fixation because, in clinical reports, FPL tendon ruptures after volar plate fixation usually occurred after fracture healing, and FPL tendon injury can occur despite the plated radius healing in anatomic alignment. Therefore, we did not simulate a radius fracture.

Results: Contact pressure between the FPL tendon and the distal plate edge was 0 N/cm² when the distal plate edge was placed proximal to the watershed line ("P" position) in all specimens. The contact pressure increased when the distal plate edge was placed at the watershed line ("A" position) compared to the P position in five specimens. Specifically, when a 3-kg load was added to the FPL tendon, the mean SD contact pressure was 0.8 SD 0.8 N/cm² at 60° extension and 0° ulnar deviation and 1.0 SD 0.8 N/cm² at 60° extension and 20° ulnar deviation of the wrist. These values were significantly greater than those at the "P" position ($p < 0.05$). The contact pressure also increased when the distal plate edge was placed distal to the watershed line ("D" position) in all specimens. Specifically, when a 3-kg load was added to the FPL tendon, the mean SD contact pressure was 2.9 SD 1.5 N/cm² at 30° extension and 20° ulnar deviation, 3.9 SD 1.8 N/cm² at 60° extension and 0° ulnar deviation, and 4.0 SD 1.7 N/cm² at 60° extension and 20° ulnar deviation of the wrist. These values were significantly greater than those at the "P" and "A" positions ($p < 0.05$).

Conclusion: Our quantitative results support the theory that plates placed distal to the watershed line have the potential to impinge on the traversing FPL tendon, even when a radius fracture heals anatomically. This study clarifies a mechanism of FPL tendon irritation after volar plate fixation for distal radius fractures.

A-0011 Elbow flexion recovery in C5C6 and C5C6C7 post-traumatic palsies. Comparison of single versus double nerve transfers. Study of 29 patients

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Introduction of fascicular neurotizations changed the surgical view on the plexus brachial and the peripheral nerves. In order to restore function by targeting one or more muscles, and to reduce the time of denervation, different surgeons have sought to bring the front of the axonal growth closer to the neuromuscular junction. Elbow flexion is a simple model that was applied in the early 90s by Oberlin from a partial transfer of the ulnar nerve (PTUN). Twenty nine patients were operated on from April 2003 to January 2010. Fifteen 'simple transfers' (PTUN on the nerve of the biceps) and 14 'double transfers' (simple transfer and partial transfer of the median nerve on the brachial) were realized. The average age was 30.2 years old, the operative delay was an average of 6 months, and the follow-up was an average of 34.3 months. We chose for the final evaluation, a minimum follow of at least 15 months. Both populations showed equivalent clinical characteristics with the exception of paralysis, of which C5C6 was 20% in the 'simple transfer' group and 50% in the 'double transfer' group. In the simple transfer group, 60% of the patients recovered British Medical Research Council grade M4 with a force of 2.2 kg. The average time to restore grade M4 was 13.2 months. In all cases of C5C6 palsies (three cases), patients recovered grade M4. In the group double transfer, 85% of patients recovered grade M4, with a force of 2.9 kg. The average time to restore grade M4 was 11 months. In all cases of C5C6 palsies (seven cases) patients recovered grade M4. No significant differences were established for these data. Among patients under the age of 40 years, 77, 3% have retrieved a M4 elbow flexion, whereas only 51% of patients over 40 years have achieved a similar score. Delay to surgery was also found to influence the final overall result, as 75% of the patients operated before 6 months were able to achieve a grade M4 elbow flexion. Recovery of elbow flexion was also correlated to the functional status of the shoulder as all patients who underwent a successful nerve reconstruction for shoulder function ended up with a M4 elbow flexion regardless of the type of neurotiziation used for the motor nerve of the biceps. Seven patients had a deficit in clinical

testing to the contra-lateral side; three of these patients experienced a sensory deficit and four, motor weakness. No discomfort was expressed by these patients. The double neurotiziation seems to achieve better results despite the greater proportion of C5C6 lesions in that group. Patients with a C5C6 showed a better outcome when considering recovery time and strength against resistance. The restoration of the shoulder function improves the final result, including flexing the elbow, most likely owing to its stabilizing effect. The clinical analysis found a deficit of 7 out of 29 cases. No functional impairment was expressed by the patient.

A-0014 Development of a bioactive membrane with stem cells and growth factors for cartilage regeneration in hand surgery

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Nowadays treatment of osteo-arthritis is a public health problem and a non-regenerative one. Our aim was to develop a new implant for cartilage diseases in hand surgery using nanotechnology (nanostructured membrane). The study concerns a highly innovating and original way to prepare a living functionalized (with a drug delivery system and stem cells) biomaterial aimed at inducing bone and cartilage regeneration after osteo-arthritis disease. This strategy consisted of developing multilayered assemblies (polyelectrolyte films), with growth factors like BMP-2 for bone and cartilage differentiation, stem cells and cartilage repair activities as an implanted biomaterial (membrane). This procedure offered the possibility to tune the compositions of the resulting material in depth as well as laterally. It was thus possible to foresee the incorporation of cells and the embedding of growth factors at different stages of the film construction. In addition, we also introduced different types of cells: human osteoblastes, chondrocytes and mice stem cells implemented into the constructions of the multilayers. Finally the *in vitro* tests, *in vivo* implantations into rat cartilage defect within chondrogenic environment and *ex vivo* analysis (microscopy, histological, mechanical tests) of this stem cell-based bone and cartilage tissue engineered product have been done for checking properties of subchondral bone and cartilage induction of these hybrid functionalized constructs. Preliminary results were already obtained making the success of this program likely possible *in vitro* and *in vivo*. The main objective of this work was to develop multilayered

assemblies, with stem cells from bone marrow incorporated into a nanostructured matrix. In this strategy, we used multilayered films, polypeptide-based growth factors (BMP-2) as reinforcement and vectors and human mesenchymal stem cells aimed to repair cartilage at the site of implantation of the membrane. In a first step, mesenchymal stem cells arising from bone marrow have been introduced within these functionalized structures and were investigated. In a second step, the same membranes were also exploited for their possibility of cartilage repair and their capacity to deliver therapeutic agents on rat cartilage defects, by the same methods. The project aims to extend the procedure to the incorporation into the membrane mesenchymal stem cells able to produce a cartilage-specific matrix under biochemical and mechanical stimulation and to test their biocompatibility.

A-0018 Use of continuous horizontal mattress suture techniques in end-to-side microsurgical anastomosis: an experimental study in rats

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Objective: The aim of this randomized controlled study was to improve the new suturing method, which increases the success rate of end-to-side microsurgical anastomosis.

Methods: Thirty-six Sprague-Dawley rats were randomly divided into three groups that consist of 12 rats in a closed envelope method. The end-to-side microsurgical anastomosis procedures were applied by the same surgeon between the left main carotid artery and left external jugular vein. The surgical evaluations were performed by anastomosis duration, leakage evaluation, vessels patency, aneurysm improvement and histological assessment.

Results: End-to-side anastomosis that were applied with a continuous horizontal mattress suture, gave statistically significantly better results in terms of leakage, anastomosis openness, aneurysm and histologic assessment. Also anastomosis duration of the continuous horizontal suture was significantly faster than the simple intermittent suture ($p < 0,001$).

Discussion: Our study revealed that the continuous horizontal mattress suture technique has the advantages of providing uninterrupted vessel flow

in a shorter time, and minimal intraluminal suture material, which increases thrombosis risk. Also the 'sac-mouth' effect of continuous suture techniques was prevented by the horizontal mattress technique.

A-0022 Weekly evaluation of quality of life after a distal radius fracture during 6 weeks: prospective multicentric assesment

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Introduction: Correlation between functional results and the type of fracture or the type of fixation are rare. There is no reported work concerning quality of life and speed of recovery after a distal radius fracture and evaluation is frequently reported at 6 months. This prospective study evaluates the speed of recovery of function (DASH scoring) week after week during the first six weeks after osteosynthesis of a distal radius fracture.

Material and methods: A group of patients with a distal radius fracture fixed in emergency, has been evaluated by a surgeon not involved in the treatment. A DASH score was registered prospectively at the end of each week during the first 6 weeks after fixation. More the score is high, less are the results.

Results: Forty-four patients, with a mean age of 62,4 y (20–82), with a distal radius fracture fixed by a plate with a polyaxial-locked screw (31 patients with a mean age of 68 y (20–82)) or fixed by 3 or 4 pins (13 patients, with a mean age of 49 y (20–69)), filled a complete DASH score each week during 6 weeks. All patients treated by pins presented the worst DASH score (80/100) at the first post-operative week, compared with the plate group. The comparison of the curve of the 6 week results of DASH scores showed that patients treated with a plate had better results obtained quickly. The predictive value of DASH was defined: at 2 weeks if the DASH score decreased 20 points the patient will obtain good functional results at 6 months. If the score decreased less than 10 points the result will be fair.

Discussion: Fixation by a plate diminishes secondary displacement. If direct costs are 10 times higher than fixation by pins, indirect costs are in favour of a locking-palmar plate. Fixation by a plate allows effective and early motion. It is the first series showing the subjective aspect of recovering, week after week, of a

fixed distal radius fracture during the first 6 weeks. A better DASH score is significantly reported with a plate and the predictive value of this score at the second post-operative week is reported.

A-0023 Bone defect at upper limb level treated by the induced membrane technique. Prospective multicentric study on 20 cases

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Introduction: Twenty cases of bone defect have been treated by the induced membrane technique avoiding allograft, microsurgery and amputation

Materials and methods: Nine cases of long bone defect (humerus and two bones arm) and 11 cases of bone defect of the hand have been included in this multicentric prospective study (3 centres). Eleven cases were traumatic, seven cases were septic non-union and two cases were tumour. For the hand bone levels reached at least one phalanx, and for the long bone the mean defect was 5 cm (3–11). All cases were treated by the induced membrane technique, which consists in stable fixation flap if necessary and in filling the void created by the bone defect by a cement spacer (PMMA). This technique needs a second stage procedure at the second month where the cement is removed and the void is filled by cancellous bone. The key point of this induced membrane technique is to respect the foreign body membrane, which appeared around the cement spacer and which created a biological chamber after the second time. Bone union was evaluated prospectively in each case by an surgeon not involved in the treatment by X-ray and CT scan. Failure was defined as a non-union at 1 year, or an uncontrolled sepsis at 1 month.

Results: Three cases failed to achieve bone union, two at hand level and one for the long bone. No septic complications occurred and all septic cases were stopped. In 14 cases, bone union was achieved with a delay of 5 months (1,5–12). Two biopsies proved that osteoid tissue was created by the technique. At hand level, all fingers were included. At shoulder and elbow level, function reached 75% of motion than the controlateral side.

Discussion: Masquelet first reported 35 cases of a large bone defect of tibia non-union treated by the induced membrane technique, which allow a bone defect to fill with cancellous bone alone. The cement spacer allows a foreign body membrane to be induced,

which constituted a biological chamber. Works on an animal model, reported by Pellissier and Viatteau, showed the properties of the membrane: secretion of growth factors (VEGF, TGFβ1, BMP2) and osteoinductive activities of the cells. The induced membrane seems to play the role of a neo-periosteum. It is possible to use this technique in emergency or septic conditions, where bone defects can not be solved by shortening. This technique avoids the use of the microsurgical technique and the limit is the quantity of available cancellous bone.

A-0024 Post traumatic arthritis of radio carpal joint treated by chondro costal graft. Preliminary evaluation of 22 patients

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Introduction: Is it possible to imagine a solution that could avoid losing motion while making the pain disappear in cases of high-demanding patients with wrist arthritis?

Material and methods: Four cases of post-traumatic arthritis of the distal radius and 18 cases of SNAC and SLAC were treated with an osteochondral costal autograft on the radius. A chondro costal graft harvested on the eighth rib was inserted and fixed by plate in place of the articular impaction in case of mal union, on the proximal part of the scaphoid after removal of the native proximal degenerative part of it in the case of SNAC or SLAC. Group 1 distal radius mal union: four patients have been operated for pain and stiffness. Location of the cartilage defect was central in two cases and palmar in the others. A dorsal approach in one case, a palmar approach in the three others, allowed reduction and reconstruction of the destroyed radial part of the joint. Group 2 SNAC and SLAC: 16 Males – 2 females with a mean age of 47,7 years (26–62 years).

Results: A graft union was achieved in all cases in both groups. No resorption and no necrosis was pointed on X-ray and RMI evaluation at the longest follow up. Histological analysis performed in three cases (removal of plate) showed the vitality of the graft Group 1: with a minimum follow up of 2 years no complication has been pointed. Integration and viability of the graft were evaluated with RMI. At the highest follow up functional results were excellent in the first case. Motion and grasp are similar to the

controlateral side. For the three others patients motion in flexion–extension reached, respectively, 74%, 69%, 54% of the controlateral side, and grasp reached, respectively, 62%, 73% and 68% of controlateral side. Group 2: at a follow up of 4,1 years (6 m–9,5 years), there was no evolution of the arthritis. One algodystrophy and one dislocation of the graft occurred in the case of SLAC, and despite the absence of the scapholunate ligament, the carpal alignment did not deteriorate in any patient. The Green et O'Brien score showed the following results: Exc: 5; Good: 10; Fair: 2; Poor: 1. 17/18 patients were very satisfied and satisfied. Samemanual work with or without modification was possible in 13/17 cases.

Discussion: Reconstruction of a partially destroyed articular surface by a costal graft is reliable and allows filling and resurfacing an articular cartilage void. If a chondro costal graft is currently used in maxillo facial surgery it is the first report in post traumatic arthritis secondary to intra articular mal-union. In the case of deficiency of the proximal part of the scaphoid costal autograft was preliminary reported by Sandow in 98, with 22 cases with good results, but 2 years of follow up. In such cases this technique is efficient but further follow up is necessary in such a degenerative disease.

A-0025 ISIS prosthesis: preliminary biomechanical and multicenter clinical evaluation of a screwed trapezium cup

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Introduction: Trapeziometacarpal prosthesis allows faster mobility and useful thumb than trapeziectomy. But successful implantation of the trapezium cup depends on the bone stock and the jig. An anatomical and biomechanical study is presented followed by a prospective clinical evaluation of the implantation of a screwed trapezium cup.

Material and methods: Cadaver study : 11 screwed trapezium implant have been implanted on cadavers (age > 70 y, alcohol conservation) following the operative technique. Extraction tests have been performed after X-ray evaluation of the position of the implant.

Clinical study: 113 prosthesis have been implanted and prospectively evaluated (DASH scoring, Kapandji scoring, pinch, grasp).

Results: Best bone stock was identified on the medial border of the trapezium. Only 1/5 trapezium cup with 5 spires was extracted (120 N). In the subgroup of the trapezium with three spires, if only two spires were screwed (first series of test) the extraction load reached 103, 24 N (57–133). No trapezium fractures have been pointed, but slight fissuration of the lateral border were observed in four cases after two series of tests. The multicentre study of 113 implants evaluated with 23 months of follow up allowed validation of the operative technique of implantation with the following results: enhancement of 70 points (DASH scoring), enhancement of 5 points (EVA), enhancement of 1 kgF (pinch), Kapandji = 9,4, grasp = 22,4 KgF). Only one trapeziectomy was necessary secondary to a per operative fracture. Each time the surgeon has pinned with no fluoroscopic assistance, the pin was never in the centre of the trapezium

Discussion: Implantation of a trapezio metacarpal prosthesis is not recommended if the trapezium is less than 8 mm. The two main complications of trapezio metacarpal prosthesis remain the instability with dislocation and loosening (22% in the 1980, 4% in 1990). If it was possible to propose an implant with retentive cup (no possibility of dislocation), and a screwed cup with strong bone implantation, prosthesis could become the reference treatment, replacing the trapeziectomy in old but active women. Fracture of the trapezium is infrequent but a well-known complication with impacted trapezium cup. Bone stock is more important on the medial side and implantation of the cup in the centre of the bone needs fluoroscopic assistance, even if the surgeon is an experimented one. The key point of such a procedure remains the implantation of the cup in the trapezium. Three spires in the bone of the tested screwed cup remain efficient to reach sufficient extraction load, which can explain the good functional results in this multicentre study of 113 implants.

A-0027 Surgical technique and evaluation at long follow-up of a chondrocostal autograft in hand surgery

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Introduction: Used routinely in maxillofacial reconstructive surgery, the chondrocostal graft is used more recently in hand surgery. The purpose of this

study was to analyse, at long follow-up, the radiological and histological evolution of this autograft, in the hand and wrist surgery.

Material and methods: Since 1992, 144 patients have benefitted from a chondrocostal autograft: 116 osteoarthritis of the thumb carpometacarpal joint, 18 radioscaphoidal arthritis, 6 articular malunions of the distal radius, 4 kienbock and 4 traumatic loss of cartilage of the PIP joint. The sample technique was always the same: a horizontal incision on the ninth rib, sample in chondral or osteochondral area function of the indications, but without interrupt the rib continuity. A radiological, RMI and histological study were performed with a mean follow-up of 68 months (4–159).

Discussion: Whatever the indication, the reconstruction by a chondrocostal or ostochondrocostal graft has allowed satisfactory clinical results to obtain at long follow-up. The donor site (the ninth rib) has a poor morbidity: we have deplored one pleural effraction sutured per-operative without radiological pneumothorax and three subcutaneous hematoma not drained. But the main question was the viability of the graft. The radiological study has showed the non-wear of the graft and a certain degree of ossification. The RMI confirmed a tiny degree of osseous metaplasia in and to the circumference of the graft, but its viability too. The biopsies showed a new vascularization of the cartilage, which is responsible of the punctual osseous metaplasia, in a normal histological hyaline cartilage.

Conclusion: Despite the strong mechanical strain in the hand and wrist, the chondrocostal graft is a biological arthroplasty, trusty and secure at long time. Despite the inevitable histological modification, the cartilage remains alive and of satisfactory quality at long time to play the part of interposition and reconstruction of an articular surface.

A-0035 Transposition of distal parts of *m.pectoralis* major for restoration of elbow flexion in patients with arthrogryposis

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The purpose of this research is examination of possibility usage of *m.pectoralis* major for restoration of elbow flexion in children with arthrogryposis.

Methods: From 2010 to 2011 we performed transposition of distal parts of *m.pectoralis* major to biceps brachii (sternocostal, costal and abdominal parts of

the muscle) in 26 children (28 cases). The age of patients was from 1 to 14 years.

Results: In 6 cases we have seen agenesis of clavicular and manubrial parts, 5 cases proximal parts of *m.pectoralis* major had fibrofatty degeneration. Three cases had fibrofatty degeneration of distal parts of *m.pectoralis* major and therefore we performed transposition of distal parts of *m.pectoralis* major to the biceps brachii in combination with *m.pectoralis* minor. In 6 cases we combined transposition of *m.pectoralis* major with capsulotomy of the elbow. The outcome results were estimated in 20 cases. Active movement in the elbow was in the range of 20 degrees to 100 degrees. Two patients had hypertrophic scars. The best function was achieved in patients with enough passive movement in the elbow and active movement in the elbow.

Conclusions: Transposition of distal parts of *m.pectoralis* major for restoration of elbow flexion is one of the suitable methods of restoration of elbow flexion in patients with arthrogryposis.

A-0037 The psycho flexed hand: diagnosis, classification and treatment

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Purpose: The psycho flexed hand is a rare disorder characterized by fixed finger contractures without organic etiology. This condition most frequently involves the three ulnar digits, but different combinations and extensions of the deformities are also possible. It is a poorly known disorder and, as a consequence, it is largely misdiagnosed. The purpose of this study was to review our clinical experience with the diagnosis and the treatment of this disorder and to propose a new classification.

Methods: A series of 20 cases, 9 males and 11 females, mean age of 56.2 years, was reported. We introduced a new classification of the various possible patterns of finger deformities in six types: Type 1: prevalent flexion contracture at the MCP and PIP joints of the last two or three fingers; the thumb and the index are not affected; Type 2: prevalent flexion contracture at the PIP and DIP joints of the last two or three fingers; Type 3: flexion contracture of all the long fingers; Type 4: flexion contracture of all the fingers of the hand, including the thumb (clenched fist syndrome); Type 5: thumb flexus-adductus isolated

(the long fingers are not affected); Type 6: flexion of digits associated with flexion contracture of other joints at the upper extremity. Non-operative treatment was performed in 14 cases and surgical treatment in six patients. A rigorous rehabilitation program was effectuated in both forms of treatment, mainly based on self-rehabilitation performed by patients at home.

Results: In all the cases we obtained satisfactory and durable finger extension.

Conclusions: Contrarily to most of the previous literature on the psycho flexed hand, our experience demonstrated that a good approach and correct treatment are successful in obtaining the correction of the deformities.

A-0039 Endoscopic cubital tunnel decompression – a modified technique

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Introduction: Over the last 10 y, Endoscopic Cubital Tunnel Decompression (ECuTR) has grown in popularity with the minimally invasive technique achieving better symptom relief and less scarring compared with open techniques. ECuTR facilitates more extensive ulnar nerve decompression compared with division of Osborne's fascia alone, with the small scar of simple decompression. However, the presently described systems utilize the original approach first described 20 years ago with the same risks of medial cutaneous nerve injury. We present our review of a new suprafascial technique using custom instrumentation (Tulip®) and a custom incision.

Technique: A 3 cm transverse incision is made just distal to the elbow using the medial epicondyle and the olecranon as landmarks. Unique to this technique is the suprafascial plane used to approach the ulnar nerve allowing direct visualization of the nerve and release of any constricting structures. The approach facilitates an extensile approach to the decompression as direct visualization of the nerve is maintained throughout the procedure. The ulnar nerve was not transposed routinely in any of our cases.

Methods: A retrospective analysis of case notes was carried out on all patients who underwent ECuTR over a 4 y period (2008–2011). Data regarding the preoperative nerve conduction studies, surgical technique and postoperative complications were extracted.

Results: One hundred and twenty-one patients (141 elbows) underwent ECuTR over the 4 y period. Greater than 90% of patients had ulnar nerve compression

confirmed on nerve conduction studies. Patients were discharged at 6 week follow up if their symptoms had improved. Improvement or resolution of symptoms was present in 90% of cases. Complication rate was comparable with current published literature on ECuTR.

Conclusion: The senior author's endoscopic technique for cubital tunnel decompression is successful and satisfactory. It provides a different approach to current techniques with the advantage of direct visualization of the ulnar nerve throughout the procedure.

A-0041 Immune system augmentation by glatiramer acetate of peripheral nerve regeneration – crush versus transection models of rat sciatic nerve

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Background: Immune system augmentation, using the antigen glatiramer acetate (GA, Teva Pharmaceutical Industries Ltd, Petach Tikva, Israel), which is known to affect T-cell immunity, has been shown to have a positive effect on peripheral nerve regeneration. The aim of this study was to evaluate a larger dose of GA (1000 microgm), and to compare the effect of GA on the regeneration of crushed versus transected nerves.

Methods: Wild type rats underwent crush or transection and repair injuries to the sciatic nerve and were treated with either GA, complete Freund's adjuvant (CFA) or saline. They were examined 3 weeks post injury both histologically (axon count) and functionally (tibialis anterior muscle weight and sciatic function index – footprint analysis).

Results: GA was found to augment the regeneration of the peripheral nerve both histologically and functionally. In the transected nerve a significant increase ($p < 0.04$) in the axon count distal to the injury site was seen in the GA group in comparison with the CFA control group. A similar yet insignificant trend was found in the crushed nerve. A significant improvement ($p < 0.04$) was found in the footprint analysis between the GA and the saline control group in both the crush and transected nerve groups. We found no difference in the axon count or in the muscle weight between the injury types, although we did find a significant improvement in the footprint analysis in the crush group in comparison with the transected groups ($p < 0.0001$).

Conclusions: The higher dose of GA tested in this study was found to significantly improve the regeneration of the peripheral nerve. In both injury types, the functional results improved with GA, although histologically it significantly improved the transected nerve axon count, in comparison with the crushed nerve. While comparing the two injury types, we saw a discrepancy between the different functional measures examined. The nerve may have sufficiently regenerated after both injury types at 3 weeks, to result in a similar proximal (tibialis anterior) muscle weight. On the other hand, the transected nerve was not as efficient as the crushed nerve in reinnervating the more distal and complex muscle functions, which resulted in a significant difference in the footprint analysis.

A-0042 Three-dimensional measurements of ulnar variance during forearm rotation

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Purpose: Positive ulnar variance (UV) is often associated with clinical wrist disorders, such as ulnar impaction syndrome, and previous two-dimensional radiographic studies reported that the UV increased during pronation. The purpose of this study was to measure UV three-dimensionally during forearm rotation and to determine how it correlates with the ulnolunate distance.

Method: Fifteen healthy forearms (3 right and 12 left) of 15 subjects (11 females and 4 males) were studied. The upper limbs were scanned from elbow to wrist in both maximum supination and pronation using three-dimensional (3D) computed tomography (CT). We created 3D bone models of the radius, ulna, and lunate; measured UV as the distance between the furthest point on the ulnar head and the base of the lunate fossa of the radius along the long axis of the radius; and examined how UV changes during forearm rotation. We also examined the relationship between UV and the shortest distance between the lunate and the ulnar head.

Results: UV significantly decreased as the forearm rotated from supination (2.5 SD 2.4 mm) to pronation (2.2 SD 2.5 mm; $p < 0.01$). However, the ulnolunate distance did not change significantly during forearm rotation. 3D animations revealed that the length change pattern of the ulnolunate distance during forearm rotation varied individually because of differences in ulnar head morphology.

Conclusion: UV decreased significantly as the forearm rotated from supination to pronation. However, the ulnolunate distance did not change significantly during forearm rotation. These findings suggest that determining UV using X-rays is inaccurate, and the theory that ulnar impaction increases during pronation cannot be substantiated.

A-0050 Establishment of volar portals for wrist arthroscopy: a useful approach of wrist arthroscopy

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Purpose: Wrist arthroscopy through volar portals is necessary to view dorsal structures inside the wrist joint capsule. This surgery has been recently advocated by some wrist surgeons. So far, this technique attracted little attention of hand surgeons, and has been rarely used in wrist arthroscopy to date. The rare use of this approach may be due to the presence of many vital structures in the volar aspect of the wrist, such as tendons, vessels and nerves, which surround volar portals and impede surgeon's willingness to access through volar portals. Here we present our procedures to establish volar portals in wrist arthroscopy and to evaluate usefulness of its clinical application.

Methods: From October 2006 to October 2010, 25 consecutive cases of distal radius fractures or ulnar side wrist pains were treated with arthroscopy through volar portals established with our procedures, of which the efficiency and complications were evaluated. Volar radial portal was established with arthroscopic monitoring through 1/2 portal and switching stick through 3/4 portal, and a volar ulnar portal was established with arthroscopic monitoring through 6U portal and switching stick through 4/5 portal. The 'inside-out' and 'outside-in' arthroscopic portal establishing techniques were performed for these patients.

Results: The fragments of distal radius end were reduced and fixed satisfactorily, and TFCC was examined and debrided successfully through volar portals. No permanent complication of vessels, nerves and tendons were found in our cases.

Conclusion: Our procedures for the establishments of volar wrist arthroscopic portals were safe and effective, with which some wrist disorders can be explored, diagnosed and treated much more accurately than using dorsal portals alone.

A-0053 Effects of tension across the repair site of a tendon on the gap formation and ultimate strength

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Purpose: How to set appropriate tension to the surgical repair site of the tendon has not been specifically investigated, but it may be an important factor affecting gap formation at the repair site. We aimed to investigate the effects of the tension across the repair site on gap formation forces and ultimate strength in tendon repair.

Methods: Fifty-seven porcine flexor tendons were repaired with a two-strand Kessler repair or a four-strand cross-lock repair. In each repair, the tendons were divided into three groups by 0%, 10%, and 20% shortening of the tendon segment encompassed within the core suture strands. The repaired tendons were subjected to a linear load to failure in a materials testing machine. The forces required for producing initial and 2 mm gap formation and ultimate failure were statistically compared for each group.

Results: The initial and 2 mm gap formation forces of the tendons in the 10% shortening group were significantly higher than those in the no-shortening group in both two-strand and four-strand repair. Further increasing the shortening degree to 20% significantly increased the gap formation forces only in the four-strand cross-lock repair. No differences were found in the ultimate strengths among the tendons of the three kinds of shortening in either two-strand or four-strand repair.

Discussion and conclusions: This study discusses an issue underlying all tendon repairs, but this topic has been rarely addressed thus far. The findings in this study show that 10% tendon shortening substantially increases the gapping formation strengths. Further shortening to 20% increases the gapping strength significantly but much less, and may not be as important as the increase from no shortening to 10% shortening. The findings of this study indicate that approximately 10% shortening of the tendon is appropriate to improve repair strengths. Our study suggests that clinically certain pre-tension to the surgically repaired tendon favours gap resistance during tendon mobilization after surgery, and tension-free tendon repair is not advantageous, in that it actually weakens gap resistance of the repair. Tension across the repair site would cause certain degrees of tendon bulkiness; *in vivo* study may address this influence. However, from our

study, a certain degree of pre-tension appears to be very beneficial to gap resistance.

A-0054 Changes in apoptosis and proliferation of the tenocytes after AAV2-VEGF gene therapy: an *in vivo* study using a chicken tendon injury model

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Purpose: Vascular endothelial growth factor (VEGF) is important in wound healing because it promotes the early events in angiogenesis, particularly endothelial cell migration and proliferation. We transferred the exogenous VEGF gene to injured tendons by adeno-associated viral serotype 2 (AAV2), which is frequently used in gene therapy, to investigate the possible protective effects on tenocyte proliferation and apoptosis *in vivo*.

Methods: Seventy-two flexor digitorum profundus tendons of leghorn chickens were repaired after being cut completely. Thirty-six tendons were injected with a total of 2×10^9 particles of AAV2-VEGF. The other 36 tendons were repaired surgically without any injection. At 1, 2, 3, 4, 6, and 8 weeks the tendons were harvested and apoptotic changes were evaluated by the TUNEL method. Immunofluorescence was used to detect the protein expression levels of proliferating cell nuclear antigen (PCNA) and Bcl-2. Another six normal tendons served as day zero controls.

Results: In the tendon surface, the apoptosis index (AI) of the tendons treated with AAV2-VEGF decreased significantly compared with that in the untreated tendons at weeks 1, 2, 3, and 4 ($p < 0.01$). The number of PCNA-positive cells was enhanced significantly in the treated tendons at weeks 2 ($p < 0.019$) and 3 ($p < 0.001$). The percentages of Bcl-2-positive cells had no difference between the treated and control tendons at the postoperative time-points except that significantly decreased at 4 weeks.

Conclusions: In this experimental model, introduction of exogenous VEGF gene by means of AAV2 to lacerated digital flexor tendons inhibit apoptotic reactions of the tenocytes in the tendon surface region and promote the proliferation of tenocytes during the early and middle healing period. Injection of AAV2-VEGF to the lacerated tendon may be a potential effective method to enhance an intrinsic tendon healing capacity.

A-0055 *In vivo* gliding resistance to tendon motion in each part of digital flexion after release of the A2 pulley

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Purpose: Increases in the resistance to tendon during movement may lead to rupture or gapping of the repaired tendon. The gliding resistance of tendon is greatly affected by the presence of the major pulleys, especially the A2 pulley. We aimed to investigate the effect of the intact A2 pulley on resistance of different parts of tendon gliding *in vivo*.

Methods: Thirty-two toes of Leghorn chickens were used. The FDP tendon was transversely partially cut and repaired with the A2 pulley intact in 16 toes and with the A2 pulley incised longitudinally in another 16 toes. At the postoperative 1 and 2 weeks, the toes were harvested and mounted to a material testing machine (Instron). Full range of active digital flexion was simulated with pulling of the Instron machine on the proximal end of the FDP tendon and total WOF was recorded during 18 mm excursion. Then the A2 pulley was incised in the toes with the A2 pulley intact during surgery to record the WOF. The changes in the WOF during each of the three parts of the simulated toe flexion (gliding excursions from 0 to 6 mm, from 6 to 12 mm, and from 12 to 18 mm) were analysed.

Results: At postoperative week 1 and 2, the total WOF as well as the WOF in each part of the toe flexion were significantly decreased after incision of the A2 pulley during surgery in 16 toes as compared with the WOF of those toes without pulley incision. In the toes with the A2 pulley intact, division of the A2 pulley in the test decreased the total WOF significantly ($p < 0.001$) by an average of 44–51%. The WOF during the 12–18 mm excursions was much more than those during 0–6 mm and 6–12 mm excursions. After the release of the A2 pulley, the WOF of the 6–12 mm and 12–18 mm excursions decreased significantly ($p < 0.05$ or $p < 0.01$), which corresponded to the reduction in the total WOF. The difference in the WOF was not found in the initial part of the toe flexion.

Discussion and conclusions: The presence of the A2 pulley increases the gliding resistance to the surgically repaired tendon significantly in the middle and final one-third of the digital flexion. This study suggests whether the A2 pulley is released during surgery has great influence to the degree of resistance encountered during early active tendon mobilization, and the resistance is the highest at the final part of digital flexion. The findings of this study indicate that surgical repair may be most vulnerable

when the finger actively flexes to approach maximal flexion and in the cases in which the major pulley remains intact during surgery.

A-0056 Trianglar fiblocartilage complex injury associated with radial head fracture: a variation of Essex–Lopresti lesion

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Purpose: Triangular fibrocartilage complex (TFCC) injury with radial head fracture has not previously been reported. We present our results of the surgical treatment in TFCC injury associated with radial head fracture, without dislocation of the distal radio ulnar joint (DRUJ).

Methods: Five patients with unilateral TFCC injury associated fracture of the radial head were treated from 2004 to 2011 in our clinic. There were three men and two women with a mean age of 34.2 years (range 29–37). They were injured in traffic accidents in two patients, fall in two patients, accident in sports activity in one patient. The type of the radial head fractures was Mason type 2 in all cases. We treated radial head fracture conservatively in four patients and surgery was done in one patient. All patients indicated wrist pain and instability at the DRUJ preoperatively. Arthroscopy revealed peripheral tears in three patients, all were treated by arthroscopic repair. Avulsions of the TFCC from fovea were treated with open repair in one patient and reconstruction using a half-slipped extensor carpi ulnaris tendon was needed in another patient. The mean duration between the injury and surgical management was 177.2 (16–561) days. A sugar-tong splint was placed for 2 weeks after the surgery, followed by lower arm casting for 3 weeks, then active range of motion (ROM) exercise began. Mean follow up period was 17 (2–39) months. Pain, ROM, and DRUJ instability at final follow were assessed with DRUJ clinical evaluation system (Nakamura, 2011) and modified Mayo score.

Results: We obtained union in the radial head fracture in all patients. They had no pain, no DRUJ instability, and no limitation of range of motion in their wrist and forearm at final follow up with the exception of short-term follow patient. We obtained five excellent results in the DRUJ evaluation system, and four excellent and one good result in the modified Mayo score.

Conclusion: TFCC injury associated with a radial head fracture can be a new variation of Essex–Lopresti lesion. All five cases showed DRUJ instability without

dislocation of the DRUJ on X-ray findings. Careful examination and diagnosis using MRI, arthrography, and arthroscopy were necessary. Much smaller force may be added on their wrist and elbow in this type of injury than classic Essex-Lopresti fracture dislocation. When the radial head was minimally displaced, detachment of the TFCC peripherally or at the fovea should be treated adequately. The radial head was displaced more than 2 mm, the fracture may be treated surgically to obtain excellent clinical results.

A-0059 An investigation of transduction efficiency and temporal expression of transgene in injured tendons: implications in future gene therapy

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Purpose: There are a number of ways to deliver gene into tissues. Comparison of different vector system for delivery of genes into injured tendon was not reported previously. We investigated efficiency of gene delivery to the injured tendons and tissue reactions caused by different vectors.

Methods: Different vectors, plasmid, adeno-associated viral (AAV), and adenoviral vectors were used to transfect the injured tendon using 72 digital flexor tendons of bilateral toes of 18 white leghorn chickens. After transverse tendon cut, pCMV-EGFP, pCAG-EGFP, rAAV2-EGFP, and Ad5-EGFP were injected to the tendons. At 3, 7, 14, and 21 days, the tendons were subjected to examination for GFP expression to determine the efficiency of transgene delivery by different vectors under a fluorescence microscope. The tendons were also stained with hematoxylin and eosin to examine the inflammation caused by these vectors. Inflammatory cells were counted under microscope and were compared statistically. We also constructed three-dimensional pictures of the tendon and observed distribution of the vectors to different regions of the tendon.

Results: Compared with normal tendons, the GFP expression was observed in tendons at 3, 7, 14, and 21 days post-injection, and was the highest at 7 days for all vectors. At 14 days, we observed a marked decrease in the GFP expression. The GFP expression in the tendons injected with rAAV2-EGFP and Ad5-EGFP were higher than those with pCMV-EGFP and pCAG-EGFP vectors. No remarkable differences in the GFP expression were detected between rAAV2-EGFP and Ad5-EGFP vectors. Tissue reactions of the tendons caused by the liposome-plasmid vector

(including pCMV-EGFP and pCAG-EGFP) were the most prominent. Inflammatory reactions of tendons with the AAV2 vector injected were the least severe. Three-dimensional pictures of the tendon confirmed that the transfected tenocytes distribute to different portions of the tendon with the region with 1 cm from the laceration of the highest density.

Discussion and conclusions: Efficiency of gene delivery by the AAV2 and Ad5 vectors is the highest among four vectors tested. AAV2 vector causes the slightest tissue reactions in the tendons. The study suggests that the AAV2 vector is an appropriate gene delivery vector for tendon gene therapy.

A-0063 Direct and indirect effects of collagenase Clostridium histolyticum (CCH) treatment in patients with Dupuytren's contracture

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Purpose: Collagenase Clostridium histolyticum (CCH; Xiapex) has proven efficacy in correcting Dupuytren's contracture (DC), as demonstrated in double-blind, placebo-controlled trials that assessed changes in range of motion (ROM) and patient satisfaction with treatment. We sought to examine interrelationships among CCH treatment, ROM, and patient satisfaction using a mediation model.

Methods: In the Phase III, double-blind, placebo-controlled Collagenase option for reduction of Dupuytren's (CORD) I study, DC patients with joint contractures $\geq 20^\circ$ received up to 3 CCH or placebo injections at 30-day intervals. The primary endpoint was correction of the affected joint to 0–5° 30 days after the last injection. ROM and patient satisfaction were also assessed. We applied mediation travelling by constructing a set of simultaneous linear regression equations to quantify the effect of treatment on patient satisfaction owing to changes in ROM (indirect effect) and the effect of treatment on patient satisfaction that was not explained, or mediated, by changes in ROM (direct effect).

Results: In CORD I (N = 308), the mean change in ROM after CCH vs placebo was 36.7° vs 4°, respectively. At the end of the study, ROM values were 80.7° for the CCH and 49.5° for placebo groups. In terms of patient satisfaction with treatment, 87% of CCH and 32% of placebo patients reported being "Very satisfied" or "Quite satisfied." Results for the two endpoints were moderately correlated ($r, -0.54$; $p < 0.0001$). The

mediation model demonstrated that 64% ($p < 0.0001$) of the effect of treatment on patient satisfaction is a direct effect and not mediated via ROM. Only 36% ($p < 0.0001$) of the effect of treatment on patient satisfaction can be attributed to mediation via ROM (indirect effect). Further, the mediation travelling by gender showed that the direct (male vs female) and indirect (male vs female) effects were not statistically different, meaning that the mediation model was gender invariant.

Conclusions: Previous studies have shown that CCH treatment improves ROM and, separately, improves patient treatment satisfaction. Although ROM plays an important role in patient satisfaction, additional effects of CCH treatment also affect patient satisfaction. Other plausible contributing effects of treatment could include inherent benefits of the minimally invasiveness nature of CCH treatment, quick recovery time, and improvements in activities of daily living and functioning. Further research is warranted to evaluate these other effects.

A-0065 Therapy of fingertip injuries – the semi-occlusive dressing as an alternative option to local skin flaps

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Purpose: Fingertip injuries are very common in emergency departments and the reconstruction is a central aim of their management. The main purpose of this study was to find out if the semi-occlusive dressing is able to replace local skin flaps on the one hand then again to expand the indications for the treatment of fingertip injuries.

Methods: 114 fingertip injuries from 2009–2011, treated with semi-occlusive dressing, were retrospective analysed. In all of the cases the injured fingers were only cleaned, debrided and covered with an occlusive dressing. The bone was not shorted, even if the bone was up the wound level. The primarily occlusive dressing was left as long as possible and had been, when necessary, obturated. The different types of fingertip injuries were classified according to the levels set by Allen. Furthermore the treatment time with the semi-occlusive dressing and the period of disability was recorded. On every patient a Semmes–Weinsteintest was performed to document the sensitive outcome.

Results: A total of 114 patients were treated with a semi-occlusive dressing. The mean age was 36 SD 14 years, the mean treatment duration 21 SD 10 days.

The mean period of disability was 30 SD 17 days. After taking off the semi-occlusive dressing the main period of disability was 8 SD 13 days. According to Allen, following composition of fingertip injuries accrued: 49% Allen 1, 33% Allen 2, 13% Allen 3 and 5% Allen 4. All patients developed a satisfactory tissue cover and the sensibility was, according to the Semmes–Weinstein test, normal. There were no complications like tissue infections, neuroma or osteitis. Also no secondary flap supply was necessary.

Conclusion: The semi-occlusive dressing is an ideal therapy for all kind of fingertip injuries, regardless of the amputation level. There may be even bone exposed on the wound level. It is an easy, cheap and safe therapy with no complications and leads to an excellent result in function, sensibility and carry capacity. The semi-occlusive dressing is a perfect alternative in treating fingertip injuries, whether will replace local skin flaps.

A-0066 MR microscopy of the human finger – correlation with histology

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Purpose: Magnetic resonance imaging (MRI) at 1.5 and 3 Tesla with small surface coils is a well-established procedure in the diagnosis of space-occupying lesions of the finger. Until now, histological examination has been required to reliably assess tumour extent and possible infiltration of surrounding structures. With ultra-high-field MRI, however, it has become possible to evaluate tumour morphology as well as infiltration into surrounding structures with sub-millimetre resolution. Using the example of different *ex-vivo* fingers, this study describes the diagnostic prospects and potential of ultra-high-field MR microscopy.

Methods: Five human fingers were examined *ex vivo* to compare the standard clinical examination and plain x-ray with ultra-high-field micro-MRI (7.1 Tesla, ClinScan, Bruker BioScan) using a small surface coil and t_2 -weighted 3D images. Imaging parameters were: TE 49 ms; TR 2500 ms; slice thickness 100 μ m; matrix size 512 \times 512 pixels interpolated to 1024 \times 1024 pixels; FOV 39 \times 39 mm; in-plane resolution 36 \times 36 \times 100 μ m/pixel; acquisition time about 24 h. Finally, the specimens were examined histologically, and the histological and MRI results were correlated.

Results: Ultra-high-field MRI at 7.1 Tesla provided images of anatomical structures of the osseous ultrastructure, the distal interphalangeal joint with its cartilage coverage, as well as the tendon inserts, the nail fold and the neurovascular bundle. Subsequent histological examination confirmed MRI findings regarding origin, internal structure and extent of the visualized structure.

Conclusions: This study demonstrates the potential of MR microscopy for imaging small anatomical structures at the human finger. The findings correlate strongly with histology, making MRI of potential central importance in determining tumour morphology, extent and potential infiltration of surrounding structures. This work was performed *ex vivo*, but with wider availability, ultra-high-field MR microscopy is expected to become an essential tool, not only in experimental studies, but also for daily routine.

A-0068 Oblique ulnar styloid osteotomy – a treatment for ulnar styloid impaction syndrome

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This study was performed at Clinique Jouvenet, French Institute of Hand Surgery, Paris, France.

Purpose: We report a series of 5 patients (mean age 41.4 years) presenting with ulnar styloid impingement syndrome (USIS) treated by an oblique ulnar styloid osteotomy. The purpose of the study was to determine whether the osteotomy is an effective method of treating USIS.

Methods: The diagnosis of USIS was made based on a history of ulnar-sided wrist pain supported by clinical and radiological findings. Clinical assessment included provocative tests to differentiate USIS from pain associated with ulnocarpal impaction syndrome. The ulnar styloid length was assessed with a posteroanterior X-ray using the methods of Garcia-Elias and Biyani. The ulnar styloid was deemed excessively long if the ulnar styloid process index was greater than 0.21 or if the overall styloid length was greater than 6 mm. Ulnar variance was recorded. All wrists were assessed by computed tomography arthrography and magnetic resonance imaging studies to rule out any associated soft tissue abnormalities including ligamentous injuries. Pre- and

post-operative pain levels were recorded using a pain scoring system.

Results: Patients were followed up for a mean period of 46 months. Before surgery, the mean styloid length was 10 mm and the ulnar styloid process index 0.32. The reported pain score was significantly reduced following surgery and all patients, except one, returned to pre-morbid levels of activity.

Conclusions: Oblique ulnar styloid osteotomy is an effective means of relieving impaction of the ulnar styloid while preserving the integrity of the intrinsic ulnar styloid ligaments.

Type of study/level of evidence: Therapeutic Level IV.

A-0072 Meta-analysis: sensory recovery outcome after digital nerve repair in relation to different reconstructive techniques

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Good clinical outcome after digital nerve reconstruction is highly relevant for proper hand function and has significant socioeconomic impact. However, the level of evidence for competing surgical techniques is low and fundamental data on surgical outcome can hardly be found. Our aim is to give a comprehensive summary about the current status of digital nerve reconstruction, addressing end-to-end and end-to-side sutures, nerve grafting, conduit-, vein-, muscle-, muscle-in-vein-reconstructions and replantations. 89 publications were expedient for precise evaluation resulting in 3071 nerve repairs, which were obeyed during follow-up. Their sensory recovery outcomes were reviewed, using the Hightet classification. For digital nerve repair there was no certain surgical technique superior over another. Only end-to-side suture seemed to have an inferior two-point discrimination in comparison to end-to-end suture or nerve grafting. Furthermore, this meta-analysis showed, that a younger age seemed to be a crucial factor for an improved sensory recovery outcome in patients, who underwent digital replantation. Also, after performed end-to-end sutures newer publications (1980–today) had statistically significantly better sensory

recovery outcomes than older ones (1965–1979). Given the minor differences in outcome, the main criteria to choose the suitable surgical technique should be the gap length and donor site morbidity caused by nerve harvesting. Data from this meta-analysis was used to provide a decision tree for digital nerve repair. However, further prospective controlled trials are mandatory to elicit additional possible advantages of any type of nerve reconstruction.

A-0076 Clinical-functional and electromyographical evaluation of carpal tunnel release in the postoperative long term

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Introduction: Decompression of the median nerve is considered the most effective therapy for clinical resolution in patients suffering from Carpal Tunnel Syndrome. Due to the difficulty of quantifying subjective symptoms, electrodiagnostic testing may be useful to provide objective parameters for evaluation of the disease.

Purpose: Our main objective is to evaluate if a complete electromyographical recovery may be achieved in the postoperative long term of carpal tunnel release. Also, we present a correlation study of the electromyographic parameters with the clinical and functional data, ten years after surgery.

Methods: This is a historical prospective study of 114 patients that received surgical treatment for Carpal Tunnel Syndrome. Electromyographical evaluation in the postoperative long term has been carried out, as well as a clinical-functional assessment as per Levine's Questionnaire.

Results: A positive electromyographic diagnosis has been found in 67% of the patients, even with a moderate degree of disease, in spite of the good data provided by Levine's Questionnaire. A direct relationship between the motor latency and the clinical scale of the questionnaire, and inverse relation between this score and the sensitive conduction velocity have been found.

Conclusions: It is necessary to consider both clinical-functional data and electromyographic testing, for the postsurgical evaluation in the long term and the revision surgery indication. In doubtful cases or differing outcomes, self-administrated scales, such as the Levine's Questionnaire must prevail over the complementary studies when the specialist makes his decision. A complete electromyographical recovery failed to register in most of the patients.

A-0078 Sonography assisted arthroscopy for wrist ganglia

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Purpose: Satisfactory arthroscopic resection of wrist ganglia has been recently reported. Generally, arthroscopic decompression has the advantage of avoiding extensive soft tissue dissection, reducing postoperative pain, scarring, and allowing early return of function as compared with open resection. However, the surgeon cannot confirm the depth and direction of the arthroscopic instruments, especially when dealing with extra-articular lesions including ganglia. In fact, there is a report of arthroscopic treatment for wrist ganglia resulting in extensor tenosynovitis, injury to branches of the radial artery and the sensory branch of the radial nerve. Furthermore, the ganglia and their stalk cannot be reliably observed in all cases with the arthroscopic technique. Therefore, arthroscopic surgeons need to localize the ganglion using indirect techniques, such as external pressure to the ganglion and dissect the joint capsule until the ganglion cysts or their stalks appear. In addition, there is concern regarding the risk of neuro-vascular or tendon injury. Sonography has limited resolution, but recent improvements in both hardware and software have made it an excellent non-invasive and dynamic imaging technique for assessing the musculoskeletal system. Sonography helps assess the mass size, internal structure, and relationship to adjacent structures, such as nerves, vessels, and tendons. The purpose of this study was to describe how to combine the complementary features of sonography and arthroscopy to make the arthroscopic resection of the wrist ganglia a safer and more reliable surgery.

Methods: A total of 22 patients with wrist ganglia underwent sonography-assisted arthroscopic resection. High-frequency linear-array transducer at frequency 13 MHz was covered by a sterilized drape, and used by assistant the surgeon simultaneously with wrist arthroscopy. Sonographic visualization of ganglia, adjacent structures (i.e. vessels, nerves, and tendons), and the cycling tip of the arthroscopic shaver were assessed. Arthroscopic visualization of ganglia or their stalk was also assessed. Clinical outcome measures included wrist range of motion, grip strength and our original patient-rated questionnaire, Hand 20.

Results: Visualization of the ganglion stalk, adjacent structures, and the cycling tip of the arthroscopic

shaver was possible by sonography in all 22 cases. However, ganglion stalks were visualized by arthroscopy in only 4 cases. The mean range of motion and grip strength was not significantly changed following surgery. However, the mean Hand 20 score was significantly improved from 17.4 to 6.2 at final follow-up. Ganglion recurrence was seen in 2 cases at 6 months and 8 months after surgery.

Conclusion: The expanded use of sonography with wrist arthroscopy provides several advantages for surgeons, including visualization of ganglia and their stalk, arthroscopic shaver and adjacent structures, such as nerves, vessels, and tendons, in order to avoid blind resections.

A-0079 Association of anthropometric factors and predisposition to carpal tunnel syndrome

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Background: An observation of patients suffering from carpal tunnel syndrome shows distinct overweight, short stature and relatively thick hands in a majority of them. The objective of this study was evaluation of the relationship of anthropometric and anatomical factors related to the hand with incidence of the syndrome.

Patients and methods: The anthropometric measurements of body weight and height, as well as anatomical of wrist girth, hand length and volume, were performed in 105 patients, 84 women (80%) and 21 men (20%), aged a mean of 59 years, with idiopathic carpal tunnel syndrome. The same examinations were made in a control group consisting of 105 healthy individuals, age and gender matched.

Results: Statistically significant differences (t-Student or U Mann-Whitney test, $p < 0.05$) were noted in all considered variables: patients with carpal tunnel syndrome were heavier (of a mean of 6%), shorter (of 1.5%) and had of a mean of 9% greater body mass index. They had also statistically significantly greater hand volume (of 13%), hand length (of 2%) and wrist girth (of 5%). Although all variables were statistically significantly greater in a study group, the clinically meaningful were considered only differences of hand volume, wrist girth, body weight and body mass index.

Conclusion: Individuals with overweight and with thicker than average hands and wrists are more predisposed to carpal tunnel syndrome.

A-0087 Our therapeutic strategy for complex regional pain syndrome type 1 and 2 of the hand (CRPS)

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Purpose: The CRPS is a complication of hand pathology that can carry a maximum elongation of the process and an aggravation of the sequelae. Its population incidence is between 5,4 and 26,2 per 100,000 person years. 50.7% of cases occur in the upper extremity. 40% of upper extremity pathology is complicated by CRPS. In 2009, we designed a therapeutic strategy for an early CRPS detection and multi-disciplinary treatment to improve functional outcome.

Material and methods: Since 2009, we have attended 55 hand CRPS patients. We analyse their age, sex, hand dominance, occupation, initial and concomitant pathologies and treatment received before arriving at our centre. The CRPS diagnosis is always based on clinical history and physical examination (IASP criteria). Patients also undergo X-ray and scintigraphy. After diagnosis, outpatient treatment is started by an orthopaedic or a hand surgeon (OS/HS). Pharmacological treatment is focused against nociceptive and neuropathic pain. Rehabilitation (RHB) treatment is always associated focusing specific treatment of CRPS and the initial underlying pathology. When there is no symptomatic improvement after 2 weeks of treatment (35/55patients), we start adjuvant pain clinic (PC). Each case study focuses personalized treatment: (a) when pain is associated to major functional limitation, hospital admission for at least 2 weeks to achieve intensive rehabilitation treatment under continuous axillary or supraclavicular perineural block anesthesia (20/35patients). (b) When there is little pain but important vasomotor or trophic disturbances of all the extremity, weekly local anesthetics infiltration of the stellate ganglion ecographically guided (24/35patients). (c) When there is a restricted pain area with few vasomotor disturbances, pulsed radiofrequency of the peripheral nerve implicated ecographically guided (17/35patients). (d) In all cases, as the evolution of CPRS goes on, we

usually prescribe a combination of the techniques described above. In 5/55 cases an adjuvant psychological (P)treatment has been necessary. We evaluate changes in pain (VAS), objective functional assessment, duration of process and sequelae. (Different cases and treatment video images are presented.)

Discussion: The best CRPS treatment is prevention. Once established, it should be treated at an early stage to prevent its aggravation. Most mild cases resolve within 1 year: in these cases a multidisciplinary treatment (OS/HS, RHB, PC, P) is useful to shorten the process. Severe cases can lead to important functional consequences: in these cases, treatment, even aggressive, should aim to limit stiffness and deformities. The strategy designed clarifies the multidisciplinary therapeutic escalation over time.

Conclusion: Although clinical manifestations of CRPS have personal variability and its etiology and treatment are not well defined, having a protocol that plans the therapeutic strategy of hand and orthopaedic surgeons, rehabilitation, pain clinic doctors, hospital nurses and psychologists has been positive for patient outcomes and the results of our organization.

A-0090 Re-displacement of metaphyseal both-bone fractures of the distal forearm in children: a randomized multicentre study

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Purpose: Displaced metaphyseal both-bone fractures of the distal forearm are very common in childhood and often treated with an above-elbow cast (AEC) after reduction. Re-displacement with secondary reduction of the fracture often occur and may be prevented by fixating the fracture with Kirschner wires (K wires). Therefore, this trial was designed to establish whether additional K wires decreases re-displacement and secondary reduction compared with treatment with an AEC alone.

Methods: In four Dutch hospitals, consecutive children younger than 16 years with a displaced metaphyseal both-bone fracture of the distal forearm were randomized for an AEC with or without percutaneous fixation with K wires. The primary outcomes were re-displacement and secondary reduction of the fracture. Secondary outcomes were limitation of pronation and supination, limitation of flexion and extension of wrist and elbow, complications, cosmetics, complaints and radiological assessment.

Results: Between January 2006 and August 2010 a total of 67 children were allocated to an AEC and 61 to fixation with K wires and an AEC. Mean age was 8.8 SD 3.1 years, 65% was male and 46% fractured their dominant arm. Follow-up rate was 96% with a mean follow-up of 7.1 months. There were significant differences ($p < 0.0001$) in both primary outcome measures. Fractures treated with an additional fixation of K wires showed less re-displacement (8% vs. 45%) and less secondary reduction (2% vs. 25%), as well as significantly less limitation of pronation and supination (mean limitation 6.9 (SD 9.4) vs. 14.3 (SD 13.6) degrees). More complications occurred in the group treated with K wires when re-displacement was left out of consideration.

Conclusions: This is the first randomized multicentre study for exclusively displaced metaphyseal both-bone fractures of the distal forearm in children. Based on the results of this study, we conclude that all displaced fractures should be considered unstable and fixation with K wires reduces the risk of re-displacement.

A-0094 Long-term results of the Ivory arthroplasty for trapeziometacarpal osteoarthritis

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Trapeziometacarpal arthroplasty is a surgical option for end-stage trapeziometacarpal osteoarthritis, when conservative treatment fails. We present the results of a prospectively evaluated consecutive cohort of 24 cases of thumb base total joint (Ivory – Memometal, France) arthroplasty after more than 5 years of follow-up. 22 cases were evaluated. The female/male ratio was 21:1 and the mean age was 65,7 (range 54–78) years. The mean follow-up period was 67 (range 60–77) months, postoperatively. All patients were highly satisfied. Opposition and retro-pulsion improved by 1,6% and 11,8%. Joint mobility of the operated thumb was restored to range of motion comparable with the contralateral thumb. Key-pinch and grip-strength (Jamar) improved by 13,2% and 40%, respectively. The overall function, according to the QuickDASH score, improved by 56,5%. Pain decreased according to the VAS by 85%. The radiological evaluation showed no loosening of the implant after 5 years. These long-term results suggest that Ivory arthroplasty is a valid treatment option for end-stage trapeziometacarpal arthritis

with very good long-term survival and functional outcome as well.

A-0100 The effect of time, after shear injury, on the subsynovial connective tissue and median nerve within the rabbit carpal tunnel

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Purpose: The most prominent non-neurological finding in CTS is fibrosis of the subsynovial connective tissue (SSCT), which consists of multiple layers of fibrous tissue, interconnected by collagenous fibres. Much research on CTS has already been done, but the mechanism that produces the nerve compression is still unknown. Recently, a rabbit model of carpal tunnel syndrome has been developed, based on the hypothesis that SSCT fibrosis causes the nerve compression. In this model, an operative procedure is performed to create an SSCT injury. After 12 weeks of observation there were signs of SSCT fibrosis, similar to CTS in humans, and there was significant decrease in electrophysiologic amplitude. The purpose of this study was to investigate the effects of the shear injury on the SSCT at different time points.

Methods: Seventy two rabbits were used in total. Sixty rabbits were operated to cause the shear injury, and were observed at two different time periods: 6 weeks and 24 weeks. Twelve different rabbits were used as controls. To create a shear injury to the SSCT, the flexor digitalis superficialis (FDS) 3 tendon was exposed proximal and distal to the carpal tunnel. First, the FDS 3 tendon was cut proximal to the carpal tunnel, and the tendon was shifted distally for 5 mm by making a tendon loop distal to the carpal tunnel. Electrophysiological testing of the median nerve was performed just before and immediately after surgery. The operated animals were sacrificed at 6 and 24 weeks after the initial procedure and were evaluated by electrophysiology (EP), mechanical testing, histology, and transmission electron microscopy. For the EP testing, the measurements were performed before and after the surgery.

Results: Electrophysiology: There was no significant difference in amplitude or latency 6 or 24 weeks after surgery, compared with the initial measurements. Histology: Six weeks after shear injury, the total cell density in the SSCT was significantly higher compared with the control population. At 24 weeks, the cell density decreased compared with 6 weeks postoperative, but it was still significantly higher

than the cell density in the controls. Transmission Electron Microscopy (TEM): The mean size of the collagen fibres in the SSCT was higher 6 and 24 weeks after surgery compared with the control population, but it was only significant at 6 weeks. Mechanical Testing: For the mechanical testing, the FDS 3 tendon was pulled out of the CT immediately after sacrifice. Both the ultimate load and the total energy absorption were significantly higher at 6 and 24 weeks compared with the controls.

Conclusions: In this animal model, there are signs of SSCT fibrosis and histology changes that are already present after 6 weeks, and are sustained after 24 weeks. Thus, this model leads to sustained fibrosis, which is one of the characteristics of human CTS. Repeated injuries to the SSCT might create even more fibrosis that can result in electrophysiology changes. This information contributes to the development of a valid animal model for CTS and may have relevance in understanding the pathogenesis of human CTS.

A-0102 Threshold for mechanical damage of the subsynovial connective tissue within the human carpal tunnel

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Purpose: The flexor tendons and the median nerve within the carpal tunnel are surrounded by subsynovial connective tissue (SSCT). One hypothesis is that tendon excursion beyond some threshold causes damage to the SSCT, which could initiate fibrosis and eventually cause CTS. This study tests this hypothesis by comparing mechanical response of human cadaver SSCT strained by different magnitudes of tendon excursion.

Methods: Specimen preparation and setup eight human cadaver wrists were mounted onto a custom test device, with the wrist joint fixed in a neutral position. The flexor digitorum superficialis III (FDS III) tendon was exposed proximal to the carpal tunnel. The physiological excursion of the FDS III was measured during full digit flexion. The proximal end of the FDS III tendon was connected to a 25 N load cell and the distal end of the FDS III, was connected to a 0.5 N weight to maintain tension in the tendon during testing. A displacement sensor was connected to the custom test device to register the exact movement for every cycle. Motion of the actuator with the specimen mounted generated relative motion between the tendon and carpal tunnel. With a repeated ramp stretch

test the specimens were tested in a cycle consisting of ramp stretch and recovery components. During the test, the FDS 3 tendon was displaced in the proximal direction, at a speed of 2 mm/s, until a predetermined excursion was reached, at which point it was released with the same velocity back to the original neutral position. Because changes in the mechanical response can be both temporary (viscoelastic) or permanent (damage), the specimen was held at this position for 15 minutes to allow for viscoelastic recovery. This provided data for 3 cycles at every excursion (60%, 90%, and 120%) level to use in order to distinguish between SSCT damage and viscoelastic stretching. The parameters obtained from the data collected were defined as follows: the excursion energy (E) until maximum displacement; the peak force (F); and the stiffness (S). For each excursion level, ratios between the first and second cycles for each of these parameters were calculated, as were the ratios between the second cycle and the third cycle.

Results: E2/E1 and F2/F1 were significantly different between each level of excursion. E2/E1 and E3/E1 were not significantly different at any level of excursion. F2/F1 and F3/F1 were significantly different only at 120% of the physiological excursion. There is no significant difference between excursion levels for S2/S1.

Discussion: There is a loss of energy after the first cycle that augments as the displacement increases, whereas the energy losses between the second and subsequent cycle are minimal. This suggests that the energy loss after the first cycle can likely be attributed to damage to the SSCT, whereas smaller decreases after the second cycle is probably owing to the viscoelastic properties of the SSCT. There is a stepwise damage that occurs in the SSCT initiating beyond a threshold at which irreversible damage occurs. Damage initiates within the physiological range of the flexor tendons.

A-0103 Results of ulnar shortening osteotomy – second-look arthroscopy and patient-based assessments

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Purpose: Previous studies have investigated the long-term outcomes of ulnar shortening osteotomy (USO) in the treatment of ulnar abutment syndrome (UCA), but none have used patient-based assessments. The purpose of this study was to investigate the long-term

clinical outcomes of USO, including the subjective evaluations of patients using the disabilities of the arm, shoulder and hand (DASH) and Hand20 questionnaires. Our hypothesis was that USO achieves reasonable results.

Methods: We retrospectively reviewed 107 patients with UCA from 1990 to 2005. Diagnosis of UCA was confirmed by radiography and arthroscopy. There were 94 wrists where arthroscopic evaluations at both USO and plate removal were performed. These 94 wrists (48 right, 46 left; 55 men, 39 women) were studied. Average age at the time of surgery was 34 years. Average duration of follow-up was 18.8 months. DASH and Hand20 questionnaires were obtained for 30 patients (minimum follow-up period of 5 years, average 11.4 years). Bony spur formations were evaluated on plain radiographs for a minimum 5-year follow-up period in 19 wrists.

Results: TFCC disc tear was detected in 51 wrists at first-look arthroscopy with USO, with 27 of these 51 wrists revealing a continuous TFCC disc at second-look arthroscopy. The remaining 43 cases showed no TFCC disc tear at either first- or second-look arthroscopy. The range of flexion–extension increased from 116° to 125°, and mean grip strength increased from 72% to 87% at second-look arthroscopy. No significant difference was identified between patients who had DASH/Hand20 and others. Mean DASH score was 9 (range, 0–41), and mean Hand20 score was 9.5 (range, 0–48.5). DASH score was 0 in 10 cases. Follow-up radiography revealed bony spurs at the distal radioulnar joint had progressed in 13 wrists (68%). Patient-based assessments did not significantly correlate with the presence of bony spurs or TFCC disc tears. Complications were rare, with no cases of ulnar non-union.

Conclusions: USO achieved excellent results in most cases. Although about half of the patients developed a bony spur after USO, bony spur formation did not affect clinical outcomes. TFCC disc tear, likewise, did not affect the clinical results.

A-0106 The benefit of wrist arthroscopy for the treatment of distal radius fracture

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Purpose: Arthroscopic reduction for distal radius fracture (DRF) must have gained widespread acceptance as an effective adjunct. However, while volar

locking plate fixation has become popular, the arthroscopic procedure seems to be despised. We developed a plate presetting arthroscopic reduction technique (PART) to simplify the combination of plating and arthroscopy. We tried to clarify the benefit of wrist arthroscopy for the treatment of DRF.

Methods: We performed a PART for 155 wrists in 153 consecutive DRF patients. The patients comprised 30 male and 123 female, age ranged from 18 to 84 years old. The fractures consisted of 37 extra-articular and 118 intra-articular fractures. The fractures were reduced, anatomical alignment was regained fluoroscopically, and then the volar locking plate was preset. Wrist arthroscopy was performed and any residual dislocations of the intra-articular fragments were reduced, soft tissue injuries were treated subsequently. Finally the plate was securely fixed.

Results: 1) Although reduction seems to be achieved fluoroscopically, residual dislocation over 2 mm is still recognized in 35.2%. 2) Intra-articular fragment that could not be recognized with X-ray preoperatively was confirmed with arthroscopy in several cases. 3) SL ligament injury was combined in 28.9%, TFCC injury was combined in 63.2%. One hundred and ten wrists were followed up over 1 year and evaluated by the Mayo modified wrist score. The final results were 84 excellent, 24 good and 2 fair. The mean DASH score at final follow-up was 4.2 points.

Discussion: Dislocation of the intra-articular fragments and soft tissue injuries can not be evaluated if arthroscopic assessment is neglected, and might lead to failure of the final result. Therefore, arthroscopic intervention is necessary for treatment of DRF; a PART can simplify the combination of plating and arthroscopy, and achieves a good final result.

A-0107 Arthroscopic diagnosis of the TFCC tear

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Purpose: Palmer's classification of TFCC injury is widely known and used globally. There is no doubt that this classification has contributed to establishing the concept of TFCC injury and its treatment; however, this classification was proposed over 20 years ago, and we have noticed that some atypical TFCC tears cannot be classified with Palmer's classification. We tried to clarify various patterns of traumatic

TFCC tears including some atypical tears that cannot be classified with Palmer's classification.

Methods: The TFCC traumatic tears in 208 wrists of 207 cases were examined with arthroscopy or direct vision. Seventy-three male and 134 female patients, ranging in age from 14 to 87, average was 51 years old were examined. The preoperative main diagnoses included 97 cases of distal radius fracture, 89 TFCC injuries, 5 DRUJ instability, 5 scapholunate interosseous ligament injuries and 12 miscellaneous conditions (ganglion, Kienböck's disease, rheumatoid arthritis, ulnar styloid nonunion and scaphoid nonunion).

Results: Traumatic tears could be divided into two types: disk tear and peripheral tear. Disk tear was subdivided into 4 types: 106 cases of slit tear, 41 flap tears, 6 horizontal tears and 6 tears within the distal radioulnar joint. Peripheral tear was subdivided into 6 types: 6 cases of ulnocarpal ligament tear, 8 dorsal tears, 6 radial tears, 42 ulnar styloid tears, 18 foveal tears and 1 distal radioulnar ligament tear. Combinations of these types of tears were found in 32 cases.

Conclusions: Wrist arthroscopy revealed various kinds of traumatic TFCC tears that cannot be classified according to Palmer's classification. It seemed to be necessary to establish a new classification of traumatic TFCC tear.

A-0108 Sauv -Kapandji and Darrach procedures: comparison of long-term subjective results

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This retrospective study estimates the long-term subjective results of the Sauv -Kapandji (SK) and the Darrach procedures for the treatment of chronic disorders and traumatic complications of the distal radio-ulnar joint (DRUJ). 44 of the 62 Darrach procedures and 26 of the 39 SK procedures answered to the subjective evaluation (about wrist pain, range of motion, grip strength, stability of the ulnar stump, and patient's satisfaction), with an average follow-up of 7.8 years (range: 0.5–16.9 years). No statistical difference between the Darrach procedure and the SK procedure was found on these items. At the last follow-up: twice more patients of the Darrach group compared with the SK group had heavy physical activity (for work and/or sport). There was 18% of complications for the SK procedure vs 1.6% for the Darrach procedure. So why chose the SK procedure for young patients and heavy workers and the Darrach procedure for old patients?

A-0111 The importance of central screw placement in simulated scaphoid waist fractures: a biomechanical study

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Purpose: To determine whether, in simulated fractures of the scaphoid waist, exact central placement of a screw in both the proximal and distal pole of the scaphoid (central position) offers a biomechanical advantage over central placement in the proximal pole only (eccentric position).

Methods: Sixteen matched pairs of cadaveric wrists from fresh cadavers were randomly assigned to a treatment group. A guidewire was drilled into the scaphoid under fluoroscopic control, using either a transtrapezial approach (central position) or a standard volar approach (eccentric position). Radiographic images were taken in the lateral, oblique and anteroposterior plane. The scaphoid was then dissected from the carpus and a transverse osteotomy was made along the scaphoid waist. The osteotomy was then fixed by a cannulated headless bone screw. For biomechanical testing, the specimen was then potted in a metal holder with use of polymethylacrylate and a Kirschner wire passed through the proximal end of the scaphoid. Each specimen was then placed into a fixture with a pneumatically driven plunger, resting on the surface of the distal pole. A load-controlled test protocol in a hydraulic testing machine (Dartec 9600) at a rate equivalent to 10 N per second was used to apply load to the scaphoid bone. Load was increased until the fixation failed by bone fracture and/or loss of reduction. Data acquisition was done with specialized software at 25 points per second. Load at 2 mm of displacement, load at failure and mechanism of failure were recorded.

Results: When compared with the eccentric screw position, the central position demonstrated 163% increased load at 2 mm of displacement (356.9 N compared with 135.4 N; $p < 0.01$) and 92% increased load to failure (415.8 N compared with 215.8 N; $p < 0.01$).

Conclusion: Exact central positioning of a screw in the proximal and distal fragment of the scaphoid offers a biomechanical advantage in the internal fixation of an osteotomy of the scaphoid waist, compared with central placement in the proximal fragment only. Surgical techniques that allow exact central positioning of the screw in the treatment of scaphoid waist fractures, can be expected to provide more rigid fixation, with less risk of loosening of the screw and non-union of the fracture.

A-0112 Surgical treatment of ulnar deficiencies in children: what is the main definition of the operation method?

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Purpose: The purpose of this investigation is a definition of optimum methods of surgical treatment of ulnar deficiency.

Material and methods: Four variants of surgical procedures were performed on the forearm level for 54 patients during the last 20 years. The patient's age ranged from 2 months to 18 years.

Results: The tactics of treatment of ulnar deficiency depended on two clinical signs: the degree of shortening of ulna and the humeroradial joint state. In the case of 2/3 part of ulna preservation, stability of the humeroradial joint and bow-shaped deformity of the radius, we performed the fibrous rod excising and corrective osteotomy of the radius. In case of existence of a half part of ulna, dislocation in the humeroradial joint and bow-shaped deformity of the radius, we restored the ulna using a Ilizarov Frame or microsurgical transposition of the transplant with growth zone. In the case of existence of 1/3 part of ulna, dislocation in the humeroradial joint and bow-shaped deformity of the radius, we divide the surgical treatment into two stages. First, we performed the fibrous rod excising and corrective osteotomy of the radius. Second, we performed the bringing down of the radius using a Ilizarov Frame and carried out the superposition operation.

Conclusions: The variant of reconstruction in patients with ulnar deficiency depends on the degree of shortening of the ulna and from the humeroradial joint state.

A-0116 Corrective osteotomy for complex distal radius malunions using preoperative three-dimensional computer planning and patient-specific surgical guides

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Purpose: Malunion is the most common complication of distal radius fractures, and can lead to significant pain, functional impairment and long-term degenerative changes. As it is mainly an anatomical problem, precise reconstruction of the anatomy is an important factor in the treatment of this disorder. The goal of this prospective study was to compare the clinical

and radiological outcome following reconstruction of a complex distal radius malunion, using preoperative three-dimensional (3D) computer planning and patient-specific surgical guides.

Methods: Eighteen patients with a complex malunion of the distal radius were included in the study. All had a corrective osteotomy using a volar approach and locking plate fixation. 14 patients had an extra-articular malunion with at least 30° of total displacement, compared with the non-affected site. 3 patients had a combined extra- and intra-articular malunion, with more than 2 mm step off of the joint surface, whereas one patient had an isolated intra-articular deformity of more than 2 mm. Surgicase software (Materialise, Belgium) was used for 3D planning of the corrective osteotomy, using the mirror image of the non-affected site as a template. Based on this planning, patient-specific guides are manufactured, sterilized and used during surgery as drill and saw guides. Both preoperatively and at follow-up, patients were evaluated clinically by a trained physiotherapist. Three observers independently measured dorsal–volar angulation, radial inclination, ulnar variance and articular congruency on both the preoperative radiographs and computer planning and on the postoperative radiographs.

Results: At an average follow up of 10 months, VAS score for pain improved from 4.2 to 2.4, DASH score from 45 to 13 and grip strength from 14 to 20.5 kg. An excellent correlation between the computer planning and the postoperative radiographs was obtained in 16 patients. No residual articular incongruency was noticed in patients where a correction of an intra-articular component had been performed. In one patient, a residual positive ulnar variance of 2 mm was observed, and in one patient, an incomplete correction of dorsal angulation was seen.

Conclusion: 3D computer planning and the production of patient-specific surgical guides facilitates the surgical correction of intra- and extra-articular malunions of the distal radius, with good clinical results and precise reconstruction of anatomy.

A-0117 Remote postconditioning attenuate ischemic–reperfusion injury in rat skeletal muscle and remote postconditioning by ATP sensitive K-channel dependent mechanism

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Purpose: Ischemia–reperfusion (I/R) injury caused by abrupt restoration of the circulation after prolonged

ischemic insult induces significant morbidity after reconstructive microsurgery. The authors investigated whether a remote post-conditioning (remote post-con) procedure attenuated skeletal muscle I/R injury and protected muscular function. In addition, the authors determined the optimal protocol of remote post-con and investigated the mechanism related mitochondrial ATP-sensitive K⁺ channels.

Materials and methods: Rat left hind limb ischemia was induced for 3 h using a tourniquet, applied around the proximal thigh. Three protocols of remote post-con procedures were applied in rat right hind limb at the end of the ischemia: 1) 10 s group: two cycles of 10 s of re-occlusion, followed by 10 s of reperfusion (40 s of total intervention); 2) 5 min group: two cycles of 5 min of re-occlusion, followed by 5 min of reperfusion (20 min of total intervention); 3) 10 min group: two cycles of 10 min of re-occlusion, followed by 10 min of reperfusion (40 min of total intervention). The wet/dry ratio of posterior calf muscle, contractility of Tibialis anterior muscle, histology was evaluated. We also intra-peritoneal injected Sodium 5-hydroxydecanoate (5-HD), specific blocker of mitochondrial ATP sensitive K channels.

Results: The 10 s group did not have a protective effect. No intergroup difference between 5 min and 10 min group was observed. Wet/dry ratio, muscle contractility, and inflammatory cell infiltration were significantly lower in the 5 min and 10 min group, and injection of 5-HD impaired the protective effect of the remote post-con.

Conclusions: This study demonstrates that remote post-con provides effective functional protection to skeletal muscles from I/R injury, possibly through mitochondrial ATP sensitive K channel activation. We suggest that two cycles of 5 min of re-occlusion followed by 5 min of reperfusion are optimal protocol of remote post-con in skeletal muscle.

A-0118 Feasibility study of matrix-assisted autologous chondrocyte transplantation in the distal radioulnar joint

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Purpose: The distal radioulnar joint (DRUJ) plays an important role in the integrated forearm–wrist–hand function through its rotational and translational motion. Treating injured cartilage of this joint by regenerative medicine techniques would be preferable since surgical options are limited to salvage procedures only, such as arthroplasty or eventually

arthrodesis. Matrix-assisted autologous chondrocyte implantation (MACI) of the DRUJ could be an interesting alternative for such procedures. This chondrocyte transplantation technique is increasingly used for the treatment of cartilage defects of the knee joint and sometimes the ankle joint. MACI includes harvesting and digesting full-thickness cartilage, to obtain primary chondrocytes. These are expanded and seeded onto a three-dimensional (3D) biodegradable scaffold, which is then implanted into a defect. Firm fixation of a 3D matrix into the DRUJ is a first requirement towards realization of MACI for this specific joint. The purpose of this study was to test the feasibility of fixation of a scaffold into a DRUJ cartilage defect. Two fixation techniques that are commonly used for MACI were therefore compared in human cadaver upper extremity models.

Methods: Collagen type I/III ACI-Maix scaffolds, without seeded chondrocytes, were implanted into standardized circumferentially created ulnar head defects in 20 cadaverous DRU joints. In 10 wrists, only fibrin glue was applied for scaffold fixation. For another 10 wrists a combination of fibrin glue and chondral sutures was used. All wrists were subjected to a rotational continuous passive motion protocol (CPM). Evaluation of both techniques was done by determining defect coverage after 10 and 110 cycles. The strength of scaffold fixation was measured after completion of CPM protocol by gradually pulling the scaffolds out of the defect. Independent T-test was used.

Results: Defect coverage after 10 rotation cycles was 93% when using glue fixation and 95% when using glue and sutures. After 110 rotation cycles, defect coverage was 88% and 95%, respectively. The strength needed to pull out the scaffold was 0.24 SD 0.19 N (mean SD) for fixation using glue and 0.67 SD 0.28 N (mean SD) for combined fixation ($p < 0.01$). None of the scaffolds were fully detached and none were damaged after the CPM protocol was completed. One case of glue fixation was considered a failure as defect coverage was diminished to 25% after 110 rotations.

Conclusion: This study shows that fixation of a collagen type I/III scaffold into a DRUJ cartilage defect is feasible for both techniques. Since fixation with the combination of glue and sutures is slightly superior, we prefer this technique, even though additional suturing is technically more demanding to perform than applying glue alone. This study is the first step towards the repair of cartilage defects of the DRU joint.

A-0120 Overall outcome in Apert's disease

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Introduction: Patients with Apert's disease are mainly known because of their craniofacial and hand problems. However, shoulders, elbows, hips, knees and feet, are involved too. This, in conjunction with a lower than normal intelligence, will have influence on the hand function, the ability to perform in daily life, and their perception of quality of life. In this study we evaluated the long-term outcome regarding hand function and general (psychological) function in patients with Apert's disease.

Patients and methods: Patients, older than 6 years, with Apert's disease are evaluated according hand function, comprising testing of intrinsic function of the thumb, index and little finger, as well as deviation in degrees; grip-strength and range of motion. Participation and quality of life is derived from questionnaires and the movement assessment battery for children 2 (MABC-2). The Oxford foot and ankle questionnaire, and the lower extremity functional scale were taken into account to evaluate the lower limb.

Results: Of the 60 patients known with Apert's disease at the Erasmus MC, 49 patients are suitable for analysis; two patients died, and nine patients are younger than 6 years of age. Mean age at evaluation, excluding patients younger than 6 years, was 22 year (range 6–66). Preliminary data in 12 adult patients (mean age 28.5 y): The mean DASH and Abilhand were 27 and 29, respectively. Scores (0–100; a high score means a good score) on hand related function, aesthetics and pain were 65, 59 and 91, respectively. Health was scored with a mean of 82. The mean LEFS was 73%. Preliminary data in 6 children (mean age 12.5 y): The mean Abilhand-kids was 28. The VAS for function, aesthetics and pain were 67, 70 and 65, respectively. The mean score on health was 77. The mean LEFS was 77%. Since it is a random evaluation of 36% of patients, we believe that the results can be extrapolated to the 49 patients that are currently examined with the aforementioned test.

Conclusion: To our knowledge, this is the first study, including long-term functional outcome of the upper and lower extremity, as well as general (psychological) functioning. Preliminary data show a good DASH and Abilhand, however, with discrepancy in the VAS given for function. Despite severe lower extremity pathology, the LEFS is good, and will be further explored with the Oxford foot and ankle questionnaire.

Results on fine motor ability and equilibrium (MABC-2) will follow, as will the plain hand function.

A-0121 Reconstruction of TFCC: our experience with open procedure

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Introduction: Restoring anatomical integrity of the triangular fibrocartilage complex allows a resolution of pain in the ulnar compartment of the wrist and restores motion of pronation and supination of the RUD, making the joint stable. The repair of the TFCC with the use of an 'open' surgery according to the surgical approach described by Garcia-Elias, has allowed us to treat these injuries and any associated pathological conditions (LT rupture, ulno carpal impingement).

Materials and methods: The authors present a retrospective study of 32 patients treated with an open technique according to Garcia-Elias approach at the University Hospital of Careggi – CTO between January 2001 and March 2010. It was in 17 cases of men and 15 women aged between 17 and 60 years. We reviewed 20 patients who were evaluated postoperatively with DASH evaluation boards, MMWS (modified Mayo wrist score), MWS (Minami wrist score) and POSAS for evaluating the final aesthetic result. The mean follow-up was 36 months.

Results: Patients treated according to the open approach have all shown results with a significant reduction of preop values. In accordance with protocols expressed by the various evaluation scores, were satisfied with the intervention in 96.8% of cases. They declared a complete resolution of pain over 2 to 3 months; like the recovery of joint range and strength occurred at a similar time. All draw on the operation.

Conclusions: The open access described by Garcia-Elias, designed taking into account the anatomy and functional characteristics of the TFC complex, has allowed us to perform, in all cases, the repair of the lesions treated, with a favourable outcome with respect to the joint range, grip strength, resolution of pain and patient satisfaction.

A-0122 Infraclavicular brachial plexus injuries: patterns of injury and implications for management

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Purpose: A study was undertaken to review the patterns of nerve and associated skeletal injury in

patients with damage to the infraclavicular brachial plexus and its branches.

Methods: Details of 95 patients referred to our service between 1997 and 2009 with brachial plexus injury predominantly affecting the infraclavicular brachial plexus and its branches were reviewed. There were 59 men and 36 women with a mean age of 45 years (range, 14–89).

Results: Observation indicated that patients fell into four categories. (a) Anterior glenohumeral dislocation (49 cases, mean age 51); (b) 'occult' shoulder dislocation or scapular fracture (20 cases, mean age 31); (c) humeral neck fracture (15 cases, mean age 56); (d) arm hyperextension (11 cases, mean age 29), the axillary (37/49), and ulnar (39/49) nerves were most commonly injured as a result of glenohumeral dislocation. 14 patients had a complete infraclavicular injury with all nerves affected. The axillary nerve was ruptured in only 2 patients who had suffered high energy trauma. Ulnar nerve recovery was often incomplete with poor intrinsic function. 17 patients had rotator cuff tears or displaced fractures of the greater tuberosity. 'Occult' dislocation refers to patients who had no recorded shoulder dislocation, but the history was suggestive that dislocation had occurred with spontaneous reduction. All had suffered high energy trauma. These patients and those with fracture of the scapula had a similar pattern of nerve involvement to those with known dislocation, but the axillary nerve was ruptured in 14 of 20 cases. Unfortunately there was significant delay in referral to the service of many patients in this group (mean delay between injury and referral = 19 weeks (range, 1–64). In cases of humeral neck fracture, nerve injury resulted from medial displacement of the humeral shaft. Arterial injury occurred in 6 cases. Surgery was performed in 13 cases to relieve pressure on the nerves, reduce and fix the fracture or insert a shoulder hemiarthroplasty. Arm hyperextension cases were characterized by injury to the musculo-cutaneous nerve, with the nerve being ruptured in 10 of 11. There was arterial injury requiring repair in 6. Seven had humeral shaft fracture or elbow dislocation. There was variable involvement of the median and radial nerves with the ulnar nerve being least affected.

Conclusions: Early nerve exploration and repair should be considered for: (a) axillary nerve palsy without recorded shoulder dislocation or in association with fracture of the scapula, as there is a high risk of rupture of the nerve in this group. (b) Musculocutaneous nerve palsy with median and/or radial nerve palsy. Most cases of infraclavicular brachial plexus injury associated with shoulder dislocation can be managed without operation. Early

diagnosis and repair of rotator cuff tears or displaced fractures of the greater tuberosity is important. Urgent operation is necessary for nerve injury resulting from displaced fracture of the humeral neck to relieve ongoing pressure on the nerves and vessels.

A-0123 Partial arthroscopic trapeziectomy with or without ligament reconstruction to treat primary thumb carpometacarpal osteoarthritis

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Partial trapezoidal excision with ligament reconstruction has proven to be an effective technique for treating primary osteoarthritis of the thumb. To determine whether ligament reconstruction affects the objective and subjective outcome, we compared the mid-term outcomes of two procedures performed under arthroscopy in similar patient groups.

Methods: Eighty three patients, divided into two consecutive groups, were included to undergo partial arthroscopic trapeziectomy, the former without ligament reconstruction and the latter with ligament reconstruction using the abductor pollicis longus. Thirty four patients were treated without ligament reconstruction (group 1) and forty nine patients with concomitant ligament reconstruction (group 2) were evaluated after a mean follow up of 44.4 months. The outcomes were assessed with the quick DASH and the Nelson hospital score. The objective results were analysed according to mobility and strength. Radiographs were evaluated to determine the recentring of the metacarpal at rest and under stress.

Results: Postoperatively, the quick DASH was 20.28 in group 1 and 15.86 in group 2. The Nelson hospital score was 12.95 in group 1 and 11.04 in group 2. Group 2 had significantly better mean score for stability and willingness to undergo the surgery again under similar circumstances. The mean score for pain, strength, mobility, and delay of recovery did not differ significantly between the groups. Both groups had satisfactory results with regard to cosmetic appearance and overall satisfaction. With the number available the amount of medial metacarpal recentring at rest and under stress did not differ significantly between the groups.

Conclusion: Ligament reconstruction affects the outcome after partial arthroscopic trapeziectomy.

A-0124 The incidence of acute traumatic tendon injuries in the hand and wrist: a 10-year rural population-based study

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Purpose: The purpose of this study is to determine the incidence and associated injury patterns of both flexor and extensor tendon injuries that may result from acute trauma to the hand and wrist.

Methods: A retrospective population-based cohort study was performed examining all acute traumatic tendon injuries diagnosed within a rural Midwest county in the USA between the years of 2001 through 2010. Cases were identified using a regional epidemiologic database and ICD-9 codes. Age, gender, year of injury, mechanism of injury and the injured tendon and zone were recorded. A Poisson regression analysis was used to determine incidence.

Results: During the 10-year study period, 458 patients were diagnosed with acute traumatic tendon injury of the hand and wrist, of which 3 patients had a bilateral injury and none of the patients had more than one occurrence of tendon injury within the studied period. The majority of cases involved a single tendon (72%). The overall age- and sex-adjusted incidence rate was 33.2 per 100,000 person-years (CI 30.1–36.2). The mean age of the patients was 35.9 years (range 1–91 years) and the rate of injuries was significantly associated with age ($p < 0.001$), with the highest crude incidence in patients aged 20–29 years. The rate of injuries was also significantly associated with gender ($p < 0.001$), with an age-adjusted incidence rate of 56.3 per 100,000 person-years for males (CI 50.6–62.0) and 10.7 for females (CI 8.3–13.2). Most tendon injuries happened in 2002, with an incidence rate of 42.9 per 100,000 persons in that year. The year 2010 had the lowest incidence rate with 24.1 per 100,000 persons and overall the rate of injuries was significantly associated with year ($p = 0.040$) with a decreasing trend over the 10-year period. Extensor tendon injuries accounted for more injuries than flexor tendon injuries ($p < 0.001$). In total, 297 flexor tendons were injured and 395 extensor tendons. Of all extensor tendon injuries, the extensor mechanism of the index finger was injured significantly more often than other tendons, namely in 15.6%, which remained significant after a Bonferroni correction ($p < 0.003$). The most commonly injured zone in all extensor tendons was zone 3 (12.6%), which was significantly more often than all other extensor zones (Bonferroni $p < 0.006$). The flexor digitorum profundus to the index

finger was the most injured flexor tendon. It was injured in 9.1%, significantly more often than other flexor tendons ($p < 0.050$) except for the flexor digitorum profundus tendons to the long, ring and little finger, which were not injured significantly less frequently. With the use of a Bonferroni adjustment, the flexor digitorum superficialis to the little finger and the flexor pollicis longus were not injured significantly less often either. Of all flexor tendon zones, zone 2 was injured in 19.1%, which was significantly more often than every other flexor zone (Bonferroni $p < 0.006$).

Conclusions: Improved and updated understanding of the epidemiology of acute traumatic tendon injuries will hopefully stimulate additional investigation into the prevention and treatment of these injuries. These data will provide a focus for future studies.

A-0125 The relation of bowstring effect to trigger finger occurrence after carpal tunnel release

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Background: Trigger finger (TF) is an entity seen commonly by hand surgeons and sometimes occurs after carpal tunnel release (CTR). Few reports have discussed this phenomenon and it has been suggested that TF that has occurred after CTR may be caused by the effects of bowstringing of the flexor tendons by the A1 pulley. However, these suggestions have been only hypothesized and have not been demonstrated in a previous study. The purpose of the present study was to demonstrate a hypothesis about the suggestions that can be made through imaging studies and to identify several risk factors of TF occurrence after CTR.

Methods: Between September 2007 and January 2011, 244 patients underwent open CTR for idiopathic carpal tunnel syndrome. The mean follow-up period was 6 months. Postoperative CT scanning was performed on both affected and unaffected wrists in 57 of the 244 patients, including 27 patients with TF occurred after CTR and 30 patients randomized without TF. We measured the volar migration of flexor tendons by comparing the distance from the most prominent dorsal cortex of capitate to the most volar surface of flexor tendons in axial plane image of CT scan between both wrists. We investigated several patient characteristics to identify those risk factors that predisposed CTR patients to TF occurrence after surgical treatment, including the cross sectional area of carpal tunnel measured by preoperative ultrasonography among other factors.

Results: In comparing the 2 groups that were divided according to the average distance of flexor tendons volar migration, TF after CTR occurred in 5 of 24 patients in group A (< 2 mm), 22 of 33 patients in group B (≥ 2 mm) ($p = 0.0013$). The average flexor tendon volar migration was 1.8 SD 0.4 mm in the non-TF occurrence group and 2.4 SD 0.6 mm in the TF occurrence group ($p = 0.0072$). The only statistically significant risk factor that we determined was predisposing to TF occurrence after CTR was osteoarthritis ($p = 0.018$).

Conclusions: Patients with more volar migration of flexor tendons after CTR are more liable to TF occurrence, and it was significant to support the suggestion reported in previous studies the bowstringing affects in TF occurrence after CTR. Osteoarthritis may be a risk factor contributing to TF occurrence after CTR.

A-0127 The effect of platelet-rich plasma on peripheral nerve regeneration in a rat model

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Purpose: Platelet-rich plasma (PRP) has been recently popular as a treatment option in many clinical areas. PRP is used to accelerate healing by acting on the target tissues. Recently, the effects of PRP on nerve regeneration have attracted interest, although PRP is not a neurotrophic factor. How does PRP affect nerve regeneration? This study evaluated the effects of PRP on nerve regeneration in a rat model with a sciatic nerve defect.

Methods: A total of 33 Sprague-Dawley rats were divided into (A) autogenous nerve graft, (B) autogenous inside-out vein graft, and (C) platelet-rich plasma (PRP) injection after inside-out vein graft. In group A, a cropped nerve was grafted into a 10-mm gap created in the sciatic nerve. A 15-mm section of jugular vein was grafted similarly in group B, and prepared PRP was injected into a grafted vein tube in group C. The sciatic functional index (SFI) was evaluated every 2 weeks during 6 months. A histological analysis, the myelinated and unmyelinated axon count, myelin thickness, axon diameter, and vessel count were evaluated every 2 months. Six months after surgery, electromyographic studies were performed and the latency and amplitude were measured

for both limbs; additionally, the wet muscle weight of gastrocnemius was determined for both limbs prior to tissue harvesting. The statistical analysis was performed using the SPSS (version 18.0). The results for the three groups were compared using a repeated-measures analysis of variance (rm-ANOVA), one-way ANOVA, and Kruskal Wallis test to determine the temporal differences. The correlations between groups were interpreted using the Bonferroni adjustment.

Results: Statistically, the SFI did not differ significantly among the groups at 6 months. However, the SFI of group C differed significantly from groups A and B between 4 and 14 weeks (both $p < 0.05$). Of the electromyographic parameters, the latency and amplitude of the experimental limb of group C showed superior results than the other two groups, but there was no significant difference. No statistically significant difference was determined at wet muscle weight of gastrocnemius. Numbers of myelinated and unmyelinated axons were not statistically different ($p < 0.05$). Myelin thickness of group C at 2 months was thicker than that of group B ($p < 0.05$) and at 6 months group C was thicker than groups A and B ($p < 0.05$). A distal axon diameter of group C showed a statistical significance from group A at 2 months and from groups A and B at 6 months ($p < 0.05$). Numbers of vessels of group C were more than groups A and B at 2 months ($p < 0.05$), however at 4 and 6 months there were no significant differences.

Conclusions: PRP may affect a grafted vessel wall to promote neovascularization, work on early nerve regeneration and accelerate remyelination of the regenerated axons. PRP injection into a grafted vein with a short nerve defect is a treatment option to promote nerve regeneration.

A-0130 Anatomic study of the volar aspect of the distal end radius: in order to avoid flexor tendon injury following volar locking plate fixation

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Introduction: Recently, osteosynthesis with a volar locking plate system has become increasingly popular among surgeons for treatment of unstable distal radius fractures. However, some authors have reported cases of flexor tendon injury after volar locking plate fixation of distal radius fractures. Orbay and Touhami reported that the 'watershed line' was defined as a useful surgical landmark for positioning a volar locking plate; implants placed over this line or extending above it could impinge on flexor tendons

and could cause injury. But the details and the definition of the 'watershed line' remain unclarified. The aim of this work was to study the anatomy and histology of the structures around the volar aspect of the distal end of the radius in order to avoid flexor tendon rupture following the volar locking plate fixation.

Methods: Twenty distal forearm regions of ten cadavers [five males and five females: mean 78.5 y/o (56–88 y/o)]. During the dissection, we recorded the macroscopic appearance of the volar aspect of the distal end of the radius, and the relationship between the bone, ligaments and flexor tendons. Observations were made by ordinary light microscopy to identify the relationship of the muscles, ligaments and bones.

Results: In the medial half of the distal volar radius two lines were identified by direct macroscopic visualization; one was the proximal line that corresponded to the distal ridge of the pronator fossa, and the other one was the distal line. The distal line was more prominent on the volar radius. An ulnar bony prominence, which was most recognizable on the volar radius, was situated on the distal line. In the lateral half, the distal and proximal lines of the medial half merged to form a single line. A radial prominence was situated on this line. The distance between the ulnar bony prominence and FPL tendon was from 7 to 10 mm (average 8.2 mm, SD 1.1). In addition, we found the peak of this ulnar bony prominence was between the FDP-index tendon and FDP-middle tendon.

Conclusion: The 'watershed line' might not be a clear line, and is corresponded to the distal margin of the pronator fossa in the lateral half of the volar radius and to the hypothetical line between the distal and proximal lines in the medial half. The ulnar bony prominence is the key structure in understanding the anatomy of the volar aspect of the radius. This data is very important to perform safe volar locking plate fixation and to design a new volar locking plate.

A-0132 Grounds for patient preference of carpal tunnel release technique in bilateral idiopathic carpal tunnel syndrome

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We hypothesized that (1) subjective outcomes would not differ 6 months after carpal tunnel release is

performed endoscopically on one hand and via mini-incision on the other, in patients with bilateral carpal tunnel syndrome; however, (2) patients would subjectively prefer one technique and (3) have specific reasons for their preference. Fifty-two patients with confirmed bilateral idiopathic carpal tunnel syndrome had one hand randomized to undergo endoscopic carpal tunnel release by the Agee technique and the other to undergo mini-incision open carpal tunnel release. Each patient was assessed using the Boston carpal tunnel questionnaire (BCTQ) and the disabilities of arm, shoulder and hand (DASH) scores pre- and post-operatively. Six months after surgery, each patient identified their preferred technique and completed a questionnaire on their reasons for not choosing the other technique. No significant differences were observed between the endoscopic release (N = 52) and mini-incision release (N = 52) groups in preoperative BCTQ or DASH scores. The mean tourniquet times were 7.5 SD 3.6 min and 6.8 SD 2.4 min for endoscopic and mini-incision release, respectively ($p = 0.552$). Six months after surgery, the groups had similar improvement in BCTQ or DASH scores, but 34 patients preferred endoscopic release, 13 preferred the mini-incision technique, and 5 had no preference. The most common reasons for not preferring the mini-incision technique were scar or pillar pain, followed by pain after hospital discharge and pain immediately after surgery. The highest ranked reasons for not choosing endoscopic release were scar or pillar pain, followed by transient worsening of symptoms after surgery and an unsightly scar. In conclusion, endoscopic and mini-incision open carpal tunnel release result in comparable improvement of function and symptoms in patients with idiopathic carpal tunnel syndrome. However, patient satisfaction may be higher after endoscopic carpal tunnel release based on our study, especially if patients are most concerned about scar and operation-related pain. Mini-incision carpal tunnel release would be better for patients concerned about transient median nerve damage or unsightly scarring.

A-0133 Total joint arthroplasty using a costal osteochondral graft for finger joint ankylosis

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Purpose: The purpose of this study is to introduce total joint arthroplasty using a costal osteochondral graft as a new treatment modality for finger joint ankylosis. This procedure can give successful and

satisfactory results in the treatment of finger joint ankylosis.

Technique and methods: Fourteen finger joints (2 MCP joints and 12 PIP joints) in 14 patients with complete bony ankylosis after trauma or infection were treated with total joint arthroplasty using a osteochondral graft harvested from a costal osteochondral junction. There were 12 males and 2 females, ranging in age from 19 to 53 (mean, 30). Ample exposure of the joint was obtained through a dorsal approach. The periosteum was elevated in concurrent with the bilateral collateral ligaments with a volar plate. The fused joint was cut closely with a chisel at the original level of the joint. Two pieces of the osteochondral graft were harvested from the 5th and 6th ribs through an ipsilateral transverse sub-mammary incision. The harvested grafts were then shaped to form a matching pair of articular surfaces of the MCP or PIP joint with adequate contour. The grafts were step-cut and stabilized using mini screws. The finger was immobilized with a splint for a week, followed by a range of motion exercises. Two cases needed an additional collateral ligament reconstruction and another case needed tenolysis. Clinical assessment was based on the range of motion and the Japanese Society for Surgery of the Hand version of the disability of the arm, shoulder and hand questionnaire (DASH-JSSH). Two-sided paired t-test was utilized to compare pre- and postoperative range of motion and DASH-JSSH score.

Results: The average clinical follow-up was 27.5 months (range, 6–69 months). Average arc of motion was 0° before surgery versus 74.2° after surgery, with a mean increase of 74.2°. Postoperative increase in each joint was 72.5° (range, 70–75°) in the MCP joint and 74.5° (range, 60–95°) in the PIP joint ($p < 0.001$). Average active extension/flexion of the reconstructed joints indicated 0°/72.5° (MCP joints) and -1.5°/76.0° (PIP joints). Radiographs demonstrated complete union of the bony part of the grafts to the base and there was no evidence of bony bridging nor narrowing of the joint space. All patients had no pain or instability at the joint and were satisfied with the treatment. The donor site in the rib did not cause any pain or any other problems except for a postoperative scar. Mean preoperative DASH-JSSH score was 37 (range, 24–49), improving significantly to 11 (range, 4–19) postoperatively ($p < 0.001$).

Conclusions: (1) Total joint arthroplasty using costal osteochondral graft demonstrated anatomical and biological reconstruction with successful and satisfactory results in the treatment of finger joint ankylosis. (2) Range of motion and DASH-JSSH score significantly increased.

A-0137 Palmar reconstruction of the triangular fibrocartilage complex for instability of the distal radioulnar joint: biomechanical study

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Purpose: Although many anatomical reconstructions for chronic instability of the distal radioulnar joint have been reported, they are generally invasive and technically demanding. We developed a less invasive and simpler reconstruction technique that utilized a remnant of the palmar radioulnar and ulnocarpal ligaments. The purpose of this study was to evaluate whether our reconstruction restores stability of the distal radioulnar joint during pronosupination.

Methods: In seven fresh cadaver upper extremities, we simulated severe distal radioulnar joint instability by cutting all the soft tissue stabilizers around the distal ulna at their ulnar attachments. The palmaris longus tendon graft was sutured in an interlacing fashion to the remnant of the palmar radioulnar and ulnocarpal ligaments via a palmar approach. First, the graft was passed through the first slit that was created at insertion of the ulnotriquetrum ligament to palmar radioulnar ligament from inside of the ulnocarpal joint to the palmar side. Second, the graft was passed around the palmar radioulnar ligament and passed through the second slit which was created obliquely at insertion of the ulnocapitate ligament to the palmar radioulnar ligament. Third, the graft was passed through the third slit which was created at insertion of the ulnolunate ligament to the palmar radioulnar ligament and sutured to the palmar radioulnar and ulnocarpal ligaments using 3-0 non-absorbable threads. The dorsal radioulnar ligament was additionally secured to the graft. A 3 mm drill hole was created on the fovea of the ulna to the posterior cortex of the ulna. The graft was passed through the bone tunnel and the end of the graft was tensioned and sutured to the graft itself after passing through the second bone tunnel just proximal to

the exit of the first bone tunnel. Loads were applied to the radius in a vector perpendicular to the coronal plane of the radius, and the total displacements of the radius relative to the ulna were measured by electromagnetic tracking device in neutral rotation, 60° pronation, and 60° supination. We compared the total displacements between before cutting, before reconstruction, and after reconstruction.

Results: The total displacements decreased significantly in all three forearm positions after reconstruction compared with before reconstruction. There was no significant difference in the total displacement before sectioning of the soft tissue stabilizers and after the reconstruction in all positions.

Conclusions: Our reconstruction using a palmar approach restored stability effectively and easily without creating a bone tunnel on the radius for unstable distal radioulnar joint. Clinically, most cases with severe distal radioulnar joint instability still have relatively robust remnants of the palmar radioulnar and ulnocarpal ligaments on the radial and carpal sides. Our results lay the groundwork for future clinical application of this procedure.

A-0139 Ulnar nerve transposition using a mini-invasive approach: case series of 30 patients

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Introduction: The treatment of ulnar nerve compression at the elbow remains controversial. No single technique has yet proven its superiority.

Methods: We describe a technique combining the advantages of the mini-invasive approach with those of transposition in a series of 30 patients. We present the follow-up of 30 patients of mean age 52 years who underwent anterior subcutaneous transposition of the ulnar nerve using a mini-invasive approach with a follow-up of more than 6 months. The incision measures 3 cm.

Results: Results were evaluated by measuring pain intensity, QuickDASH, grip force and pinch force, and McGowan score pre and postoperatively. All parameters were improved postoperative. Mean pain score went from 5.5 to 4.1, the QuickDASH from 48 to 37.59, mean grip force from 27.7 to 31 kg, mean pinch force from 4.75 to 6.4 kg, the McGowan score from 0 to 10 cases at 0, 7 to 16 cases at I, 7 to 3 cases at II and 16 to 1 case at III.

Conclusions: Analysis of our series shows that a 3 cm incision without endoscopy allows subcutaneous transposition with results at least as good as those with other techniques. The advantages of our technique are that it is easy, is a limited approach, preserves blood supply, allows placement of the nerve in a favourable environment, and decreases nerve stretching on elbow flexion.

A-0142 Oberlin's procedure for restoration of elbow flexion with Da Vinci robot: four cases

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Background: Robotics allow up to 40 times visual magnification, and 10 times magnification of surgeon's movements, as well as eliminating physiological tremors. These properties should allow the development of mini-invasive limb surgery, especially brachial plexus. The purpose of this work was to test the feasibility of the restoration of the elbow flexion according to the technique of Oberlin using a Da Vinci robot.

Methods: Our series included four patients (average age 31 years) presenting with elbow flexion paralysis. They were operated on 8 months post injury using a Da Vinci S® robot. In three patients, the open technique (technique 1) was used, and the mini-invasive approach (technique 2) was used for the last one. Strength of elbow flexion was measured.

Results: After 1 year follow-up, all the patients recovered elbow flexion. No sensory nor motor deficit was found in the ulnar nerve territory. There was no difficulty with technique 1; technique 2, however, required a conversion to technique 1 due to difficulty visualizing the operative field.

Conclusions: The results of our series show the feasibility of the robotic-assisted technique for the Oberlin procedure. The lack of sensory feedback was not an issue. The development of specific retractors and instruments should improve the mini-invasive technique.

A-0145 Surgical reconstruction for chronic posterolateral rotatory instability of the elbow: our experience with early to midterm results

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Purpose: Since its original description by O'Driscoll in 1991, posterolateral rotatory instability (PLRI) is becoming increasingly recognized as a significant cause of elbow pathology. The primary lesion in PLRI is injury or attenuation of the lateral ulnar collateral ligament. PLRI is diagnosed on the basis of careful history-taking and specific physical examination techniques. Reconstruction of the lateral ulnar collateral ligament with repair of the surrounding soft tissue structures is recommended in patients who have symptoms of recurrent lateral instability.

Methods: We reviewed the results of 12 patients (12 elbows) who underwent surgical reconstruction for clinically symptomatic PLRI of the elbow over a 2-year period from July 2007–August 2009. The symptoms resulted from previous dislocation or a hyperextension and varus stress injury of the elbow. Surgical reconstruction was performed with a free palmaris longus/plantar tendon graft in all 12 elbows.

Results: Postoperatively, no patient had residual instability or a positive pivot shift test in the elbow. Results were graded as excellent or good in nine and fair in three. Subjective assessment revealed that all 12 patients were satisfied with the outcome of the surgery.

Conclusion: Accurate recognition of PLRI of the elbow is important for appropriate management. Surgical ligament reconstruction or repair is the most favourable treatment option for restoration of normal elbow function. In our series, reconstruction of the lateral ulnar collateral ligament with a tendon graft restored stability in all cases and produced excellent to good results in 75% of cases.

A-0149 Contribution of the serratus anterior muscle to the shoulder function following the transfer of the spinal accessory nerve to the suprascapular nerve in traumatic brachial plexus injury

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Purpose: The serratus anterior (SA) muscle plays an important role in determining the final shoulder function following spinal accessory nerve (SAN) transfer to

the suprascapular nerve (SSN) in traumatic brachial plexus injury, but no previous studies have taken this into account. We studied the influence of this muscle on final shoulder function following SAN to SSN transfer in brachial plexus injury (BPI).

Methods: Nineteen patients underwent SAN to suprascapular nerve transfer following traumatic brachial plexus paralysis. They were divided into three groups depending on the type of paralysis: Group I (C5–6), Group II (C5–7) and Group III (C5–8, T1). They were also divided into two groups depending on the presence (Group A), or absence (Group B), of SA function. Postoperative evaluation included clinical and electrophysiological assessment of shoulder range of motion. The Kruskal–Wallis test was employed to compare the means of the three different groups, and the Mann–Whitney test was utilized to compare the two groups with paralyzed or functioning SA muscle. Results were considered significant for $p < 0.05$.

Results: Group I patients (C5–6 palsy, $N=4$), with a functioning SA muscle, obtained the best range of flexion and abduction of the shoulder. The final gain in the range of motion of Group II (C5–7 palsy, $N=7$) varied depending on the level of injury. Group III patients (C5–8, T1 palsy, $N=8$) did not achieve satisfactory functional recovery. Regardless of the level of injury and the type of paralysis, there was a statistically significant ($p < 0.05$) difference in the shoulder function of patients with a functioning SA muscle (Group A) than those in whom it was paralyzed (Group B).

Conclusions: (1) Regardless of the type of paralysis, Group B patients with partially working SA muscle achieved better results than those of Group A with complete paralysis of the SA muscle. (2) Although the priority of nerve repair for shoulder reconstruction following BPI is suprascapular nerve neurotization, the long thoracic nerve should also be repaired when it is injured.

A-0150 Sibling recurrence risk in Dupuytren's disease

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Purpose: Dupuytren's disease (DD) is a benign fibroproliferative condition of the hand, and the most common inherited connective tissue disease in humans. Surgical and minimally invasive treatments may be effective in correcting the deformity caused by DD; however, recurrence and complication rates are high. DD is a complex disease, meaning both genetic and

environmental factors play a role in its aetiology. The genetic contribution to disease development is supported by familial clustering, population studies and molecular genetics. However, the precise degree to which genetic factors contribute to the disease has not been adequately quantified. The main aim of this study was to quantify the extent to which genetic factors predispose an individual to DD through the calculation of sibling recurrence risk, a standard measure of heritability risk, and to calculate the proportion of heritability accounted for by currently known genetic loci in DD. Secondly, the influence of other factors – age, gender and disease severity – upon sibling recurrence risk was examined.

Methods: Using the BSSH Genetics of Dupuytren's disease database, 562 index patients who had previously undergone surgery for DD were contacted. Of those, 174 had siblings who agreed to take part in the study. Where multiple siblings of the same index patient agreed to take part, one was randomly selected for inclusion to avoid ascertainment bias by ensuring that larger families were not overrepresented. Of the 174 siblings who agreed to take part, 100 were examined for DD by a surgeon with over 5 years' experience in diagnosing and treating DD. Controls were recruited from a non-diabetic ophthalmology outpatient clinic. Other variables recorded were age, gender, ethnicity, handedness, taught handedness, the presence of diabetes mellitus and a past history of surgery for DD.

Results: There were no statistically significant differences between the case and control groups in terms of baseline demographics or presence of diabetes mellitus. DD was significantly more common in the sibling group than in the control group. Of siblings, 47% (47/100) were found to have DD, compared with 10.48% (13/124) of controls ($p = 1.006 \times 10^{-9}$). The sibling recurrence risk was found to be 4.48 (95% CI 2.57–7.81). Sex-specific sibling recurrence risk was found to be 3.40 (2.02–7.54, $p = 9.238 \times 10^{-6}$) for brothers of index patients compared with male controls, and 6.30 (2.32–17.09, $p = 8.480 \times 10^{-6}$) for sisters of index patients compared with female controls. Age-specific figures reached statistical significance in the 61–70, 71–80 and 81–90 age groups, where it was found to be 9.78 (2.49–38.36), 5.89 (1.85–18.70) and 2.37 (1.10–5.12), respectively. Currently known loci predisposing to DD account for 12.1% of the total heritability of the disease.

Conclusions: Our data add to the evidence supporting a genetic basis of DD, and accurately quantify the degree to which genetic factors influence disease development. This quantification made it possible to determine that 12.1% of heritability has been

accounted for to date. Further molecular studies are required to reveal the full genetic architecture of DD, which in turn may lead to the rational design of new therapies aimed at both treating the disease and preventing recurrence.

A-0154 Comparing classifications for radial polydactyly: the change in distribution for different subtypes

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Introduction: Universal, all-embracing classification systems are important in evaluating radial polydactyly regarding clinical outcome. The Wassel classification is mostly used in the current literature. Subsequently, other classifications have added subtypes in order to describe the different radial polydactylies. The Rotterdam classification was developed to classify subtypes of radial polydactyly, including thumb triplications and radial polydactyly with a triphalangeal thumb. We compared the Wassel and Rotterdam classifications regarding incidences of the different types, and possibility to classify all polydactylies.

Methods: Patient records of patients with radial polydactyly at the Catholic Children's Hospital Wilhelmstift in Hamburg, Germany, and the Erasmus MC University Medical Center in Rotterdam, The Netherlands, were evaluated. Only records with available X-rays and operative reports were included. Strict interpretation of the Wassel classification and the Rotterdam classification were both applied to describe the type of radial polydactyly.

Results: In total, 191 patients met the inclusion criteria, yielding 220 cases of radial polydactyly. Of these, 61 cases (27.7%) were unclassifiable upon strict application of the Wassel classification, in contrast to all cases when using the expanded Rotterdam classification. Some 5% of Wassel type IV cases were classified as Type III and 3% of Wassel type II as type I in the Rotterdam classification. Furthermore, 88.6% of Wassel types II and IV radial polydactyly could be further classified for: triphalangism, deviation, hypoplasia, symphalangism and triplication in the Rotterdam classification model.

Discussion: A clear difference in frequency is present in the classification systems discussed. For clinical

use, the Rotterdam classification may be too time-consuming. However, we believe that this classification will be more suitable for research purposes and evaluation of (long-term) outcome. Additional data need to be evaluated to increase the studied population. A comparison of the Wassel classification as used in daily practice will also be evaluated in the future.

A-0155 Evidence for effectiveness in the reconstruction of the digital nerve

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Background: The digital nerves are obligatory for a normal hand function; they make the hand, and especially the digits, a very distinctive, accurate and sensitive organ. Digital nerve transection is often present in trauma of the upper extremity. When faced with a transection, the hand surgeon has several options, as reported in the literature. Despite the abundance of published studies, there is no hard evidence as to which technique is the most appropriate for any specific situation. Therefore, the aim of this systematic review was to provide an evidence-based overview of the effectiveness of interventions used in reconstruction and post-surgical management of digital nerve injuries.

Methods: The Cochrane Library, PubMed, EMBASE, CINAHL and PEDro databases were searched for randomized controlled trials (RCTs) and controlled clinical trials. Two reviewers independently applied the inclusion criteria to select potential relevant studies, extracted the data and performed a methodological quality assessment. The GRADE method was used to summarize the results and grade the quality of evidence of the included trials.

Results: Eight RCTs were included, five on surgical and three on post-surgical interventions. Low-quality evidence was found for effectiveness in favour of a PGA conduit compared with primary neurotaphy or autologous graft, in digital nerve gaps of ≤ 4 mm and ≥ 8 mm in long-term follow-up. Very low quality of evidence was found for effectiveness in favour of EMLA cream, compared with placebo, in enhancing sensory relearning for the short-term, but not for the long-term outcomes. Low quality of evidence was found for effectiveness in favour of early tactile stimulation

compared with control at long-term follow-up. For other interventions, no evidence for effectiveness was found.

Conclusions: This systematic review is, to our knowledge, the first in the field of digital nerve reconstruction. Eight RCTs were included, five on surgical and three on post-surgical interventions, with evidence for effectiveness found in favour of: (1) the Neurotube™, compared with the gold standard (primary neuro-rhaphy or autologous graft), for gaps of ≤ 4 mm and ≥ 8 mm; (2) repeated forearm anaesthesia compared with placebo; and (3) early tactile stimulation compared with control. For the other interventions no difference in effectiveness was found. Indications for effectiveness of some treatment strategies were found, but due to a minimal number of RCTs in this field no firm conclusions could be drawn for the different techniques. Observational studies show encouraging results, but for a more confident estimate effect, more high-quality RCTs are a necessity.

A-0156 Single versus double wire anterograde intramedullary nailing for the treatment of metacarpal neck fractures

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Purpose: Intramedullary splinting for metacarpal neck fractures with a single pre-bent wire is a procedure that is becoming popular, but there is still concern about some lack of stability during the postoperative early mobilization.

Methods: From January 2010 to September 2011, 39 metacarpal neck fractures in 37 consecutive adult patients with a 30° to 70° palmar displacement were randomly divided in two groups and treated with closed reduction and anterograde intramedullary splinting either with a single wire (Group 1: 19 patients) or two wires (Group 2: 18 patients). According to the medullary canal diameter a single wire of 1.5–2.0 mm in diameter was used in Group 1. In Group 2 the wires were of 1–1.2 mm in diameter. Functional mobilization in a metacarpal brace with twin tape was started within 1 week after surgery in both groups. A radiological and clinical assessment was done at 2, 4 and 8 weeks.

Results: Reduction was maintained in all patients until fracture healing, and there were no malunions. No statistically significant difference in consolidation time was found between the two groups. The operating time in Group 1 was significantly shorter. One patient in Group 1 had a slight proximal mobilization of the wire after 3 weeks with no consequences on

fracture reduction. This was due to a discrepancy between the diameter of the wire and the metacarpal medullary canal. All patients regained a full range of pain-free movement at 8 weeks and went back to work except one patient in Group 1 who suffered CRPS and regained full function after 4 months

Conclusion: We conclude that intramedullary splinting with a single wire for displaced metacarpal neck fractures is a simpler procedure that produces results comparable with intramedullary splinting with two wires.

A-0163 Long-term results of the total arthroplasties in the treatment of carpal-metacarpal osteoarthritis

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Introduction: Many different surgical techniques have been recommended for osteoarthritis of the basal joint of thumb: trapectomy, trapezio-metacarpal arthrodesis, LTRI, and joint replacement. Total joint replacement has been an effective treatment for this condition, because of the earlier post-operative recuperation and better replication of axes of rotation of the original joint that substitute, but the problem is the durability of these implants over time. The purpose of this paper is to present the results of long-term follow-up (more than 10 years) of total arthroplasties non-cemented and non-constrained for trapezium-metacarpal osteoarthritis treatment.

Methods: Total joint arthroplasties for the treatment of carpal-metacarpal osteoarthritis were performed on 62 thumbs of 59 patients (54 women and five men) to treat advanced osteoarthritis (Eaton and Littler stages III and IV). The prostheses were done between May 1999 and May 2002. The indications for surgery were severe pain, loss of pinch strength, and reduced thumb motion that restricted activities of daily living. The implants in this series were 60 Arpe prostheses, and two Ivory. The average follow-up time was 10.8 years. At the last follow-up, five patients had been lost for different reasons; therefore there were 57 implants in 54 patients included in the study.

Results: Some 57 of the performed implants were finally reviewed; of them, 55 (96.5%) remain in place, and in two (3.5%) the implant was removed and they now have an LTRI. In all, 53 (93%) are functional and two (7%) are not. One of the patients (the third of the series) with the prosthesis luxated from the early post-op refused the surgical revision. Five prostheses in this series have been surgically revised: the first due to a luxation of the components when removing

the cast, which was successfully corrected and in the final follow-up is functional; three others because of loosening of the cup, one resolved with bone graft and a new cup, and the other two with a Zancolli LTRI. In one, the medium-size neck was exchanged for a long size, and the prosthesis is now functional. Functionally, the average thumb palmar abduction is 20°, the radial abduction is 25° and thumb opposition always reaches the base of the small finger. The average pinch strength was 5.5 kg. Two patients complained of minimal pain at resting, two others have pain upon minimal effort, and the remaining 34 patients were pain free. The average preoperative Dash was 52 points (40–63), and in the final follow-up was 31 points (23–35). Radiographic studies at the final follow-up evaluation did not show signs of implant loosening, although some showed an appearance of subsidence of the components, due to periprosthetic ossifications.

Conclusions: Total joint arthroplasties of the carpal-metacarpal joint of the non-cemented and non-constrained thumb have proven to be efficacious in improving movement, strength, and relief of pain. The implants have also performed well over time (similar to hip or knee implants).

A-0166 Spontaneous distal biceps tendon ruptures: are they related to statin administration?

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Introduction: Cases of statin-attributed tendinous complications have been reported in the literature. The purpose of this study is to identify a possible correlation between statin administration and incidence of spontaneous distal biceps tendon ruptures.

Methods: We retrospectively reviewed 104 patients with distal biceps tendon rupture that were treated surgically from 2004–2010. Patients were divided into two groups based on the mechanism of injury. Group 1 involved spontaneous tendon rupture and Group 2 involved rupture after severe extension force to a flexed elbow with eccentric contracture of the tendon. We recorded and analyzed data for patient demographics, statin administration, range of motion (ROM) and strength of the operated and of the non-operated extremity.

Results: From the 104 patients, 102 were male and two were female with average age 47 years (range, 22–78). After statistical analysis, there was a trend towards increased spontaneous ruptures in patients taking statins, at nearly two times more likely to have spontaneous distal biceps tendon rupture with use of

statins. Patients in Group 1 compared with Group 2 were older, had weaker postoperative strength in both operated and non-operated hand and had similar postoperative ROM. Patients taking statins compared with those that were not taking statins were older, had same postoperative strength in both operated and non-operated hand and had similar postoperative ROM.

Conclusions: Based on the results of our study we conclude that statin administration is associated with the incidence of spontaneous distal biceps tendon ruptures. In addition, spontaneous distal biceps tendon ruptures are found to be related to the patient's age.

A-0168 Early results of collagenase injection in 77 patients with Dupuytren's disease and satisfaction survey: a single center experience

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Introduction: Dupuytren's disease is a fibroproliferative hand condition causing progressive digital flexion contracture; treatment, when necessary, has usually involved surgery. Injectable collagenase *Clostridium histolyticum* (CCH) is a minimally invasive, non-surgical therapy to correct Dupuytren's contracture. We evaluated the contracture correction, efficacy and patients personal opinion of the results of CCH injections. In this abstract, we report results from patients treated by a single center during 2010.

Methods: Some 77 patients (58 male/19 female) with a mean age of age 66 years (range, 45–85) were treated with CCH in 2010; these patients received a total of 102 CCH injections. Inclusion criteria were Dupuytren's disease with fixed flexion contracture $\geq 30^\circ$ in the metatarsophalangeal joint (MPJ) and proximal interphalangeal joint (PIPJ) causing functional impairment and presence of cords in MPJ and PIPJ. Exclusion criteria were known allergy to CH, hand surgery not related to Dupuytren's disease within 90 days of the first selected injection, and surgeon's preference for other treatment. We performed assessment of primary contracture reduction (using the Tubiana classification system), patient satisfaction (through clinical examination and phone survey) and report of side effects.

Results: Injection/Hand was in the right hand in 51 and in the left hand in 36, with nine in both hands. The Injection/Joint ratio was in MPJ: 79 and in PIPJ: 23. In total, 70 patients received one injection, five patients

received two injections and one patient received three injections in the same cord. The ROM after the injections improved significantly in the majority of the patients. Only three patients had no improvement in the contracture deformity. From 79 patients received treatment we were able to reach 58 patients for the phone survey 1 year after the injection (73%). Most of the patients were satisfied with the result of the injection (81%), and 70% would do it all over again, considering the result and the side effects of the injection. The cost of the injection was considered high by 22.4% of the patients. Pain (26%), ecchymosis (36%), swelling (21%) and skin breakage (10%) were the most common side effects. No tendon ruptures and no nerve damage were reported.

Conclusions: For patients with Dupuytren's disease, injectable CCH significantly improved both ROM and degree of contracture with few adverse events. Pain, ecchymosis and swelling are common complications. Most of the patients were satisfied with the results 1 year after the injection. Collagenase injection is an effective and safe alternative treatment in patients with advanced Dupuytren's disease. Our findings support the use of CCH as an alternative to surgery for treatment of Dupuytren's disease. Further patient follow-up will continue to evaluate possible contracture recurrence.

A-0169 Osteosynthesis of distal radius fractures by a new pinning technique

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Introduction: The treatment of distal radius fractures is controversial. Locking plates offer a very good stability allowing early mobilization, but require a wider approach and are not cost-effective. Intrafocal pinning is percutaneous and cost effective, but provides less stability. The purpose of this study is to compare a preliminary clinical series of the new pinning technique (NPT) and a series of volar locking plates (VLP).

Materials and methods: Our series included 66 patients, with a mean age of 62 years and two-thirds are women. They all had a distal radius fracture with posterior displacement (according to the AO: 0% A2.1, 40,1% A2.2, 12,1% A3.2, 4,5% B3, 22,7% C1.1, 7,6% C1.2, 3% C2, 1,5% C3). Thirty were treated with the NPT which consists of forming a rigid frame by joining together an intra-focal pin to a subchondral pin by an external connector. Thirty-six were treated with a VLP. All patients were encouraged to mobilize their wrist

immediately except one, treated with pinning. The evaluations criteria were pain numeric scale (0–10), mobility (compared with the controlateral side), Quick DASH (0–100), strength of the grip, pronation and supination (compared with the controlateral side) The distal radio-ulnar index and the radial and volar tilts were measured on radiographs after consolidation.

Results: At a mean follow-up of 40 months, pain was 1.3 for NPT and 1.2 for VLP. The DASH score was 19.7 for NPT and 16 for VLP. Mobility compared with the controlateral side was 85.3% in flexion for NPT and 91.9% for VLP, 93.1% in extension for NPT and 95.4% for VLP, 97.8% in pronation for NPT and 97.3% for VLP, 96.2% in supination for NPT and 97.3% for VLP. The strength compared with the contralateral side was 75.8% in grip for NPT and 76.4% for VLP, 85.9% in supination for NPT and 95.7% for VLP, 85.6% in pronation for NPT and 96.5% for VLP. The distal radio-ulnar index averaged was +1.3 mm for NPT and -0.7 mm for VLP, the radial tilt averaged 20.8° (NPT) and 20.2° (VLP). The volar tilt averaged 6° for NPT and 8.5° for VLP. In the NPT series we noted a superficial secondary cutaneous infection in four cases, three non-reoperated secondary displacements, one pin migration without consequence, two complex regional pain syndromes type 1, and two EPL rupture. In the VLP series we noted three flexor tendon tenosynovitis without rupture and one carpal tunnel syndrome.

Conclusion: The main disadvantage of the NPT is the presence of external connectors that can cause secondary infections of the skin. It is, however, a way to stable percutaneous osteosynthesis, allowing immediate mobilization, more cost effective than the plates. Its indications will be defined after reviewing a larger number of cases with a longer follow-up.

A-0173 Modified pull-in suture in mallet finger (Technical note)

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Purpose: For treating mallet finger surgically, pull-out suture, tension band fixation, compression fixation pin, distal interphalangeal pin fixation, and extension blocking pin fixation have been suggested. Pull-out suture may cause complications such as skin damage and necrosis; thus a new surgical technique is required to lower skin damage, necrosis, and infection. Here, the authors introduce a new technique called modified pull-in suture for treating mallet finger.

Methods and materials: Modified pull-in suture and Kirschner wire fixation was performed in 17 patients who had been admitted to Wonju Christian Hospital between March 2008 and February 2011. Those with closed bony mallet finger where closed reduction cannot be achieved, bony mallet with minute bony fragment, and open or closed tendinous mallet finger were selected for the procedure. Of these 17 patients, 12 were male and five were female. The age distribution was from 16–60 years old. There were six cases of direct injury, and indirect injury was found in 11 cases. Time taken from injury to surgery was 6.5 days on average (1–14 days). All patients had follow-ups at every 2 weeks postoperatively. Open reduction was first performed, and suturing was begun at the proximal part of the ruptured extensor tendon. The suture was circled around the distal phalanx using an 18 gauge needle to complete the repair. Finally, K-wire was used to fixate the distal interphalangeal joint (picture 1). Immediately after the surgery, active ROM exercise was initiated to proximal interphalangeal and metacarpophalangeal joints. K-wire was removed 6 weeks after the surgery, and active ROM exercise was also initiated to the distal phalangeal joint. After 1 week, the exercise was continued without any limitation, and evaluation was made by measuring joint range using goniometer, radiologic results, and patient satisfaction.

Results: Mean follow-up time was 25 weeks (8–42 weeks). All 17 patients returned to their daily activities. Mean distal phalangeal extension angle was 4° (0–8°), and mean distal phalangeal flexion angle was 75° (57–90°). Crawford's evaluation criteria yielded 12 excellent, four good, and one fair satisfaction results.

Conclusions: The modified pull-in suture does not cause skin necrosis or ulceration, or require any special modalities such as mini screw, mini external fixator or mini bone anchor system. Also the surgery is performed under direct view, not requiring C-arm. Although this method requires a delicate technique, the modified pull-in suture technique, with its more successful results and higher patient satisfaction, is considered an effective method to treat mallet finger.

A-0175 Efficacy and effectiveness of collagenase *Clostridium histolyticum* for Dupuytren's Contracture: comparison of real-world data with clinical trial results

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Purpose: Collagenase *Clostridium histolyticum* (CCH) is approved for the treatment of Dupuytren's Contracture (DC) in the United States and Europe. The objective of this study was to determine if effectiveness of CCH in real-world settings is comparable with efficacy demonstrated in clinical trials.

Methods: A retrospective chart review was conducted at community and academic practices across the United States (Mar–Dec 2010). Physicians or their medically trained staff at each site collected data on patient history and CCH treatment outcomes from patient charts using a predefined case report form. Clinical effectiveness results were compared with efficacy findings from the clinical registration trial (CORD-I) on 1) final contracture angle, 2) change in contracture, 3) final range of motion (ROM), and 4) change in ROM. The equivalence range was set at $\pm 10^\circ$. Descriptive and inferential statistics are reported.

Results: A total of 501 patient charts from 10 sites were reviewed. Patients had a mean age of 65 years and 74% were male. Of the 629 unique joints treated in 2010, 93% (586/629) were treated with one CCH injection. Of these, 63% (398/629) and 37% (231/629) were metacarpophalangeal (MP) and proximal interphalangeal (PIP) joints, respectively. A total of 44%, 39%, and 17% of MP joints and 65%, 22%, and 13% PIP joints of little finger, ring finger and other fingers, respectively, were treated. For all joints treated, degree of contracture improved by $36.6^\circ \pm 20.3^\circ$ ($n = 546$) and an 84% improvement in ROM was noted (change in ROM $37.2^\circ \pm 19.1^\circ$ ($n = 206$)). The means of the four effectiveness measures were $12.1^\circ \pm 16.7^\circ$, $36.6^\circ \pm 20.3^\circ$, $81.3^\circ \pm 13.9^\circ$, and $37.2^\circ \pm 19.1^\circ$ for final contracture, change in contracture, final ROM, and ROM, respectively. The 95% confidence interval (CI) for each of these measures fell within the corresponding predefined equivalence range of $\pm 10^\circ$ from the CORD I trial. The total number of injections per joint rate was 1.08 ± 0.32 ($n = 629$ joints) with a 95% CI between 1.05 and 1.11, which is significantly different ($p < 0.05$) from the reported CI of 1.5 (CI 1.39–1.61) to achieve reduction in contracture to $\leq 5^\circ$ in CORD I. The average number of office visits/treatment (including CCH injection, extension and follow-up) was 2.92 ± 1.05 ($n = 620$). Local anesthetic was used in 86% of finger extensions; oral pain medication was used in 16% and 10% of patients, in the days prior to and day of finger extension, respectively. No serious adverse events were reported.

Conclusions: Real-world CCH clinical effectiveness was similar to that published for the CORD I trial. However, injection per joint use was 28% lower, and number of visits per treatment cycle was also lower than in the CCH CORD I study. Reasons for the lower number of CCH injections used in real-world settings could be: (a) treatment was not blinded; (b) finger

extension was conducted with local anesthesia; and (c) patient-focused treatment outcomes were achieved without the strict protocol requirements of a clinical trial. A reduction in CCH injections and visits while maintaining treatment outcomes has significant positive implications for patients, payers, and physicians.

A-0176 Use of collagenase *Clostridium histolyticum* in earlier vs. advanced stage Dupuytren's Contracture results in better outcomes

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Purpose: Dupuytren's Contracture (DC) is a progressive disease, with the contracture angle and related disease stage often increasing over time. Treatment with ≥ 1 injection of collagenase *Clostridium histolyticum* (CCH, XIAPEX) has been demonstrated to result in a 76% average reduction in contracture from a mean contracture of 50.2° at baseline to 12.2° following treatment.¹ For this study, we evaluated whether treatment of early stage Dupuytren's disease (palpable cord/1–30° contracture) with CCH results in better outcomes than treatment of advanced stage contractures (> 30° contracture) in actual practice.

Methods: We undertook a retrospective chart review of DC patients treated with CCH after US FDA approval at community and academic practices across the United States (March to December 2010). Patient history and CCH treatment outcomes data were collected at each site by physicians or their medically trained staff using a study-specific case report form. Male and female patients who had only one affected joint treated with CCH in 2010 were included and outcomes assessed after the first injection. Treatment results for early versus advanced disease were compared using the *t*-test.

Results: The inclusion criteria for this analysis were met by 302 of 501 patients from 10 study sites. Patients had a mean age of 65.7 years and 75% were male. Early and advanced contractures were observed in 61 and 241 CCH treated joints, respectively. The mean final joint angle in CCH treated joints with earlier stage DC (3.8 ± 6.9) was significantly better than in joints with advanced stage DC (14.0 ± 18.0 , $p < 0.0001$). Nonetheless, joints with initially advanced DC had a significantly greater mean improvement in

degrees of contracture (43.6 ± 17.9) versus early stage DC joints (20.8 ± 8.0 ; $p < 0.0001$). These findings were significant even after statistically controlling for joint type (metacarpophalangeal or proximal interphalangeal) in a general linear model. A trend toward a higher mean percent reduction in contracture angle was observed with early stage joints (85%) than advanced stage joints (78%); however, the difference was not significant after controlling for joint type ($p = 0.15$). No serious adverse events were reported in the study.

Conclusions: This analysis indicates that, on average, CCH treatment of early stage joints results in significantly better outcomes, to near normal correction, than treatment of advanced stage joints. On average, a significantly greater magnitude of improvement in degrees of contracture was observed in CCH-treated joints with an advanced stage of contracture, likely because of the higher baseline severity. This analysis did not assess if additional injections into advanced stage joints would result in equivalent final contracture outcomes, or if early treatment diminishes progression or recurrence of DC. These cross-sectional findings favoring early treatment with CCH will need to be validated in longitudinal studies. Based on careful assessment of the risk–benefit ratio, CCH may provide an additional benefit over surgery which is usually reserved for more severe cases of DC.

A-0182 Comparison of clinical results for AO C3-type distal radius fractures between volar locking plating and non-bridging external fixation

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Purpose: AO C3-type distal radius fractures which are intra-articular comminuted fractures are known to be arduous, and various treatments are attempted. We analyze the comparison of the outcomes of volar locking plating (VLP) and non-bridging external fixation (NBEF) for this fracture.

Methods: For this study 71 cases of AO C3-type distal radius fractures were included. There were 36 cases for LP and 35 cases for NBEF groups and the mean ages were 57.4 and 56.7, respectively. Radiograms, the transitions of the gaps and step-offs of the intra-articular fragments and the range

of motions were reviewed before and after surgery, and at the last follow-up.

Results: The post-operative correction loss of the ulnar variance (UV) was greater for NBEF (0.8 mm) than VLP (0.04 mm) but the difference was small regarding the correction loss by A3 fracture. Other parameters (volar tilt, radial inclination) showed similar results. Three cases of LP and two cases of NBEF showed transposition of the intra-articular fragment during follow up. Range of motion of volar and dorsal flexion, pronation and supination showed similar results in the two groups.

Conclusion: VLP surgery is the mainstream for the treatment of unstable distal radius fractures currently, but focusing on C3 type fractures, our study did not show a significant difference between the two methods: VLP and NBEF. NBEF may be inferior to plating when considering the ability to maintain the length of the radius, but the shortening of the distal part of the radius is not so remarkable compared with the comminution for C3-type fractures and therefore this leads to a small degree of correction loss. NBEF is more facile and has higher latitude of pin insertion to fix the intra-articular comminuted fragments compared with VLP. NBEF is an effective therapy option for this type of fracture.

A-0184 Surgical treatments for mallet finger – which is the best method?

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Purpose: Our purpose was to compare the results of various surgical methods in order to find out which is the best method for the treatment of extensor tendon injuries in Verdan zone 1. In our unit, due to the large number of cases and hand surgeons, different surgical methods are used for the treatment of extensor tendon injuries. Simple K wire transfixation in extension of the distal interphalangeal (DIP) joint, extensor tendon suture with or without joint transfixation, Langeman GIG protected tendon sutures, dermatotenodesis and definitive arthrodesis of the DIP joint were the most frequently used methods.

Method: Retrospective analysis of the last 3 years of surgical treatment for extensor tendon injuries in Verdan zone 1 was performed. The type of injury and type of treatment were considered. The range of motion (ROM) was measured, and pain and patient satisfaction were determined using 10-point visual analogue scales (VAS).

Results: In the last 3 years a total of 97 cases of extensor tendon injuries were operated on. In case of pure tendon injuries ($n = 61$) the most frequently used method was dermatotenodesis with DIP joint transfixation with K wire, (57%), followed by tendon suture with DIP transfixation with K wire (24%), dermatotenodesis without DIP transfixation (13%), Langeman GIG protected tendon suture (4%) and DIP arthrodesis (1%). In the case of osseal avulsion ($n = 36$), methods used were K-wiring and DIP transfixation (39%), Langeman GIG (22%), periosteal suture and DIP transfixation (22%), mini screw osteosyntheses (5%) and in 3% of cases Ishiguro K-wiring. In 52% of cases a total ROM was achieved at 6 months. Loss of ROM in 23% of cases was less than 15°, in 16% between 15–25°, and in 9% more than 25°. The rate of complications was less than 5%.

Conclusion: Our results have not demonstrated the superiority of any one method. There were no significant differences in favour of any method. A comprehensive individualised decision is needed for each patient. We can also conclude that in the hands of an experienced, skilled hand surgeon, different methods can give similar results.

A-0185 Buried Kirschner wires in hand trauma: do they reduce infection rates and is it worth the extra cost?

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Purpose: There has been little research to date comparing the rate of infectious complications between buried and percutaneous Kirschner wire use in surgery for fractures of the hand. In a cash-limited health system, the additional cost of removing Kirschner wires should be justified by a demonstrable reduction in the frequency and/or severity of infectious complications.

Methods: We prospectively collected data on injury and patient-related factors (age, gender, smoking status, fracture location and soft tissue status), peri-operative factors (type of anaesthetic, antibiotic use, surgery, surgeon experience, duration, number of wires and wire protrusion or burial), aftercare (time and location of Kirschner wire removal) and details of any infective complications including Oppenheim grade.

Results: We observed seven (10%) infections in 70 patients who had 134 wires left protruding through skin and three (9%) infections in 34 patients who had 68 wires buried deep to skin. In the group where wires were left protruding, four grade I, two grade II and one

grade V infections were observed, whereas in those with buried wires, there were two grade I and one grade IV infectious complications. There was no statistically significant difference in the rate of infectious complications between cases using buried versus percutaneous Kirschner wires. Metacarpal fractures and age between 20 and 25 years were associated with an increased rate of infectious complications. Although removal of buried Kirschner wires will result in an additional cost to the service of at least £251 per patient, when the sequelae of infectious complications and the removal of two patients' wires in clinic were considered, the extra cost per patient was found to be £235.51 for use of buried wires. Although the cost for removal of Kirschner wires is negligible, due to infective complications and the fact that nine patients did not tolerate removal of wires in clinic, the cost per patient was £90.80 for use of percutaneous wires.

Conclusions: In conclusion, we did not demonstrate a statistically significant reduction in the frequency of infectious complications by burying Kirschner wires as opposed to leaving them proud; however, the severity of infection may be less. The increased cost of removing buried wires resulted in a more than two and a half increase in additional cost per patient, even considering the increased infection severity. Overall, it is difficult to justify the additional cost of burying Kirschner wires given the high cost and little, if any, improvement in infectious complication rate or severity.

A-0186 Long-term results and complications following operative treatment of mallet finger

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Aims: Mallet finger deformity is characterized by extensor lag in the distal phalanges of the injured finger. The treatment of mallet finger remains a controversial topic. Most studies recommend surgical treatment if the fragment involves at least one-third of the articular surface, and/or if there is a volar subluxation in the distal interphalangeal (DIP) joint. Few studies focus on complications and long-term follow-up results. Therefore we wish to describe our experiences.

Methods: In total, 57 patients (61 digits) were treated in the Department of Hand Surgery of the National Institute of Traumatology between 2005 and 2007. In all cases we performed open reduction and internal fixation with K-wires. After surgery, we splinted the operated finger for 6 weeks. Following removal of the

wires, all patients underwent physiotherapy. At a long-term, follow-up DASH scores was taken and we analyzed the radiographs.

Results: In our study, 18 of the patients were women, and 39 men. Their age at the time of surgery ranged between 17 and 85 years, with a mean of 36 years. One of the fractures involved the thumb, five the index finger, 13 the middle finger, 19 the ring finger, and 23 the little finger. In 82.6% of the cases, we achieved anatomical reduction post-operatively, and there was a displacement of at least 1 mm articular step-off in 17.3% of the cases. Early re-displacement was observed in 32.7% of the cases, septic complication occurred in 8.7% of the cases and reduction was anatomical in 58.6%. The mean follow-up period was 66 months (range: 50–82 months). At long-term follow-up, most of the patients were satisfied, even though the extensor lag was 5° in the DIP joint, and active flexion was 67° on average. Almost 34.7% of the radiographs obtained at follow-up showed slight degenerative changes of the DIP joint and 10.8% resulted in ankylosis or arthrodesis, while congruency of the DIP joint was anatomical on 54.3% of the radiographs.

Conclusions: The aim is to reach anatomical reconstruction of the injured joint surfaces to provide good extensor function. The function depends on the correct reconstruction of the joint surfaces. The rate of early re-displacement was high, a fact which makes the efficiency of this method of treatment questionable. Despite the relatively insufficient radiographic and functional results, patients were satisfied, as the DIP joint is a 'small' joint and the loss of function can be compensated.

A-0187 Surgical treatment of the dorsal rheumatoid wrist: a long-term assessment of the subjective results

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Purpose: Wrist problems occur frequently in rheumatoid arthritis, affecting 65–95% of cases. The goal of surgical treatment is to ensure a correct function without return of normal anatomy. The purpose of this work is to evaluate the long-term subjective satisfaction of patients undergoing dorsal wrist arthritis. Some 95 wrists operated between 1995 and 2008 were evaluated with an average of 9 years.

Methods: From 1995–2008, 144 dorsal rheumatoid wrists were operated in 128 patients. Among these 128 patients, 68 patients corresponding to 95 wrists operated responded to a questionnaire by telephone during the first half of 2009. Different parameters

were studied: objective clinical parameters (visual pain-rating scale VAS), subjective clinical parameters (the impact of wrist surgery on quality of life, subjective feeling of stiffness in the wrist, the strength of the wrist, the subjective assessment of pain and overall satisfaction of the patient). Finally, the functional score of the upper limb QuickDASH was made.

Results: At the medical inspection after surgery, 84 wrists (88%) were pain improved since the surgery, while 11 wrists (12%) were unimproved or worse; 88 wrists (92%) were satisfied or very satisfied, while seven wrists (8%) were not satisfied with the operation. Eighty-five wrists would be operated again while 10 wrists would not, or were uncertain about the idea of re-operation. VAS average was estimated at 3. The average DASH at medical inspection after the surgery was 39 (from 0–90). The wrists treated with total arthrodesis had a feeling of stiffness significantly higher than the wrists which received another stabilization procedure. Wrists with healthy tendons in the pre-operative period had a feeling of stiffness higher than the group of injured or broken tendons. Patients with healthy tendons were more often found among those who would not re-operate or would be uncertain about the idea of re-operation.

Conclusion: Surgery of dorsal rheumatoid wrist delivers good results, which seem to have a long-term efficacy. This is a successful treatment, regardless of the type of operation. Pain sedation is almost always obtained. Preventive surgery must be balanced with the fact that it brings less subjective patient satisfaction. Palliative surgery results in more stiffness but provides excellent subjective patient satisfaction.

A-0189 Comparison of nine outcome systems for evaluating treatment of radial polydactyly

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Introduction: Various outcome assessment scores/systems have been used to describe the results of surgery in treatment of radial polydactyly. We conducted a study to determine which of these systems should be considered superior based on inter-rater reliability and correlation with manual activity questionnaires.

Methods: Patients with Wassel types 2 and 4 radial polydactyly, with a minimum age of 4 years and at least 1-year post-operative follow-up, were selected from the hospital registry. Nine outcome assessment

systems were selected from literature based on validity and historical relevance. Two congenital hand surgeons and one independent examiner evaluated all patients. Patients were asked to fill out the ABILHAND-kids and a modified version of the Prosthetic Upper Extremity Functional Index (PUFI) questionnaires. Parents/patient and examiners, assigning visual analogue scale (VAS) scores on function and aesthetics, performed a subjective evaluation. Inter-rater reliability was assessed using inter-class correlation (ICC) and Pearson's correlation coefficients with the manual activity questionnaires were calculated.

Results: This study included 36 patients, yielding 40 cases of radial polydactyly in total. All patients were evaluated by at least two independent raters. Mean outcomes were fair to good depending on the scoring system evaluated. The reliability was highest for the JSSH, Larsen's and Cheng's scoring systems, with a consistently good ICCs (≥ 0.70) and excellent validity. The ICC on VAS scores (patient vs. examiner) on function ranged from 0.41–0.66; on aesthetics from 0.39–0.63. Thirty-five patients completed the ABILHAND-kids questionnaire, 27 patients filled out the modified PUFI. Poor correlation (range -0.33–0.43) was found between the outcome scores and the results of the manual activity questionnaires.

Discussion: With the exception of the JSSH system, the ICC between the two hand surgeons was always higher than the ICC for the independent examiner and either hand surgeon. This may prove to be important in a study protocol with an independent examiner. The low agreement on subjective scores on function and aesthetics underscores the fact that the patient might not agree with the examiner. The poor correlation between the outcome scores and manual activity questionnaires corresponds with previously published literature.

A-0190 Safer arterialized free venous flap for the reconstruction of the hand

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Purpose: Arterialized free venous flaps with proximal parallel veins have been already proven to be a safe procedure for complex defects of the hand. However they are still considered a 'second choice' for their controversial healing (monitoring) and their frequent partial loss.

Methods: The authors performed nine arterialized venous free flaps having at least two parallel proximal veins for the reconstruction of small and medium defects of the hand. The mean area of coverage was 39 cm². The donor site was the palmar aspect of the proximal forearm in four cases, the middle forearm in three cases and the thenar area in two cases. The donor site was always closed primarily. Three flaps were sensate by including the lateral cutaneous nerve of the forearm. One flap was a composite flap including the palmaris longus, the flexor carpi radialis and the lateral cutaneous nerve of the forearm. Three flaps were flow-through flaps. Four flaps were monitored peroperative with fluorescein by direct injection in the flap on the table and later after the inseting in order to visualize the vascular tree pattern of the flap and to prove the immediate complete revascularisation.

Results: All flaps survived with no epidermolysis except one that had 25% of loss because a technical mistake.

Conclusion: The authors had satisfactory results using arterialized unreversed venous free flaps having at least two parallel veins. All flaps were highly customized with regard to donor site, shape, quality of skin, pedicle length, vessels size, inclusion of extra anatomical structures other than skin and fat.

A-0192 Ulna shortening using the oblique intra-articular osteotomy (Comtet-Sennwald osteotomy): a review of 54 patients with a 1-year follow-up

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Introduction: Following a presentation at the congress of the French Hand Surgery Society in 2008, the oblique intra-articular osteotomy method designed by JJ Comtet and G Sennwald has been officially affirmed in resolving the ulnar impaction syndrome.

Methods: We are reporting upon 54 cases which include a follow-up after 1 year. The mean follow-up is 13.7 months.

Results: Pain decreased from 2.97 to 0.26 on a scale of 4. Range of motion in flexion and extension has been improved by a few degrees. Prono-supination increased from 20–153° to 20–175°. This functional result has been obtained in an average of 5 weeks, with self-mobilisation in 60% of the cases. Early immobilisation used a splint for 3 weeks only. Bone healing was obtained in a mean of 5.3 weeks. The Quick Dash was 35.14 at follow-up. Pain in particular was improved.

Conclusions: The rapidity in which the results were obtained is in and of itself a major argument in the effectiveness of this method. This technique has greatly simplified the ulnar shortening with rapid postoperative results. This method is recommended for ulnar shortenings less than 4 mm.

A-0194 Pyrocardan® implant: free pyrocarbon interposition for resurfacing trapeziometacarpal joint

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Objectives: The aim of our study was to evaluate preliminary results of the Pyrocardan®, a new pyrocarbon implant for trapezio-metacarpal joint in the treatment of early trapezio-metacarpal osteoarthritis: Dell or Eaton stages (I or II).

Methods: The rectangular-shaped implant is a free trapezio-metacarpal resurfacing spacer with two concave tubular surfaces opposed perpendicularly to one another. Its central thickness is 1 mm. It is inserted through a dorsal approach by folding over a dorsal capsuloligamentous flap from the base of the first metacarpal, or an anterolateral approach. Bony resections are performed inside the joint and involve only the extremities of the trapezoid and metacarpal saddles. No ligamentoplasty was needed. Our prospective study concerned a continuous series of 31 patients with an average age of 58 years. Mean follow-up was 24.6 months (18–30 months).

Results: No revision surgery was needed. All patients increased their range of motion and their strength to numbers equivalent to the controlateral side. Pain score greatly improved from an average 7.1 out of 10 points pre-operatively to 1.3 post-operatively. The average PRWE and QuickDash functional scores were, respectively, 66.2 and 53.1 pre-operatively and 11.3 and 9.6 post-operatively. On control radiographs, the implants remained in their initial position and no adverse effects on the bone or the surrounding soft tissue were observed.

Conclusion: Preliminary results of the Pyrocardan® are promising. This implant is modestly invasive and well tolerated. It is a valid alternative to other surgical techniques in the treatment of early stages of trapezio-metacarpal osteoarthritis. It does not jeopardize the use of more conventional arthroplasty techniques in case of failure.

A-0195 MMP-2, MMP-9 and MMP-12 expression in flexor tenosynovium in idiopathic carpal tunnel syndrome

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Introduction: It is well known that main pathological in idiopathic carpal tunnel syndrome finding includes proliferative atherosclerotic change in flexor tenosynovium. This pathological change is closely related to decreased elastin within and around vessels. Elastin can be degraded by MMP-2, 9, and 12. However, it is not clear which MMPs are involved in degrading elastin. The purpose of this study is to investigate expression of the MMPs with regard to elastin degradation.

Materials and methods: The study groups consist of a patient group with idiopathic carpal tunnel syndrome and control group comprising fresh frozen cadavers without known symptoms of carpal tunnel syndrome. The specimens used were flexor tenosynovium obtained from 11 patients with idiopathic carpal tunnel syndrome and 12 fresh frozen cadavers. All specimens were embedded in paraffin block. Section slides 5 μ m thick were made for staining. Elastin was stained by elastic van Gieson staining. The relative amount of elastin was measured by image analysis using a light microscope. MMP-2, 9, and 12 expression was evaluated by immunohistochemical staining. The MMP-2 and 9 expression rates were calculated from the percentage of positive cells. MMP-12 expression was measured by image analysis.

Results: MMP-2 and 9 were mainly stained at cytoplasm of fibroblasts and entire vessel walls, while MMP-12 was stained widely in extracellular matrix and vessels. The staining intensity of MMP-12 was less than that of MMP-2 and MMP-9. The average amount of elastin was 2.00 ± 0.45 in the patient group and 3.35 ± 0.75 in the control group ($p < 0.05$). The percentage of MMP-2-positive cells was $66 \pm 15\%$ in the patient group and $27 \pm 16\%$ in the control group ($p < 0.05$). The percentage of MMP-9-positive cells was $82 \pm 18\%$ in the patient group and $37 \pm 26\%$ in the control group ($p < 0.05$). The expression rate of MMP-12 was 2.18 ± 0.87 in the control group and 1.16 ± 1.11 in the patient group ($p < 0.05$).

Conclusion: it is suggested that the elevated expressions of MMP-2, MMP-9 and MMP-12 are related to atherosclerotic changes with regard to elastin degradation in idiopathic carpal tunnel syndrome, and may be associated with fibrosis of collagen fibrils changes in tenosynovium.

A-0197 Post-operative night splinting for 12 weeks is no better than 6 weeks in Dupuytren's disease: a prospective randomized trial

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Purpose: Controversy surrounds the use of postoperative splinting following surgery for Dupuytren's disease. Many believe splinting prevents early recurrence of contracture; however, much of the information about its value as a therapeutic tool is based upon empirical evidence. Further controversy exists on the duration of splinting. We investigated the duration of static night splinting on recurrence of flexion contracture and range of motion following fasciectomy.

Methods: This prospective randomized controlled trial was undertaken at Austin Health. Patients with Dupuytren's contracture had fasciectomy. Following 1-2 weeks in a volar plaster slab applied in theatre, subjects were randomized into two groups of static night extension splinting for either 6 or 12 weeks postoperatively. In total, 250 subjects with 311 affected metacarpophalangeal (MCP) joints and 223 affected proximal interphalangeal (PIP) joints were randomized. Range of motion measurements were taken pre-operatively, then at the following time points postoperatively: 1-2 weeks, 3 weeks, 6 weeks, 12 weeks, 18 weeks, 24 weeks and 1 year.

Results and conclusions: We found that night splinting for 12 weeks following surgery had no extra benefits than night splinting for 6 weeks. No significant differences were found between the two groups in terms of achieving and maintaining joint extension or regaining joint flexion after surgery. As the joint was not violated in the operative procedure, it was suggestive that post-operative night splinting during the fibroblastic phase of wound healing was sufficient to prevent early recurrent joint deformity due to scar contracture. Importantly, the use of night splinting did not adversely affect the ability to regain active joint flexion as MCP, PIP and distal interphalangeal joint flexion were regained to preoperative levels during the 18-week postoperative follow-up period in both groups.

A-0198 The effect of dividing muscles superficial to the transverse carpal ligament on carpal tunnel release outcomes

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Purpose: We aimed to test the hypothesis that division of muscle fibers lying over or within the transverse carpal ligament (TCL) in an open carpal tunnel release does not have an effect on outcomes in patients with carpal tunnel syndrome (CTS).

Methods: A total of 152 patients with a mean age of 57 years (range, 31–83) diagnosed with CTS were enrolled for intra-operative observation of the muscles overlying or within the TCL as seen through the 3rd web space incision of 3 cm length. These muscles when present were also incised layer by layer in line with division of the TCL with special care to the motor branch. Patients were divided into three groups according to the extent of the muscles covering the TCL. The three groups were compared for outcomes of surgery at 6 months in terms of the Boston and DASH scores, grip and pinch powers, and scar pain.

Results: Some 75 patients (49%) had a purely ligamentous TCL (group I), 52 patients (34%) had muscle fibers covering less than 50% of the incision length (group II), and 25 (16%) had muscle fibers covering more than 50% of the incision length (group III). There were no differences in the postoperative Boston symptom and function scores and the DASH scores among the groups. In addition, there were no differences in the grip and pinch strengths and scar pain. There was no case of motor branch injury.

Conclusions: Division of the muscles overlying or within the TCL in line with the 3rd web space incision does not affect postoperative outcomes after carpal tunnel release in terms of the Boston and DASH scores, grip and pinch powers, and scar pain.

A-0199 Vitamin D levels in postmenopausal Korean women with a distal radius fracture

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Introduction: The purpose of this study was to investigate serum levels of vitamin D in postmenopausal Korean women with a distal radius fracture (DRF), and to determine if there is any association between vitamin D levels and bone-related variables such as bone mineral densities (BMDs), serum parathyroid hormone (PTH) levels, and several bone turnover markers.

Materials and methods: The data of 104 postmenopausal women surgically treated for a distal radius fracture (DRF group) and 107 age-matched control

patients without a fracture (control group) were compared. Serum vitamin D levels (25-hydroxycholecalciferol, 25(OH)D3) were compared between the groups with consideration of age and seasonal variations. BMDs, serum PTH, and several bone turnover markers including serum osteocalcin, C-telopeptide, and urine N-telopeptide were measured and analyzed to find any association with vitamin D levels.

Results: The mean 25(OH)D3 level was significantly lower in the DRF group compared with the control group ($p < 0.001$). In particular, patients in their sixth and seventh deciles in the DRF group had significantly lower 25(OH)D3 levels than patients in the control group ($p = 0.001$ and 0.013 , respectively). When seasonal variation was considered, significant differences of 25(OH)D3 levels were found between the groups in autumn and winter. Hip BMDs were significantly lower in the DRF group than in the control group, and there was a positive correlation between serum 25(OH)D3 levels and hip BMDs. Bone turnover markers were not significantly different between the two groups, although serum PTH levels were marginally higher in the DRF group ($p = 0.08$).

Conclusions: Postmenopausal Korean Women With A Drf Were Found To Have Significantly Lower Serum Vitamin D Levels Than The Control Group, And Vitamin D Levels Were Particularly Lower In Women In Their Sixth And Seventh Deciles, Who May Be A Good Target Group For Prevention Of Future Fractures. Future Investigation Should Focus On Determining Whether Vitamin D Supplementation Can Be Helpful In Preventing Future Fractures In Patients With A Drf.

A-0200 Isokinetic evaluation of pronation after volar plating of a distal radius fracture

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Introduction: Pronator quadratus (PQ) is an important contributor to forearm pronation, and there is concern that volar plating of a distal radius fracture (DRF) may damage the PQ function. The purpose of this study was to determine whether isokinetic pronation strength would decrease considerably after volar locking plating of a DRF, and whether clinical outcomes would be affected by any pronation strength decrease.

Materials and methods: In this study, 34 patients of mean age of 55 years (range, 21–74 years) underwent bilateral isokinetic testing at 6 months and 1 year after open reduction and internal fixation using volar plating. Isokinetic pronation and supination strengths

were compared between the operated and normal sides. Clinical outcomes such as grip strengths, range of motions, and DASH scores were evaluated and analysed for any associations with isokinetic results.

Results: At 6 months, peak torque and total work values for both pronation and supination were lower in the operated sides than in the normal sides (all $p < 0.001$). However, at 1 year postoperatively, the differences in pronation strength were not statistically significant ($p = 0.188$ for peak torque and $p = 0.190$ for total work), while supination torque and total work were still significantly lower in the operated sides ($p = 0.015$ and $p = 0.029$ respectively). Decreases in pronation strength were found to correlate significantly with decreases in supination strength and grip power. Wrist motion and DASH scores were not found to be correlated with decreases in pronation or supination strengths.

Conclusions: In patients with a DRF treated by volar plating, pronation strength was not significantly different between the operated and normal sides at 1 year postoperatively, and decreases in pronation or supination strengths were not found to affect clinical outcomes as assessed by DASH scores. This study suggests that dissection of the PQ may have minimal clinical impact on forearm pronation function.

A-0202 Long-term results of soft tissue distraction prior to dynamic centralization in longitudinal radial deficiency type III and IV

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Introduction: Patients with longitudinal radial deficiency (LRD) type III and IV have a radial deviation at wrist level, with volarly dislocated and proximally displaced carpal bones. Immediate centralization is hindered by high tension on the soft tissue when the wrist is moved dorsal, distal and ulnar. To overcome this, soft tissue distraction with an external fixator has been introduced. We describe the long-term results on 'dynamic centralization' – stabilizing the wrist on the distal ulna without arthrodesis – following soft tissue distraction (STD) compared with 'dynamic centralization' alone.

Patients and methods: In 25 years we have seen 67 patients with a LRD type III or IV; 43 were eligible for this study, counting for 54 treated upper limbs, 23 left-sided and 31 right-sided. Some 68% of patients were male; 37 patients were syndromal. X-rays were evaluated according to Manske's measurements before operation, at an average of 2 years follow-up and at the time of this study.

Results: Mean age at first operation in the STD group was 4.8 years compared with 3.7 years in the non-distraction (ND) group. Nine hands involved type III and 46 type IV LRD. The preoperative angle of hand position was -56 and -59° for the ND and STD group, and improved to 4 and 13° , respectively, after centralization (NS). Moreover, the STD group showed improved correction in angle prior to centralization. With an improved relationship of the carpus to the ulna, centralization was experienced to be easier in the STD group. The wrist was not fused in either group at centralization. Ulna width increased with a ratio from 0.95 to 1.46 when compared with the normal opposite side. The growth plate was present in 22 out of 24 reviewed STD cases, compared with five prematurely fused growth plates in the ND group. Long-term follow-up showed an increase in radial deviation in the ND and STD group of -18 and -19° (angle between ulna and middle of the third metacarpal), respectively, after 6.7 and 5.6 years.

Conclusion: Soft tissue distraction will positively add to improving the position of the hand on the distal ulna in STD type III and IV prior to centralization, making centralization easier in balancing the wrist, without much force from the carpus on the distal ulna. The STD makes it possible to preserve the growth plate. Moreover, in the STD group the distal ulna widens in time, serving as a base for the wrist. However, relapse occurs and may be related to the severity and tightness of the primary deformity in both groups.

A-0203 Scaphocapitate arthrodesis: indications, technique and outcome in 45 cases

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Purpose: Compared with other partial wrist fusions, scapho-capitate arthrodesis, as first described by Sutro in 1946, has received much less attention. We have preferred this form of partial wrist fusion for several reasons. The surface between the scaphoid and capitate is large and congruent. There is only one articulation to fuse. The column of the thumb is not immobilized. The arthrodesis concerns the mid-carpal joint – like scaphotrapezotrapezoid arthrodesis – but the scapho-capitate fusion mass can tilt with respect to the lunate and hamate bone, which is visible on dynamic radiographs and allows for greater range of motion (ROM) in radio-ulnar deviation. The purpose of this study was to further assess the clinical value of the concept of scapho-capitate arthrodesis.

Methods: We retrospectively analyzed the clinical and radiological results of 45 patients (36 men and nine women) who underwent scapho-capitate arthrodesis. ROM measured by goniometer, and grip strength per Jamar dynamometer (Camp Ltd., NJ, USA), were recorded pre- and postoperatively for the operated wrist and compared with the opposite side. Anteroposterior and lateral radiographs were evaluated for evidence of union, proper alignment and hardware placement, and signs of adjacent osteoarthritis. Pain was evaluated on a scale from 1 indicating no pain and 4 indicating persistent or severe pain.

Results: Union was achieved in 42 of 45 patients; 14 were manual workers, and 15 were work accidents. There were 26 right and 19 left wrists, of which 28 concerned the dominant wrist, and 19 had surgery prior to scapho-capitate arthrodesis. The mean age was 39 years. The most frequent indication was scapho-lunate instability in 30 cases, followed by Kienböck's disease in 10, scaphoid nonunion in three, chondrocalcinosis in one, and midcarpal instability in one, respectively. At a mean follow-up of 103 months, grip strength averaged 65% of the uninjured side. Postoperatively, the average ROM was 39° in flexion, 48° in extension, 13° in radial deviation and 27° in ulnar deviation, respectively. Pain could be diminished from 3.05 preoperatively to 1.21 at latest follow-up. Complications included three nonunions, three deep infections and one postoperative complex regional pain syndrome.

Conclusion: Our data demonstrate that scapho-capitate arthrodesis is an effective procedure that allows for good long-term functional outcome, provided that surgical technique is adequate.

A-0206 Posttraumatic arthritis: can total wrist arthroplasty (TWA) be an option?

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Purpose: Little evidence is available concerning the indication for and the results after total wrist arthroplasty (TWA) in posttraumatic arthritis. The purpose of this study was to analyze the data in the European Re-motion database on this topic.

Methods: The Re-motion database continuously collects and analyzes data provided by users of the Re-motion TWA. It is entirely web based, administrated

by two of the authors (MB and GH), independent of industrial interests and financed by university funds. To date, data on 218 cases have been collected. Of these, 40 were posttraumatic. For the present analysis, only data from centres that have contributed with at least 15 cases, and only cases with at least 2 years follow-up have been considered: 103 consecutive cases in total.

Results: Diagnosis: 74 inflammatory arthritis, 18 posttraumatic (distal radius fx, SLAC or SNAC), eight degenerative arthritis and three others. Mean follow-up time 4 (2–8) years. Pain (VAS 0–10) improved: 6.9 preop and 0.45 at follow-up for the posttraumatic vs. 7.0 and 0.55, respectively, for the total sample. QuickDASH (0–100) improved: 52 and 41 vs. 56 and 36, respectively. Grip strength (kgF) improved: 18 and 21 vs. 10 and 15, respectively. Motion in wrist did not change significantly in any direction or subgroup. Radiology: in the posttraumatic group 22% presented some degree of osteolysis. In the non-traumatic group 10% presented some degree of osteolysis and 4% presented definite loose implants. The probability of implant survival was identical in both groups: 90% at 8 years. Comparison of the probability of implant survival for low-demand patients (age >60 years AND inflammatory arthritis) with high-demand patients (age <60 AND other diagnoses) showed a significant lower implant survival in high-demand patients.

A-0207 Trapesometacarpal arthrosis – tendon interposition or suspension arthroplasty?

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Purpose: Severe arthrosis of the thumb carpometacarpal (CMC) joint in our unit is treated by two different methods. The resection of the trapezium is followed in some cases by a suspension and interposition arthroplasty with the APL tendon (Eaton–Littler) or only by an interposition of the split FCR tendon (modified Epping). Our purpose was to analyse and compare the results of these two methods.

Materials and methods: All 56 patients who underwent the above two procedures in our department during the last 3 years were included in this retrospective study, except six cases who were lost to follow-up. The mean follow-up time was 6 months. The functional outcome of the two operative methods was measured by the means of range of motion of the thumb, grip and pinch strength and pain. We used a subjective visual pain score as well as DASH score to quantify our findings.

Results: Out of the 50 hands of 50 patients (48 females, two males) included in this study, 24 had Eaton–Littler ligament reconstruction and 26 had modified Epping tendon interposition. Postoperative pinch grip, key grip, three finger grip and power grip was significantly weaker pre-operatively in both groups. We found no statistically significant differences in the subjective and objective outcome measures between the Eaton–Littler group and the modified Epping group. The two methods gave an excellent result in 85% of the cases, good results in 10% of the cases and fair results in 5% of the cases.

Conclusions: Our results are comparable with the corresponding figures in the literature. In our study the Eaton–Littler ligament reconstruction and the modified Epping interposition technique for the operative treatment of unsalvageable thumb CMC joint osteoarthritis proved to be equally effective in our hands. Due to this we can conclude that suspension of the first ray does not contribute significantly to higher success and patient satisfaction.

A-0208 Reliability of teardrop angle measurement in the intra-articular distal radius fractures

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Purpose: There have been several radiological parameters of fracture displacement in distal radius fractures. Recent studies have shown importance of teardrop angle (TDA) as an indicator of intra-articular displacement, but there is lack of information about the reliability of the TDA. The purpose of this study was to measure the TDA in distal radius fracture wrists and to examine intra-observer and inter-observer reliability between different examiners.

Methods: We extracted 20 distal radius intra-articular fractures in our institution. All fractures had an intra-articular involvement, which was judged by computed tomography. The teardrop was identified as a volar rim of the lunate facet of the radius on the lateral wrist view, and the TDA was determined as an angle between the central axis of the teardrop and the central axis of the radial shaft. Three observers independently measured the TDA, and intra-class correlation coefficients (ICC) were calculated.

Results: The TDA was a mean of 55° in non-fractured wrists and 43° in fractured wrists. Inter-observer ICC TDA values were 0.28 (fair agreement) in uninjured wrists, and 0.93 (almost perfect agreement) in injured

wrists. Intra-observer ICC values were 0.64 (substantial agreement) in uninjured wrists, and 0.95 (almost perfect agreement) in injured wrists.

Conclusions: There were lower agreements of TDA in uninjured wrists compared with injured wrists. The lower agreement of the TDA in uninjured wrists was due to the fact that the teardrop was not clearly delineated, leading to variable reliability. Inter- and intra-observer reliabilities in the injured wrists showed an almost perfect agreement. Because radial inclination of the injured wrists was decreased by 10° with a displacement of the distal fracture fragment, a clear visualization of the teardrop was provided (10° tilt view), increasing the reliability of the TDA measurement.

A-0226 The motor branches of the median and ulnar nerves in the forearm

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Objective: To investigate the topographical anatomy of the motor branches of median and ulnar nerves in the forearm.

Method(s): From July to August 2011 20 forearms were dissected. There were three female and seven male corpses. The forearms were measured with a regular ruler. In this procedure the elbow articular line (determined by the medial and lateral epicondyles of the humerus), and the wrist articular line (determined by the styloid processes of the radius and ulna) were taken as reference. The median and ulnar nerves and their muscular branches were identified proximal to the elbow articular line and until carpal tunnel and Guyon's canal. The nervous branches were measured in respect of the elbow articular line, using the analog rule. According to the obtained data, the means of the lengths of the forearms and the motor branches of median and ulnar nerves, the number of nervous branches and the penetration points of the nervous branches could be calculated.

Result(s): The forearm length varied from 23.5–29.0 cm, with average length of 27.3 cm. The number of branches of the median nerve to the muscles (except the anterior interosseous nerve) varied from 8–10, with an average 9.22 branches. In the pronator teres there were three branches extending from the median nerve at the average distance of 0.5 cm from the elbow articular line, with length of 4.2 cm, 4.5 cm, and 6.5 cm. Palmaris longus had one branch, at an average distance of 1.3 cm, with length of 7.7 cm. Flexor

carpi radialis had one branch, at an average distance of 2.1 cm, with length of 10.7 cm. Flexor digitorum superficialis had four branches at average distance of 0.5 cm, 3.0 cm, 11.0 cm and 18.0 cm from the line of the elbow, and their lengths were 7.5 cm, 10.7 cm, 3.5 cm and 2.8 cm, respectively. The number of branches of the ulnar nerve to the muscles varied from 3 to 4, with an average 3.97 branches. In the flexor carpi ulnaris there were three branches extending from the ulnar nerve at average distance of 1.0 cm, 2.0 cm, 8.5 cm from the elbow articular line, with length of 3.5 cm, 7.0 cm, and 7.0 cm, respectively. Flexor digitorum profundus had one branch, at average distance of 3.5 cm, with length of 5.5 cm.

Conclusion(s): Topographic anatomy of the muscular branches of the median and ulnar nerves in the forearm is fairly constant. In our opinion, branches to the pronator teres, flexor digitorum superficialis and flexor carpi ulnaris are the most suitable sources of motor fascicles for nerve transfers in the forearm.

A-0227 The perivascular sympathectomy at the fracture of the distal radius complicated complex regional pain syndrome 1 type

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Objective: The surgical treatment of fracture distal radius-complicated complex regional pain syndrome (CRPS) is a serious problem. Open reduction and internal fixation are quite surgically aggressive, and are contraindicated in CRPS 1 type.

Method(s): From January 2009 to December 2011, 17 patients (14 women, three men) who had a mean age of 56 years (49–68 years) with distal radius fracture and CRPS were treated. Mean time after fracture was 9 days (4–23 days). All patients before admission to hospital had closed manual reduction. CRPS symptoms appeared after an average of 2–3 days: pain, swelling of the wrist and fingers. For clinical investigation we used X-ray, CT, examination of range of motion, grip strength and VAS scale, computer thermography. According to laser Doppler flowmetry all patients were diagnosed with sympathetically dependent CRPS. The operation consists of simultaneous brachial artery and vein sympathectomy on the level of shoulder for 6 cm and open reduction internal fixation (ORIF) of the distal radius with angle volar plate.

Result(s): All patients pre-operatively had a mean score of 8 (6–9) on the VAS scale. Perivascular sympathectomy (brachial artery and vein) on the level of the shoulder decreased sympathetical activity in 75–85% of all the patients according to laser Doppler flowmetry. In the first 7 days after the operation there was a decrease in pain of 3–4 points. Relief of pain and 0–1 points were achieved within 2 weeks after the operation. This pain level makes early rehabilitation possible, with satisfactory movement 3–4 weeks after the operation. Regression of oedema, wrist and fingers occurred 3 weeks after surgery.

Conclusion(s): Simultaneous operative procedures for treatment of distal radius fractures complicated by type 1 CRPS is very promising method which allows improvement of patients' quality of life, and reduces the length of patients' disability.

A-0228 Re-innervation of the skin following nerve autograft reconstruction in a rat model

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Purpose: For the reconstruction of large, traumatic, peripheral nerve defects, the nerve autograft is still considered the best strategy. However, epidermal sensory recovery following reconstruction has not yet been fully investigated. Epidermal sensory nerve fibers consist of peptidergic (visualized with CGRP and Substance P) and non-peptidergic fibers (visualized with P2X3). These fibers are responsible for all sensory input and one of the key's signals is transferring noxious stimuli and thermal nociception. The A delta fibers are myelinated fibers – labelled with NF200 – and represent a group of fibers responsible for mechanical and thermal stimuli and for the fastest transmission of noxious stimuli. This study investigates the re-innervation of these different skin neural fibers in the rat foot sole, 12 weeks after reconstructing a nerve defect with an autograft.

Methods: In five animals, a 15 mm sciatic nerve defect was reconstructed using an autograft. Five healthy animals served as control. Von Frey hairs were used to assess the mechanical threshold and sensibility after reconstruction. Twelve weeks after grafting, the sole of the foot of the operated hindpaw was excised and stained according to the necessary protocols for

CGRP, Substance P, P2X3 and NF200. Control staining was performed with PGP 9.5 (a pan-neuronal marker). The fibers were counted in the distal and proximal section of the footpad. In addition, individual countings were performed for epidermal, crossings and dermal skin. Re-innervation percentages are based on the number of fibers in the epidermal-dermal crossings of the skin.

Results: Twelve weeks after grafting, the withdrawal response of the operated paw was significantly delayed as compared with the healthy control response. The operated leg showed a significant increase in the withdrawal threshold, compared with the healthy control ($p = 0.019$). The mean threshold for the animals treated with the autograft was 10.7 g (SD \pm 3.09) in contrast to the threshold for healthy animals, which showed a withdrawal reaction at 8.5 g (SD \pm 2.23). All markers showed significant differences between both groups. Overall re-innervation of the skin sensory nerve fibers stained with PgP 9.5 was 70%. The peptidergic fibers (CGRP and Substance P) had an average re-innervation of 70%, and the non-peptidergic fibers (P2X3) regenerated up to 35%. The myelinated fibers had a 80% re-innervation.

Conclusions: This is the first study to demonstrate the re-growth of different nerve fibers in the dermis and epidermis after nerve injury. At 12 weeks post-reconstruction the foot sole is not fully re-innervated. The CGRP and Substance P-stained fibers had a stronger regeneration than the P2X3 fibers. In general, the peptidergic fibers were shown to have a higher number of marked fibers compared with the non-peptidergic (i.e. P2X3) fibers. The specific NF200-marked myelinated fibers had the strongest re-innervation, which could be explained by the fact that for survival, vital sensory transmission is the most important factor and will therefore regenerate the fastest.

A-0230 Recurrence rates in patients with Dupuytren's Contracture 3 years after successful treatment with collagenase *Clostridium histolyticum*

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Australia, Auxilium Pharmaceuticals, Malvern, USA, Pfizer Ltd., Surrey, UK, Pfizer Inc, Groton, USA

Purpose: Collagenase *Clostridium histolyticum* (CCH), recently approved in Europe, is an effective, minimally invasive and well-tolerated treatment for Dupuytren's contracture (DC). An ongoing, prospective 5-year follow-up study (CORDLESS) enrolled patients with DC who participated in Phase III clinical studies of CCH treatment and had at least one fixed flexion contracture (FFC) measurement. This analysis reports efficacy/safety and recurrence rates 3 years after CCH treatment.

Methods: The CORDLESS study enrolled patients with DC from all five previous phase 3 clinical studies of CCH; patients were evaluated annually for recurrence starting at 2 years after CCH injection. Detailed history, examinations, additional treatments for DC and complications were recorded. Recurrence was defined as (1) increase in contracture of $\geq 20^\circ$ and finding of palpable cord; or (2) the joint receiving further medical/surgical treatment. In addition, a post hoc analysis defined recurrence as a $\geq 30^\circ$ increase in joint contracture, a commonly used clinical threshold for secondary surgical intervention in published literature. Recurrence incidence by baseline disease severity was also calculated. Low baseline severity was defined as FFC $\leq 50^\circ$ for metacarpophalangeal (MP) joints and $\leq 40^\circ$ for proximal interphalangeal (PIP) joints, and high baseline severity FFC $> 50^\circ$ for MP and $> 40^\circ$ for PIP joints.

Results: A total of 602 patients (84% male, mean (SD) age 66.0 (9.2) years) were evaluable at Year 3. Of 1080 treated joints, 623 (58%) achieved clinical success (FFC of affected joint improved to 0–5°). By year 3, 35% (217/623) of successfully treated joints had recurrence ($\geq 20^\circ$), in 27% (120/451) of MP and 56% (97/172) of PIP joints. By 3 years, 138 joints (22%) met the $\geq 30^\circ$ definition of recurrence; rates were 16% in MP joints and 38% in PIP joints. In successfully treated joints, lower severity at baseline was associated with lower recurrence rates in PIP (50% low vs. 71% high) but not in MP joints (28% low vs. 18% high). Mean FFC for nonrecurring joints (MP 2.8°; PIP 7.8°) was nearly the same as mean FFC at time of initial success (MP 1.2°; PIP 1.7°). Mean FFC for the recurrent joints at Year 3 (MP 32.8°; PIP 36.7°) were below the pretreatment levels (MP 36.5°; PIP, 40.1°). Approximately 7% of joints underwent medical (CCH) or surgical intervention for recurrence by Year 3. No new long-term adverse events (AEs) or serious AEs related to previous CCH treatment were observed.

Conclusions: This analysis indicates that CCH is effective and well tolerated in patients with DC 3

years after initial treatment and treatment response is durable. Using 20° and 30° definitions, overall recurrence rate by Year 3 of this study was 35% and 22%, respectively. Recurrence was more common in PIP than MP joints, in line with published surgical literature. Less severe PIP contracture at baseline resulted in better outcomes. The absence of new or serious AEs at indicates a good long-term tolerability profile for CCH.

A-0234 De Quervain's disease: multidisciplinary consensus achieved on treatment guidelines – results from the European HANDGUIDE study

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Purpose: The aim was to achieve multidisciplinary consensus on treatment guidelines for De Quervain's disease.

Methods: First a systematic review was finalized on the effectiveness of surgical as well as non-surgical interventions to treat De Quervain's disease. Based on the presence and absence of such evidence, the Delphi consensus strategy was used to develop the guideline. Hand surgeons (FESSH), hand therapists (EFSHT), and P&RM physicians were asked to participate in a Delphi consensus strategy by delegating experts in the field of hand surgery and rehabilitation.

Results: Within the European HANDGUIDE study, Delphi consensus strategies were used to achieve consensus on treatment guidelines for five non-traumatic hand disorders: trigger finger, De Quervain's disease, Dupuytren's disease, carpal tunnel syndrome, and Guyon canal syndrome; 112 experts (hand surgeons, hand therapists and PR&M physicians) from 17 European countries participated to achieve the consensus. One of the disorders on which already consensus is achieved is De Quervain's disease. To achieve consensus for this part of the HANDGUIDE study 35 experts cooperated.

Conclusions: Multidisciplinary consensus is achieved on treatment guidelines for De Quervain's disease. These guidelines may not only guide hand surgeons, hand therapists, and P&RM physicians specialized in hand rehabilitation, but may also help other health-care professionals in treating these patients in clinical practice.

A-0237 A new approach to assess the gastrocnemius muscle volume in rodents using ultrasound; comparison with the Gastrocnemius Muscle Index

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Purpose: In the quest to improve outcome following peripheral nerve surgery, not only results count, but also the rate and quality of nerve regeneration. One of the key evaluation techniques in the evaluation of peripheral nerve regeneration in reconstruction models is the Gastrocnemius Muscle Index (GMI). This determination of the muscle mass is the current gold standard for quantifying muscle atrophy after nerve injury and nerve regeneration in animal models. However, since this technique is a sacrificial procedure it is desirable to develop a new technique. The purpose of this study was to determine whether the application of ultrasound in assessing the gastrocnemius muscle noninvasively after nerve denervation is a reliable and accurate measure of muscle mass compared with the GMI.

Methods: In sixteen male Wistar rats an 8 mm nerve gap was created in the sciatic nerve. In the following 2-month period, the gastrocnemius muscle in a pair of rodents was examined by two different ultrasound systems. Afterwards, both animals were sacrificed to determine the GMI. During the ultrasound recordings, the location used to measure muscle thickness was standardized to find the most reproducible measure of the gastrocnemius muscle at, or close to, its thickest point. The standardized protocol consisted of identifying three pre-defined anatomical landmarks in: 1) the fibula bone, 2) the peroneal nerve, and 3) the junction between the most distal point of the semitendinosus muscle and gastrocnemius muscle. After identifying these three anatomical landmarks, we measured the muscle thickness as the diameter of the muscle between the third anatomical point and perpendicular to the peroneal nerve and to the fibula bone. In a sacrifice procedure, the gastrocnemius muscles were removed and the GMI calculated.

Results: The three anatomical landmarks could be unambiguously identified. One week after the nerve defect was created, a steep decline of muscle weight of 24% was already encountered. In the following weeks, the weight further decreased and then remained stable from 6 weeks onwards, resulting in

a maximal decrease muscle weight of 82%. The correlation coefficient between the muscle diameter and weight using both ultrasound systems was >0.96 . The inter-observer reliability between the two investigators was excellent for both devices on the operated side (0.99 for both) and good for the non-operated site (0.84 and 0.89 for both systems). At sacrifice, the difference between GMI ratio and the muscle thickness ratio atrophy generally did not differ more than 5% with two outliers of approximately 13%.

Conclusions: We have developed a new highly reliable and reproducible technique for quantifying muscle atrophy after nerve injury. This technique allows serial measurements in the same animal over time. This is a significant advantage compared with the conventional technique for quantifying muscle atrophy (i.e. the GMI), which requires sacrificing the animal.

A-0242 Diffuse noxious inhibitory control in patients with posttraumatic cold intolerance

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Introduction: Diffuse noxious inhibitory control (DNIC) is a phenomenon whereby wide dynamic range neurons are inhibited through the central nervous system by noxious stimuli applied to another body part. DNIC is abnormal in pain syndromes such as fibromyalgia and migraine. Because the pathophysiology of cold intolerance in patients is still unknown, this study investigates the role of this excitatory and inhibitory system on pain perception in patients with cold intolerance.

Methods: Fifteen healthy controls and 29 patients diagnosed with cold intolerance using the Cold Intolerance Symptom Severity (CISS) questionnaire were included. The patients consisted of 11 patients with peripheral nerve lesions, 13 with an amputation of one or more digits, and five with a hand fracture. The pain threshold for mechanical pressure was measured at the affected region. Then, the contralateral hand received a cold stimulus of ice water to evoke the noxious conditioning. After the cold stimulus, the pain threshold for mechanical pressure was determined again.

Results: We found a significantly higher threshold for mechanical pain after the noxious conditioning in both controls (pre-conditioning 8.0 kPa \pm 2.8 versus post-conditioning 10.8 kPa \pm 3.3, $p<0.01$) and patients (pre-conditioning 8.3 kPa \pm 3.0 versus post-conditioning 9.5 kPa \pm 3.7, $p<0.01$). Comparing the controls with the patient group, we found a significantly ($p<0.01$) lower threshold for the patient group.

Conclusions: In this study, we found a DNIC response after a cold stimulus in both controls and patients. We can conclude that patients with cold intolerance show a weaker DNIC response compared with the controls, as also found in other chronic pain conditions. These results suggest that the conditioned pain modulation system within patients with cold intolerance is altered.

A-0249 Surgical treatment of severe forms of Dupuytren's contracture

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Introduction: Treatment of Dupuytren's contracture, a desmogenic progressive contracture of the fingers, is a still unresolved problem. In the specialized department of hand surgery between 1998 and 2009, we treated 1682 patients with Dupuytren's contracture. The patients were mostly male (87.8%), in the 60–70 years age group (32%). There were 1605 (96%) patients with severe Dupuytren's contracture (III, IV, V degree). Relative to their work activity, persons whose jobs were associated with physical work and extended tension of their wrist and hands (65%) predominated. In most cases, the patients who were operated on had contracture of IV degree (55.1%). Onset of the disease was more likely to occur on finger IV (40.7%). Severe contractures developed predominantly on the fourth and fifth fingers, and most often affected one or two of the fingers.

Methods: For the best surgical approach to aponeurosis, we used sections parallel to palmar creases of the hand and fingers. Application of transverse sections, parallel to palmar creases along the altered palmar aponeurosis, followed by separation of the skin from palmar aponeurosis within the healthy tissue, allows the most complete removal of the scar tissue taenia. Z-plasty is indicated in bundled forms and recurrent Dupuytren's contracture in the presence of keloid strands. In such case, Z-plasty-displaced flaps are executed both on the fingers and hand without excision of aponeurosis in the area of triangular flaps. In order to prevent any development

of necrosis, the flaps are cut out together with the aponeurosis. As a result of amended lines of force in the manipulated tissue, the pathological process in the aponeurosis acquires a tendency toward regression. When expressed arthrogenic changes were noted with tissue rigidity, application of a distraction device is indicated, distracting some 2–3 mm per day in three stages. If there is a tightening scar, severe stiffness of tissues, or scar-modified cicatricial skin changes with the underlying tissues, oblique incision of the scar was performed before applying the distraction device. Fixation in the device lasted up to 2 months. In all cases, the applied method of treatment was very effective.

Results: Long-term results of the operations were studied for 6 months to 5 years in 82% of patients. Assessment of treatment results has been carried out only in severe-group patients (III, IV, V degree of Dupuytren's contracture). Good results were obtained in 66%, satisfactory in 24.3%, and unsatisfactory in 9.7% of all cases. It should be noted that, despite the poor results, in almost all of these patients we obtained improvement in hand function.

Conclusions: Our positive treatment results, obtained in 90.3% of cases, support the effectiveness of the proposed methods of treatment, and may justify recommendation for incorporating the developed treatment methods into the practice of medical institutions.

A-0252 Long-term outcome of trans-scapho-perilunate fracture dislocations: comparison of objective, subjective and radiological findings

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Introduction: Trans-scapho-perilunate dislocations result from high-energy trauma on the hyperextended or flexed wrist. Mostly young male patients with a risk profile for private activities are affected. The acute treatment is based on reduction of dislocated fragments, accurate fixation and reconstruction of the damaged bony and fibrous structures. However only a few reports on long-term follow-up are published. We aimed to investigate and correlate long-term follow-up with objective clinical data, subjective patient data and radiological data from x-rays and magnetic resonance imaging (MRI).

Methods: Twenty patients treated in our clinic from 1994–2008 were analyzed and examined for outcome. All patients had been treated with open reduction,

scaphoid reduction and fixation and temporary fixation of the lunotriquetral interval with K-wires. Mean follow-up was 67 months (25–145).

Results: The grip force was 86% and wrist motion angle reached 82% of the healthy opposite side. Of these patients, 16 were satisfied with the results (PRWE mean score 24.05; SF-36 mean score 77.58). The radiological evaluation showed little change in scapholunate angle, carpal height, width of scapholunate interval, while osteoarthritis was present in all cases in MRI visualization.

Conclusions: From our data we conclude that adequate reconstruction of all damaged structures results in good clinical outcome. Function remains stable over a long period of time. Patients are satisfied and have good subjective scores despite poor appearance on MRI.

A-0253 Brunelli pull-out technique in flexor tendons repair in zones II: new results

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Purpose: Reconstructing the continuity of long fingers' flexor tendons in zones II and III still raises problems from operative point of view. One of the surgical methods with a great success rate for zone II lesions is the pull-over technique described by Brunelli. In this paper we will present the modifications proposed by us for this technique, as well as the indication's expansion for lesions in zone III.

Method: The study refers to 65 cases involving flexor tendon lesions in zone II and III, operated in our service since the year 2000 to date. Of these, 58 were zone II lesions and seven were zone III lesions. Lacking the very long and highly curved needles used by Brunelli, we modified the initial technique by starting from the proximal towards the distal area and used two straight needles and continuous threads. In addition, and especially for the zone III lesions, we incised the digital skin until near the insertion area of the flexor digitorum profundus and the suture thread was passed through the tendon in one or more steps to reach the distal end of the tendon. In 42 cases we used non-absorbable sutures that were removed after 21 days, and in 23 cases absorbable sutures, that were only cut after 21 days. In 57 cases the surgical procedure took place under regional anesthesia that allowed the reinforcement of patient's psychological motivation, seeing favorable results during surgery. The recovery started from the first post-operative day with passive fingers mobilization, and

48 h after the surgery we initiated active against-resistance mobilization.

Results: The patients were followed for 3–24 months after the surgery. We obtained a complete flexion in 32 patients; in seven patients we had a flexion deficit of 5–10°, in 19 patients we had a 10–20° flexion deficit, and in seven cases we had a 20–30° flexion deficit (all of them having zone III lesions). All the patients were able to resume social life and work after a maximum 45 days. We had no rupture cases and tenolysis was necessary in only five cases (patients with complex traumas).

Conclusions: We consider that Brunelli's technique is a very good method for zone II lesions, and that the modifications proposed by us allow a broadening of its field of indications

A-0254 An experimental study to determine and correlate choline acetyltransferase assay with functional muscle testing after nerve injury

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Purpose: Choline acetyltransferase (CAT) is an assay based on the synaptic pathway in motor neurons. CAT is an enzyme that is synthesized within the body of a neuron during communication between the pre- and postsynaptic neurons. Axoplasmic flow results in transferring the CAT to the nerve terminals and helping CAT connecting to choline. This connection results in the neurotransmitter acetylcholine. To be able to quantify CAT – in theory – is therefore a way of determining not only motor neuron function, but could also assist differentiating between motor and sensory fibers. Therefore the purpose of this study was (1) to determine the CAT activity in the normal and injured sciatic / peroneal nerve in a rat model; (2) to evaluate the correlation between CAT and the motor recovery; (3) to find the relationship between CAT activity and the isometric muscle force; and (4) to elucidate the parallel between the CAT activity and Karnovsky staining.

Methods: Sixty animals were divided in three groups. Group 1 comprised a sciatic nerve transection without repair, in Group 2 the transected nerve was reconstructed, and in Group 3 a crush injury was applied, followed by transection and reconstruction. Twelve weeks after surgery all animals were tested for the maximal isometric tetanic force in their tibial anterior muscle and the muscle weight was evaluated. Acetyl cholinesterase activity (AChE) and CAT activity were determined histologically.

Results: For the isometric tetanic force measurement and the tibial anterior muscle weight index (TAMI) there was a significant difference comparing Group 1 with Group 2 and Group 3 ($p < 0.0001$). Comparing Group 2 and Group 3 no significant difference was found ($p > 0.05$). The correlation between the force measurement and the TAMI was 0.382. For both the AChE measurement and CAT activity, significant differences were found between the amount of fibers in the operated nerve and the contralateral nerve, as well as differences in percentage of recovery between the three groups. The correlation between the isometric tetanic force measurement and the CAT analysis in Group 1 and 2 was 0.468. The correlation for the AChE staining and the isometric tetanic force measurement was 0.111. The correlation between the wet muscle weight and the CAT levels was 0.773. The correlation between the TAMI and the AChE stained fibers was 0.640. Correlating AChE staining to the CAT analysis we found a correlation for $r = 0.712$.

Discussion: This study showed a high level of variability in the CAT activity of both the injured and normal nerve. We evaluated the correlation between CAT and the motor recovery; which proved to be weak since both the GMI and the isometric tetanic force measurements did not correlate highly with the CAT levels. The fourth goal was to illustrate a possible correlation between AChE staining and CAT levels, which proved to be weak ($r = 0.712$). Thus, the huge variability in both groups and the weak correlations to the functional muscle assessments and the AChE staining do not encourage continuation of this evaluation technique.

A-0258 Metacarpal shortening: methods of lengthening

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Introduction: Shortening of metacarpal bones is observed in congenital and acquired pathological conditions in children, leading to varying degrees of functional disorders and cosmetic. There are three basic methods to lengthen: one-step bone grafting, two-step bone grafting using distraction devices and the method of distraction osteogenesis. Our purpose is the determination of indications for different operative techniques aimed to correction of the length of the metacarpal bones.

Materials and methods: The results of treatment of 30 patients of different age groups with shortening and large defects of the metacarpal bones are presented. In children with a small degree of shortening,

we used one-step bone grafting. Two-stage bone grafting was used in the cases of large defects after tumor resection and osteomyelitis. As a first step, application of a distraction device was performed for the gradual compensation of the shortening, and the second stage was bone grafting. Non-vascularized autograft and vascularized autograft in a free and non-free variation were used. The method of distraction osteogenesis was used in all other cases.

Results: One-step bone grafting is a technique with low complication rates, but empirically it was found that the maximum lengthening of the metacarpal bone which may be obtained in the one-step technique is 1 cm. We had only one case of complication. Two-stage bone grafting can be successfully applied in cases of replacement of bone defects with a significant shortening in cases of poor conditions for distraction osteogenesis. The maximum preoperative shortening was 55 mm. We have not had any complications in this group. The method of distraction osteogenesis had the highest number of complications (18% in our study). The maximum elongation obtained in one phase of treatment was 25 mm.

Conclusions: One-step bone grafting can be successfully used in cases of shortening of the metacarpal bones less than 10 mm. Indication for a two-stage bone grafting is shortening with significant defects, especially in conditions unfavorable for distraction osteogenesis, such as osteomyelitis, tumors and severe trauma. Using the method of distraction osteogenesis requires mandatory pre-evaluation of factors affecting regeneration in order to predict possible outcomes of distraction osteogenesis and the choice of tactics for post-operative patient management.

A-0264 The cutaneous ligaments of the finger: Cleland and Grayson

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Purpose: The earliest anatomical descriptions of the cutaneous ligaments of the finger go back for centuries. Until now, no unequivocal description exists about anatomical location, function and movement of the ligaments of Grayson and Cleland. As long as the exact anatomy of these ligaments is unclear, the course of certain diseases such as Dupuytren's disease cannot be explained thoroughly. The purpose of this anatomical study was to re-evaluate the anatomy and function of these cutaneous ligaments.

Methods: We micro-dissected six little, eight ring and six middle fingers from 20 fresh frozen human

cadaver hands. Four fingers from three human cadaveric hands preserved with Thiels method were dissected for a better understanding of the dynamics. During dissection the following measurements were taken for Cleland and Grayson: location, width of origin and insertion, and the length between origin and insertion for all different bundles.

Results: Grayson's ligament appeared to be a network of fibres originating from the flexor tendon sheet; it inserts at the contra lateral side in different planes into the skin, always volar to the neurovascular bundle. It acts as a stabilizer of the skin. Cleland's ligament appeared to consist of four distinguishable ligament pairs, directed oppositely, of obliquely orientated ligaments; 1A and 1B originating mainly from the proximal phalanx, and 2A and 2B originating from the middle phalanx. Each ligament consisted of different layers originating from the tendon sheet and periosteum. Its function is to prevent the skin from bagging, protecting the neurovascular bundle, creating a sliding path for the lateral slips of the extensor tendon and stabilizing the finger.

Conclusion: Our research further disclosed the detailed anatomy and function of the cutaneous ligaments of the fingers. Grayson's fibres appeared to be important in preventing movement of the skin, which contributes to a more solid grip. The position, orientation and dynamics of Cleland's ligament gave a clear insight into its function.

A-0266 Re-innervation pattern of subgroups of specific sensory nerve fibers of the skin after a vein-muscle graft reconstruction supported with bone marrow stromal cells in a rat model

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Purpose: An alternative to the autograft in experimental nerve reconstruction is the vein-muscle graft supported with bone marrow stromal cells (BMSCs). BMSCs have the potential to differentiate into SC-like cells and can therefore support nerve regeneration and, as a consequence of this differentiation, the mesenchymal stem cells will synthesize and secrete neurotrophins. Also undifferentiated mesenchymal stem cells in a nerve conduit stimulate axonal regrowth and motor function recovery. The skin sensory nerve fibers can illustrate the regeneration in

the most distal terminal of the injured nerve. The different peptidergic (visualized with CGRP and Substance P) and non-peptidergic fibers (visualized with P2X3) are responsible for signalling noxious and termed nociception. The A δ -fibers are the myelinated fibers (visualized with NF200). The A δ -fibers are responsible for mechanical and thermal stimuli and for the fastest transmission of noxious stimuli. This study investigates the re-innervation of these skin neural fibers in the rat foot sole, 12 weeks after reconstructing a nerve defect with a vein-muscle graft and a vein-muscle graft filled BMSCs.

Methods: In 10 animals a 15 mm sciatic nerve defect was reconstructed using a vein-muscle graft. In five animals the vein-muscle graft was filled with BMSCs after connecting the vein graft to the nerve ends. Von Frey hairs were used to assess the mechanical threshold and sensibility after operation. Twelve weeks after grafting, the sole of the foot of the operated hindpaw was excised and stained according to the necessary protocols for CGRP, Substance P, P2X3 and NF200. Control staining was performed with PGP 9.5 (a pan-neuronal marker). The footpad was divided in a proximal and a distal section and the epidermal, crossings and dermal skin layers were counted individually. Re-innervation was measured as the number of fibers in the dermal-epidermal crossing of the skin. A comparison between these groups was made and another comparison with the number of fibers after autograft reconstruction was added (data from an earlier study).

Results: The mean threshold for the animals treated with the vein-muscle graft (group I) was 10.7 g (SD \pm 3.09) and the animals with the vein-muscle graft with BMSCs (group II) showed a withdrawal reaction at 8.5 g (SD \pm 2.23). The vein-muscle graft with the BMSCs showed a significant difference compared with the vein-muscle graft for all five stainings. The vein-muscle graft with BMSCs had approximately 50% re-innervation of the sensory skin fibers (stained with PGP 9.5). The myelinated fibers had an increased re-innervation of approximately 190% favouring the vein-muscle graft with BMSCs. The vein-muscle graft with the BMSCs had a stronger regeneration compared with the vein-muscle graft for the non-peptidergic fibers which were stained with P2X3 (18% vs 9.5%).

Conclusion: Twelve weeks after reconstructing a nerve defect using a vein-muscle graft with/without BMSCs, we found strong indications for the beneficial effect of the supportive cellular therapy (i.e. the BMSCs). In particular, the faster and more prominent regeneration of the myelinated and the non-peptidergic fibers were a beneficial effect after introducing the BMSCs. However, compared with the autograft both conduits were outperformed.

A-0267 Autologous chondrocyte transplantation for the treatment of thumb carpometacarpal joint degenerative arthritis: preliminary results

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Introduction: Degenerative osteoarthritis of the thumb is particularly common in middle-aged or post-menopausal women. Synovitis and initial cartilage damage nevertheless start earlier, and then progressive degenerative arthritis develops leading to osteophyte formation, joint narrowing with progressive exposure of subchondral bone, subluxation, deformity, involvement of surrounding joints. The aim of this study is to evaluate the outcome of the first treated cases using autologous chondrocyte transplantation at the trapeziometacarpal joint.

Materials and methods: Ten cases of thumb carpometacarpal (CMC) arthritis stages II and early stage III were treated by arthroplasty of the thumb CMC joint with autologous chondrocyte transplantation by open or arthroscopic technique. All patients had persistent pain unresponsive to different kinds of non-operative treatments. Approval from the Ethics Committee of our Institute was obtained. Fragments of 3–4 mm² of cartilage were harvested under arthroscopy or by open technique in the wrist joint or elbow joint. Cartilage cells were sent to the laboratory to grow on a collagenous biphasic matrix. After 3 weeks it was possible to re-implant the chondrocyte-augmented scaffold in the trapezio-metacarpal joint using fibrin glue, or to freeze it to allow a later operation. Ten joints in eight patients aged 42–68 years (mean 53) were treated. All patients were female. The dominant hand was treated in six cases, and two patients had a bilateral operation. In the cases operated by open technique a ligament reconstruction procedure was used to stabilize the TM joint.

Results: Patients were examined at a mean of 20 months follow-up (range 3 months–4 years). Impairing pain disappeared in all patients; three cases still had occasional pain. Full range of motion was obtained in all cases and grip increased in all cases. No complications at the CMC joint or at the donor site occurred post-operatively.

Conclusions: Tissue reconstruction is theoretically the optimal treatment for cartilage damage. The preliminary results are encouraging, but we do not know if the implanted cartilage will last and how long. The potential advantage of this technique is to postpone more aggressive procedures at the TM joint to an older age. In cases with instability we think it is

necessary to add a ligament stabilization procedure to avoid subsequent damage to transplanted cartilage. A longer follow-up and a greater number of treated cases are necessary to establish the usefulness of this procedure, which has the advantage of being completely biological but has high costs.

A-0268 Neurogenic Thoracic Outlet Syndrome: objective criteria to indicate surgery

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Introduction: Reviewing the literature, the indication for Thoracic Outlet Syndrome (TOS) surgery is based on clinical findings only in the majority of the cases, due to lack of objective findings. In a retrospective study we have analyzed our cases in order to evaluate objective criteria for surgical intervention.

Methods: In total, 60 patients (five male, 55 female, aged 10–71 years) were diagnosed clinically 69 times for TOS (duration of symptoms 44 months, NRS 7). In addition, objective investigations were performed: X-ray of the cervical spine to detect a cervical rib; a comprehensive electroneurographic investigation to detect signs of nerve compression; and MR-angiography of the subclavian artery with elevated and adducted upper extremity to detect a stenosis of the artery as an indirect sign of compression of the brachial plexus.

Results: Concerning the objective assessment, a cervical rib was present in 50% of our cases. The electroneurographic investigation revealed signs of nerve compression in 47% of our cases. In nearly 90% of our cases a stenosis of the subclavian artery confirmed the clinical diagnosis. In 59 cases TOS surgery was performed via a small single supraclavicular incision, in 10 cases via a supra- and infraclavicular incision, and all patients recovered from their symptoms.

Discussion: In our series we based the indication for TOS surgery not only on clinical examination, but also on objective findings, either the presence of a cervical rib and/or positive electroneurographic findings and/or a stenosis of the subclavian artery. The MR-angiography was the most significant investigation to objectify the clinical findings. The presented investigational setup seems to be appropriate to objectively diagnose TOS and indicate surgery. The small supraclavicular incision gave adequate access to perform neurolysis of the brachial plexus, scalenotomy and resection of cervical or first rib without major complications in all cases.

A-0271 Evaluation of fracture patterns of radiocarpal joint surface in intra-articular distal radius fractures with computed tomography

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Purpose: Arthroscopic reduction for intra-articular distal radius fracture has gained widespread acceptance as an effective adjunct. We have employed arthroscopy for almost all patients with distal radius fracture. However, the arthroscopic procedure is somewhat time consuming and complex. If we can know in advance the types of fracture requiring arthroscopic reduction, we can simplify the treatment. The purpose of this study is to clarify the need for arthroscopic reduction for any type of intra-articular distal radius fracture.

Methods: We evaluated fracture patterns of radiocarpal joint surface in intra-articular distal radius fractures in 100 patients. Preoperative computed tomography and intraoperative arthroscopic evaluation was performed on all patients. The patients ranged in age from 17–85 years (mean age of 60.7 years), and comprised 31 men and 69 women. Using the AO classification, seven cases were categorized as type B3, 32 as C1, 13 as C2, and 48 as C3. First, the fractures were reduced and anatomical alignment was regained with the aid of an image intensifier. Wrist arthroscopy was then performed, and any residual dislocations of the intra-articular fragments of more than 2 mm were reduced.

Results: Some 52 patients required arthroscopic reduction in all cases; 29% of B3; and 38% of two-part fractures (C1+C2); in particular, 57% of the dorsal medial fragments (die-punch fragment) required arthroscopic reduction; 75% of three-part fractures; and 71% of four or more part fractures were treated with arthroscopy.

Conclusions: On the basis of these results, we concluded that fractures with dorsal medial fragment and three or more part fractures required arthroscopic reduction, and thus wrist arthroscopy is mandatory for treatment of intra-articular distal radius fractures.

A-0272 Pronator-sparing plate osteosynthesis in distal radius fractures: early functional outcome

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Introduction: Thanks to modern anatomic stable angle plate and screw designs in distal radius

fractures, early mobilization is possible and pronation torque of the wrist is more important in early recovery. Pronator-sparing plate osteosynthesis of the distal radius is a relatively new approach. A short overview of the technique is given, with some tips and tricks.

Material and methods: We compared early postoperative grip force, pronator force and swelling of two randomly assigned comparable groups of 30 patients, respectively operated with or without pronator-sparing plate osteosynthesis. All fractures were unstable distal radius fractures with dorsal displacement. Force and swelling were compared with the contralateral side.

Results: The pronator force at 3 weeks and 6 weeks was significantly higher in the 'pronator sparing' group, respectively 57% and 80% of contralateral side compared with 43% and 67% in the 'non-sparing' group. Also, swelling was significant less in the pronator-sparing group. There was no significant difference in grip force between the two groups.

Conclusion and discussion: Pronator-sparing plate osteosynthesis in distal radius fractures seems to give better pronation force and less swelling in early recovery after volar plate osteosynthesis. This technique seems not to have beneficial results on grip force.

A-0274 External fixation in finger joints fractures with a new dynamic device

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Objectives: Articular fractures of the fingers remain a major functional problem. The ideal treatment assumes both fragment stabilization and early mobilization. In complex fractures, the Suzuki concept is the most used, but its bilateral volume and radioopacity may be problematic, and intraosseous wire rotation can lead to osteolysis. We designed an external dynamic fixator to allow radiotransparency, to decrease fixator volume, and to avoid intraosseous wire movement.

Methods: We present the device, its placement and removal, with a video, along with results from eight cases. The device comprises two articulated polycarbonate plates, multi-perforated to introduce K-pins straight into the bone. The hinge must be centered on the articulation with a centering pin. It allows immediate mobilization. Eight fixators on

eight patients have been used, for seven P2 base and one P1 head fractures.

Results: All fractures but one healed in 6–11 weeks. One had to be grafted a second time. Motion was from 50–90% from the contralateral joint at fixator removal time. Mobilization could be started within 4 days. Profile radiography was easy with the radiolucent device.

Conclusion: This fixator is indicated in open articular finger fractures, or closed fractures when stabilization with traction is needed. Thanks to its design, it can be used dynamically where the phalanx head is involved in the fracture, which other devices do not allow. It can be used for metacarpophalangeal fracture of the first, second and fifth rays. Compared with the Suzuki or derived techniques, there are good results with more advantages than with other external dynamic devices.

A-0275 Surgical treatment of the cubital tunnel syndrome: anteposition or simple neurolysis?

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Purpose: In our hand surgery unit, the surgical solution of cubital tunnel syndrome includes two different methods. One method is the simple neurolysis, the other is neurolysis with subcutaneous anteposition of the nerve. The purpose of our study was to compare the results of these two methods.

Methods: We have compared the data from 63 patients (22 neurolysis, 41 anteposition) operated on between 1 January 2009 and 31 December 2010. The presence of pain, numbness, hypersensitivity and Tinel's sign was evaluated 1 month and 1 year after surgery. Grip strength was compared with the other side at 1 month and 1 year after the operation. The patient satisfaction and the need for reoperation was also considered. Our results were compared with data from international publications.

Results: At 1 month we found the presence of pain in 9.1% of patients in the neurolysis group compared with 12.2% in the anteposition group. Numbness of the fingers was present in 13.6% after neurolysis and 14.6% after anteposition. The grip strength compared with the unaffected side was 78% in case of neurolysis, and 73% in the other group. We found the presence of Tinel's sign in all the cases of both groups. On the visual analogue scale, overall patient satisfaction in the neurolysis group was 6.9 in average, and in the anteposition group was 7.1 on a scale of 10. The results at 1 year were comparable with those at 1

month, with the exception of a slight hypersensitivity at a higher rate in the anteposition group.

Conclusions: Analyzing our results, we conclude that both methods give good results with a slight but not significant difference in favour of the simple neurolysis. A prospective randomized study could solve the limitations of our present study.

A-0278 Newborn compartment syndrome: difficulties in treatment of the sequelae

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Introduction: Prenatal ischemic contractures are seldom but regularly seen in pediatric hand surgery centers. After newborn compartment syndrome severe damage of forearm and hand occurs, because normally no child is treated causatively by fasciotomy in the first hours after birth. Mostly the forearm is affected circumferentially, and all tissues are damaged: skin, nerves, extrinsic muscles and bone changes caused by growth plate disturbances. The damage increases over the whole growth period. To avoid deterioration and for improvement we need all microsurgical reconstructive techniques, and the capacity for complicated bone corrections including callus distraction devices.

Cases: From 1998 to date we have seen 20 children with newborn compartment syndrome or the resulting Volkmann contracture. Two children were treated early, 2 and 7 days after birth. Six children were treated (plus three planned) later, from 4 months up to 2 years after birth, with established contractures and paralysis. One of the most severely affected boys was treated at age 8 years because of severe contracture recurrence and skeletal deformities, and again at 14 years because of worsening of his supination contracture. Those without aggressive resection of fibrotic muscles developed severe contractures in growth, which are very difficult to treat in a 14-year-old. They were treated by different combinations of neurolysis of the main forearm nerves, debridement of fibrotic muscle parts, tendon transfers, free flaps and soft tissue distraction followed by corrective osteotomy and bone grafting and a three-dimensional callus-distraction using a hexapode fixator.

Discussion: As far as our experience goes, early contractures should be treated aggressively by resecting the fibrotic muscles and the neurolysis to avoid impediment in the first big growth period. It is more difficult to choose the best treatment when

contractures recur and growth disturbances occur. Presenting the histories of our patients, we discuss what to do in cases of recurrence, and when and how later bone deformities should be treated.

A-0284 Comparative morphometry of the proximal carpal row and metatarsal heads: applications to surgical transfers for carpal reconstruction

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Introduction: Carpal surgery (proximal row carpectomy, partial or total arthrodesis) is palliative and decreases wrist mobility. Wrist reconstructive surgery has not yet been developed.

Objectives: The aims of this study were (1) to lead a 3D morphometric study of carpal bones and metatarsal heads; and (2) to describe the surgical technique for harvesting and transfer part of the metatarsal articular surface onto the carpus.

Methods: For this study, 32 pairs of anatomical specimens were used: 32 left proximal carpal rows and 32 second and third metatarsal heads. 3D surfaces of these osteochondral pieces were acquired thanks to a laser scan. Transversal and sagittal rays of curvature could then be compared. The better orientation of the metatarsal heads was defined to use them for replacement of the lunate and/or the proximal pole of the scaphoid. Choice and locations of microsurgical anastomoses, osteosynthesis and ligamentous reconstruction techniques are discussed.

Results: The proximal articular surface of the lunate can be replaced by the 2nd metatarsal head, supplied by the 1st intermetatarsal artery; its orientation is sagittal; its plantar aspect fits with that of the carpal volar aspect. Deep transverse intermetatarsal ligaments can be used to reconstruct the interosseous ligaments. The proximal pole of the scaphoid can be replaced by the 2nd metatarsal head. Its orientation is transverse; its plantar aspect fits with the medial aspect of the lunate; the metatarsophalangeal capsule can be sutured to the scapholunate ligament.

Conclusion: The first clinical application of the transfer of the 2nd metatarsal head to replace the proximal pole of the scaphoid is presented, with its clinical and radiological outcome 1 year later.

A-0287 Evaluation of the efficiency of 6 cm nerve gap repair using epineural tube grafts implanted with bone marrow stromal cells in sheep model — a preliminary report

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Purpose: The aim of this study is to evaluate the efficiency of a novel method for nerve regeneration. The technique utilizes autogenic/allogenic epineural tube grafts supported with autogenic/allogenic bone marrow stromal cells (BMSC) to restore median nerve gaps (6 cm) in a sheep model.

Materials and Methods: 6 outbreed rams weighing 30–50 kg, 6–8 months old were used in this pilot study. Bone marrow was harvested and stromal cells were cultured for 2 weeks. A 6 cm long gap was created in the median nerve of the right forelimb, followed by implantation of 6 cm long autogenic epineural tube grafts filled with sterile saline (Group 1) or autogenic BMSC (Group 2). Allogenic model was composed of allogenic epineural tube grafts filled with allogenic BMSC (Group 3). Harvested whole nerve was used to create an empty epineural tube graft by removing the fascicles inside using pull-out method. The contralateral forelimb median nerves were used as either control (uninjured median nerve) or repaired with autogenic median nerve graft for restoration of 6 cm long nerve defect. Electrophysiological studies were performed at 3 months and 6 months under general anaesthesia. Samples of the grafted segments and control nerves were obtained for histology and morphometric analyses. Immunofluorescence staining was performed in order to determine the immunological, angiogenic, and neurotrophic properties of naïve epineural sheaths. The following procedure was used for immunofluorescent analysis: freshly dissected nerve sheaths from median nerves were snap-frozen in liquid nitrogen, fixed in cold acetone for 10 min, and stained for the presence of GFAP and laminin B for 30 min. The binding of primary antibodies was detected using the immunofluorescence method with FITC conjugated secondary antibody. Slides were mounted in Vectashield mounting medium with DAPI for fluorescence and analyzed using fluorescence microscopy.

Results: Ambulation was normal in all animals after the surgery and there were no pressure sores around the hoof. Surgical incisions exhibited good wound healing in all animals 2–3 weeks after surgery, except 1.5–2 cm wound dehiscences were observed in two animals during the healing period. All sheep had recordable nerve action potentials and hoof twitch

responses with stimulation. Both laminin and GFAP markers were strongly expressed on the surface of the whole nerve and removed fascicles. Weaker expression of laminin was observed in case of epineural sheath and empty epineural tube.

Conclusions: 1) We introduced and tested a new surgical technique for the restoration of long nerve gaps. Proposed method may be of future benefit to patients with nerve injuries resulting in long defects by eliminating the need for nerve autograft harvesting or immunosuppressive treatment in allogenic nerve transplantation. 2) Immunofluorescent staining indicates that sheep epineural sheath is neurogenically neutral and has a high potential to provide a scaffold for angiogenesis during axonal regeneration due to laminin B expression. The lack of GFAP expression assures that newly regenerated nerves will originate only from the recipient nerves.

A-0288 A novel surgical approach for peripheral nerve regeneration after acute crush injury in rats

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Purpose: We hypothesize that naïve epineural sheath (ES) creates optimal conditions for nerve regeneration in both normal and unfavourable wound healing conditions after acute crush injury.

Materials and Methods: Eighty male Lewis rats were allocated into 8 experimental groups of 10 rats each and a 2 mm long, 17.4 Nt/mm crushing force was applied for 5 minutes to the right sciatic nerve. The crushed nerve was left without intervention, as a control, or was wrapped with fat, isogenic, or allogenic ES in groups I–IV, respectively. In groups V–VIII, unfavourable wound conditions were created by removal of the ES before application of the crushing force to the sciatic nerve, as well as the surrounding muscles, for 5 minutes. The nerve was left without intervention as control, or was wrapped with fat, isogenic or allogenic ES in groups V–VIII, respectively. In both groups results were evaluated at 6 and 12 weeks. Nerve regeneration was assessed using pin prick (PP), toe spread (TS), somatosensory evoked potentials (SSEP), and gastrocnemius muscle index (GMI). Samples were sent for histomorphometry and immunohistostaining.

Results: Functional evaluation showed improved motor recovery (TS after 5 weeks: 2.83/2.6 in Groups VII and V, respectively) in unfavourable wound

conditions after isogenic ES application. Sensory recovery was improved in both normal (PP 2.83/2.7/3/3 in groups I, II, III, and IV, respectively) and unfavourable wound conditions (PP 2.8/3/3/3 in groups V, VI, VII and VIII, respectively) after both isogenic and allogenic ES applications at 6 weeks. At 6 and 12 weeks, the GMI results were similar in all groups. SSEP tests showed that ES applications (Groups III–IV at 123% vs 125%, respectively) revealed shorter P1 latency at 6 weeks when compared with Groups I and II (138% vs 146%). Under unfavourable wound conditions ES applications revealed P1 latencies at both 6 weeks and 12 weeks. The isogenic ES groups (III–VII) had the highest amplitudes (58.3% / 66.2%) and better GMI outcomes at 12 weeks. All groups had comparable results for mean fibre diameters, myelin thickness, and axon density at 12 weeks. Immunofluorescence staining showed that the epineural sheath did not express MHC class II, GFAP, NGF, or S-100. There was a weak expression of MHC class I and negligible expression of VEGF. Application of the epineural sheath resulted in lower amount of macrophages in contrast to samples with adipose tissue. Immunofluorescent staining confirmed high VEGF expression in the cross-sections where both the isogenic and allogenic ES were applied. Significantly lower VEGF expression was observed in the nerves which were wrapped with fat.

Conclusion: Application of the ES served as a protective barrier and created an optimal microenvironment for nerve regeneration by acting as a proangiogenic scaffold providing VEGF. In contrast to the results of adipose tissue application, the ES created an efficient anti-inflammatory protective barrier for regenerating the nerve and decreasing scar tissue. ES patch application is a reliable and effective method of supporting nerve regeneration following acute crush injury.

A-0291 Bony fusion of the distal phalanges in the Apert hand causes growth disturbances of the proximal phalangeal, metacarpal, and carpal bones

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Purpose: The distal phalanges of the digits are frequently fused in the Apert hand. The third finger is the longest finger, and the fused distal phalanges

may cause longitudinal bone growth in a proximal direction, and subsequent growth disturbances of the phalangeal, metacarpal, and/or carpal bones can be expected. The purpose of the study is to verify this hypothesis using hand radiographs.

Methods: Seven patients of Apert acrosyndactyly with fused distal phalanges were observed both preoperatively and postoperatively. Two patients were male, and five were female. The average age at initial operation was 18 months (range 9–26 months). We evaluated the relative position of each finger ray of the carpal, metacarpal, and phalangeal bones preoperatively. Postoperative analyses of these relative positions were also done.

Results: Proximal migration of the third metacarpal bone and growth retardation of the capitate were observed in all patients. The second finger ray showed apex radial angulation at the metacarpophalangeal level, and the third finger ray showed apex ulnar angulation at the metacarpophalangeal level, which looked like a 'diamond-shaped deformity'. After surgical release of the syndactylies, proximal migration of the third metacarpal bone was eliminated and catch-up growth in the capitate was observed within several months. Late deviation of the index and ring fingers were also observed as a result of the growth imbalance of the phalangeal heads of these two digits.

Discussion: As bony fusion of the distal phalanges creates a diamond-shaped configuration, growth disturbances of the phalangeal, metacarpal, and carpal bones occurred. Therefore, early separation of the long finger is as important as the separation of the border digits and it should be performed before the progression of the diamond-shaped configuration.

A-0292 Exploration of the intravascular stenting for vein grafting on artery defect for sub 1 mm vessels

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Background: The IVaS (intravascular stenting) method consists of using a monofilament nylon stent to make the anastomosis of small vessels easier. The aim of this study was to explore the IVaS technique in order to determine its advantages, disadvantages, and usefulness for inexperienced microsurgeons and also for more experienced practitioners during difficult anastomoses such as vein grafting on artery defect.

Materials and Methods: Twenty Wistar rats were used, with each rat acting as his own control. Group 1 had a vein graft done on an artery defect with the IVaS

technique. The epigastric vein was used as a graft to repair the femoral artery defect. A stent was used to facilitate the double anastomosis. Group 2 had the same procedure done without a stent. All anastomoses were performed by the same trainee surgeon with 1 year's experience in microsurgery. The diameters of the external artery and vein, stent length, graft length, number of sutures, stent preparation, and installation time and suture time were all measured. Anastomotic patency was verified using O'Brien's patency test. The rats were anaesthetized 1 month later to reassess the patency of the vessels.

Results: The study shows an improvement in suturing time and in Patency test in the IVaS group. The time required for preparation and installation of the stent was inferior to the time saved by the use of the stent.

Discussion: IVaS technique is a useful method of vessels anastomosis especially for juniors surgeons. Difficult anastomosis such as vein grafting on artery defect for sub 1 mm vessels are improved in terms of suturing time and patency test with the use of a stent. The reason why the patency rate was not 100% may be because of excessive manipulation of the stent causing thrombosis in the IVaS group and imperfections in suturing technique by a trainee surgeon. Different aspects of the method are open for discussion such as consideration of the stent size and execution of the anastomosis.

Conclusions: The IVaS technique helps in the execution of anastomosis in microsurgery and allows for more precise suturing. It is a useful trick especially for a junior microsurgeon. Care, however, must be taken in its execution and manipulation so as to avoid any lesions of the intima of the vessels.

A-0295 Treatment of undisplaced scaphoid fractures: a literature review

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Background: The scaphoid bone in the wrist is the most frequently fractured carpal bone (60–70% of all carpal bone fractures), and is second only to the distal radius in wrist fracture frequency. Treatment remains the most controversial aspect. Displaced scaphoid waist fractures — defined by most authors as those with > 1 mm displacement — have a worse outcome, with an increased risk of non-union, and so the recommended treatment is open or closed reduction and internal fixation. Is still in debate the optimal method of treatment of nondisplaced or minimally displaced fractures. The purpose of this work is to

investigate effectiveness of conservative vs surgical treatment for nondisplaced or minimally displaced scaphoid waist fractures.

Methods: A systematic review of the literature was done comparing randomized controlled trials and meta-analysis that evaluated conservative vs surgical treatment for nondisplaced or minimally displaced scaphoid waist fractures.

Results: Surgical treatment was better in terms of patient satisfaction, grip strength, time to union, and time off work, with return to work approximately 7 weeks quicker in the surgical group than in the cast treatment group. No significant differences were found between surgical and conservative treatment with regard to pain, range of motion, rates of non-union and malunion, and total treatment costs. The rate of complications was higher in the surgical treatment than in the conservative group.

Conclusions: The final conclusion of this literature analysis is that surgical treatment is favourable for acute non-displaced and minimally displaced scaphoid fractures with regard to functional outcome and time off work, but engenders more complications. Long-term risks and short-term benefits of surgery should be always carefully weighted in clinical decision making.

A-0296 Percutaneous needle fasciotomy for Dupuytren's disease: 11 year follow-up

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Between December 1997 and March 2002 percutaneous needle fasciotomy was performed on 103 digits across 73 patients. All cases were carried out under local anaesthetic and the cord was divided in the palm. There was one flexor tendon injury. The procedure was performed on 1 index, 11 middle, 41 little, and 50 ring fingers. The mean age of patients at the time of surgery was 67 years (36–86). The patients were followed up at a mean of 11 years (9–14). The mean pre-op MCP contracture was 42° which improved to 5.7 post-procedure. The mean pre-op PIP contracture was 17°, which improved to 15.8 post-procedure. Of 63 digits that we were able to follow-up, 11 had died without further surgery and 32 digits were revised at a mean of 5 (1–11) years. Twenty digits were available for clinical review at a mean of 11 years. This group had a mean MCP contracture of 15° and PIP contracture of 19°. This group had a milder pre-operative contracture with an MCP contracture of 36° and a PIP contracture of 8.5°, which corrected to 4° at the MCP and 8° at the PIP. The average recurrence rate in this subgroup was 1° per year per joint in this group. The

group of patients who had been revised were significantly younger (mean 63) ($p = 0.03$) at the time of their fasciotomies when compared to those who had not had surgery (mean age 68) or those whose fasciotomies had outlived them (mean age 73). We conclude that needle fasciotomy is an efficacious procedure with acceptable long-term outcomes, particularly in the older patient group with predominantly MCP disease.

A-0298 All-arthroscopic repair of 1B triangular fibro cartilage complex (TFCC) tears by all-inside Fast-Fix™ repair suture system: an anatomic study

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Purpose: Injuries to the TFCC (Triangular Fibro Cartilage Complex) are a common cause of pain and instability of the wrist. Peripheral tears type 1B of Palmer's classification have the potential for healing due to their vascularization. Many surgical techniques have been described for the repair of these lesions. The gold standard is an outside-in arthroscopic repair requiring additional incisions. All-inside meniscal repairs by Fast-Fix™ repair suture system with PEEK (PolyEtherEtherKetone) blocks (Smith & Nephew Endoscopy, Andover, Massachusetts) have already shown their ability in the knee. This study aims to evaluate on cadavers the Fast-Fix™ system effectiveness and iatrogenicity for TFCC arthroscopic repair.

Methods: The anatomical study was performed on 10 fresh cadavers. The Fast-Fix™ devices were inserted through 3-4 portal from radial edge of the TFCC to the capsule with the arthroscope in the 6R portal. Each wrist was dissected after Fast-Fix insertion to assess skin, tendon, vascular, or nervous damage. The average load to failure of the suture was finally measured in Newtons using a digital dynamometer.

Results: No anatomical structure has been damaged and the penetration of the capsule was easily felt. The depth penetration limiter was unusable in the wrist. The arthroscopic testing of suture with the probe was satisfactory. Three implants were introduced dorsal to the ulnar styloid process TFCC and seven palmar. Palmar implants were located on average 6.56 mm of the FCU (flexor carpi ulnaris) and 9.95 mm from the dorsal sensory branch of the ulnar nerve. Dorsal implants were located on average 4.1 mm of the ECU (extensor carpi ulnaris) and 7.7 mm from the dorsal sensory branch of the ulnar

nerve. The average load to failure was 69 N with the suture cutting through the TFCC.

Conclusions: This study has demonstrated the feasibility of suturing type 1B tears of the TFCC with the Fast-Fix™ system. The average load of failure was sufficient and confirmed the previous studies of Yao. We did not notice any anatomic lesions in the cadaveric study without depth penetration limiter. We could not eliminate the risk of lesion unless the release of the blocks requires pushing the needle 8 mm behind the capsule. The feeling of the penetration of the capsule was reliable then we are waiting the next Fast-Fix device with manual release blocks to use it in clinical practice.

A-0303 Evolution of arthroscopic classification in scapholunate complex lesions

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Introduction: Arthroscopy of the wrist has opened a new field in the understanding of carpal ligament injuries. Under arthroscopy it is possible to visualize intrinsic ligaments, a great amount of extrinsic ligaments, to test carpal bone stability, and to evaluate cartilage damage. One of the most important carpal instabilities is the scapholunate instability because of its frequency and because it can lead to degenerative arthritis of the wrist (SLAC) in the late stages. Several arthroscopic classifications have been developed within the last two decades, mostly describing acute injuries only, while we know that chronic injuries can be severe and more challenging for the surgeon to treat. A development of the previous classifications has been developed by the EWAS group, of which the aim is to have a better definition of acute and chronic injuries, understanding partial and complete lesions of scapholunate, scapholunate complex, and STT injuries.

Materials and Methods: From the study of 20 cadaver specimens that were studied under arthroscopy sectioning the different parts of SL ligament and extrinsic ligaments, and from the data from 80 patients affected by SL lesions examined under arthroscopy and treated, the following classification has been proposed. EWAS classification stage I: Sprain haemorrhage of SL ligament treatment: immobilization acute only. Stage II sprain (lesion of central part) RC: attenuate SL lig, haemorrhage, absence of widening of SL space at instability test.

Acute/chronic treatment: immobilization/shrinkage/ pinning. Stage III A: partial lesion anterior of SL w/ without SC ligament lesion probe passage with partial anterior SL widening at dynamic instability test (anterior instability). Acute/chronic treatment: acute: pinning + immobilization; chronic: pinning/capsulodesis (anterior). Stage III B: partial lesion posterior intermediate, and posterior part of SL lig +/- dorsal capsule +/- DIC dorsal SL widening at instability dynamic (posterior instability). Acute/chronic treatment: acute: pinning + immobilization; chronic: open or arthroscopic capsulodesis, +/- pinning, bone to bone reconstruction. Stage III C: complete SL lesion central, anterior, posterior SLIOL lesion + DIC or SC complete widening of SL space only at dynamic test. Acute/chronic treatment: acute: pinning or arthroscopic dorsal capsulodesis + pinning; chronic: open or arthroscopic capsulodesis, +/- pinning or bone-to-bone reconstruction. Stage IV: a) complete SL lesion + extrinsic ligament lesion (DIC, SC, LRL); b) possible additional involvement of other extrinsic ligaments DRC; STT; TH RC e MC: passage of arthroscope through SL space DISI reducible. Acute/chronic treatment open or arthroscopic capsulodesis + pinning or screwing or reconstruction with tendon (three ligament tenodesis or other techniques) + pinning (b).

Discussion and Conclusions: The development of this classification is useful to classify a variety of acute and chronic scapholunate injuries. The aim is not only to have a better understanding of the lesions but to define or improve the treatment in the different stages.

A-0304 Vascularized medial femoral condyle graft for management of scaphoid non-union

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Purpose: The purpose of this study is to evaluate the results of the Vascularized Medial Femoral Condyle Graft free transfer for the management of scaphoid nonunion. Indications, technique, and results are evaluated in details.

Patients and Methods: Our study includes 16 patients, with a mean follow-up of 12 months. The patients included in this study are patients with scaphoid nonunion with avascular necrosis of the proximal pole or patients with persistent nonunion of the scaphoid despite previous surgery with bone graft and scaphoid nonunion associated with humpback deformity. In our study we evaluated the

patients in terms of scaphoid consolidation, range of motion, DASH score, VAPS, and morbidity at the harvesting site.

Results: Fourteen cases showed full consolidation, one case showed nonunion which will be managed by a salvage procedure, and healing in one case was doubtful.

Conclusion: The free medial femoral condyle vascularized bone graft can provide not only structural support, but also a consistent and robust blood supply that results in excellent rates of union. We conclude that the vascularized medial femoral graft is superior and promising alternative in management of scaphoid nonunion with avascular proximal pole, humpback deformity, failure of union despite previous operation.

A-0306 Percutaneous humeral derotational osteotomy in obstetrical brachial plexus palsy: a new technique

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Purpose: Shoulder deformity is the most common secondary deformity after incomplete or delayed nerve recovery in obstetric brachial plexus palsy (OBPP). The internal rotators usually overpower the external rotators, causing internal rotation contracture, leading to progressive glenohumeral joint deformity and incongruence. Children with flat humeral head and deformed shoulder joint are best treated by derotational osteotomy of the humerus, repositioning the upper limb into a better position of external rotation, improving appearance, and enhancing activities of daily living. We have developed a new minimal invasive technique of percutaneous osteotomy of the humerus. The aim of this study is to report the technique and to evaluate the functional results of the operation.

Methods: Two patients with glenohumeral joint deformity and incongruity were treated with percutaneous humeral derotational osteotomy and Hoffman II external fixation. The osteotomy level was just distal to the deltoid insertion. Functional evaluation was made according to range of motion, modified Mallet scoring system, and upper limb motion analysis.

Results: The average amount of humeral derotation was 90°. The children had immediate postoperative active motion of the upper extremity. Solid periosteal bone healing was obtained after 60 days on

average. No complication occurred and the external fixator was well accepted by the child and the parents. The surgical scars were minimal. A significant increase in shoulder function was found in the two patients with improvement of modified Mallet score from 2 to 4 postoperatively with disappearance of the trumpet sign.

Conclusion: Humeral derotation osteotomy is the treatment of choice for patients with long standing OBPP who developed moderate to severe glenohumeral deformity. A new technique is presented, percutaneous humeral osteotomy and external fixation. The method is effective, simple, and easy, results in early periosteal consolidation and rapid shoulder function improvement with minimal surgical scars.

A-0309 Treatment of scaphoid nonunions in adolescents with vascularized bone grafts from distal radius

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Purpose: Scaphoid nonunions are rare in adolescents. The use of vascularized bone grafts (VBG) from the distal radius as an alternative to conventional grafting for the treatment of established scaphoid nonunion in adolescents is described. The union rate and donor site morbidity with VBG are evaluated in the present study.

Methods: The technique was applied in 11 patients with symptomatic scaphoid nonunion resulting from fractures. All patients were male with average age of 16.5 years (15–17.5). The average period from injury to surgery was 8.3 months (4–13). Patients underwent vascularized bone grafting and internal fixation with K-wires. In 5 patients with proximal pole nonunion a VBG from the dorsal distal radius was used and in 6 with a waist nonunion a VBG from the palmar distal radius. All patients were evaluated radiographically and clinically. Functional outcome was assessed with DASH and VAS score, measurement of grip strength and ROM, and subjective satisfaction parameters. The time to return to daily activity and sports was also recorded.

Results: Mean follow-up was 62 months (12–122 months). The union rate was 100% (11/11 cases). Union was achieved within an average period of 6–12 weeks without complications from the epiphyseal plate of the distal radius. The ROM and grip strength was 89% and 92% of the contralateral hand, respectively. The mean postoperative DASH score was 8 and

the VAS was less than 1. All patients returned to daily activities in a mean period of 4 months.

Conclusions: Deformity and carpal height were corrected and union was achieved in all patients resulting to return painless motion and grip strength, without complications from the epiphyseal plate of the distal radius. The use of VBG from the distal radius provided a permanent solution in the rare case of scaphoid nonunion in adolescents.

A-0311 Trapeziometacarpal arthrodesis compared to trapeziectomy with LRTI in the treatment of trapeziometacarpal osteoarthritis: a randomized clinical trial

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Introduction: Based on an extensive systematic review of the current literature we concluded that at this time no surgical procedure is superior over another in the treatment of TMC OA. However, given the lack of high level RCTs on TMC arthrodesis and based on good results of this technique in studies with less methodological quality, we postulated that there could be differences between the various surgical procedures. Therefore, we conducted a high-level RCT in which TMC arthrodesis is compared with trapeziectomy with LRTI.

Material and Methods: After approval of the scientific committee, women above 40 years of age with stage II or III primary TMC OA were enrolled in an RCT between 2008 and 2011. The TMC arthrodeses were performed by a dorsal approach using plate and screws, and the trapeziectomy with LRTI procedures were based on the technique subscribed by Weilby. Both subjective (DASH and PRWHE) and objective outcomes (strength, dexterity, patient global assessment, and complications) were assessed before surgery, at 3 months, and 1 year after surgery.

Results: So far 15 patients in the arthrodesis group and 18 patients in the trapeziectomy with LRTI group fulfilled the 12 month follow-up. In both groups DASH and PRWHE scores were significantly improved after 12 months ($p < 0.001$), but if we compare the groups there are no significant differences. Furthermore, strength, dexterity, and overall satisfaction also showed no significant differences between the groups. However,

if we asked the patients if they would have the same surgery under the same circumstances 90% of the trapeziectomy with LRTI group said yes, against 55% of the arthrodesis group ($p = 0.022$). Additionally, 5 complications were observed in the trapeziectomy with LRTI group and 15 in the arthrodesis group ($p = 0.039$).

Discussion: The published results of comparative studies on TMC arthrodesis in the treatment of TMC OA are of limited methodological quality and showed inconsistent outcomes, therefore it is impossible to conclude based on present literature whether TMC arthrodesis is superior or inferior to any other technique. Based on the preliminary results of this RCT we concluded that we do not recommend routine use of TMC arthrodesis in the treatment of TMC OA.

A-0312 Correlation between magnetic resonance and intra-operative findings in patients with brachial plexus injury

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Introduction: Brachial plexus injury is a very frequent injury in our country due to the increasing number of motorcycles. The electrical study, clinical findings, and imaging study can give us a suspicion about the extension of injury. However, especially regarding the MRI findings, there are some controversies about its specificity and sensibility. Our goal was to correlate the pre-operative findings obtained using MRI with the intra-operative ones.

Materials and Methods: We did a prospective study of 10 patients who sustained brachial plexus injury with different clinical patterns. In a double-blind fashion, the radiologist and surgeon staged the brachial plexus injury, first using MRI and secondly reporting the intra-operative findings. A questionnaire was filled out by both about the brachial plexus status and the information were crossed to obtain specificity and sensitivity. The surgical findings were considered the gold standard.

Results: Root avulsion: 95% specificity, 90% sensibility. Postganglionic injury: 80% specificity, 88%, sensibility. Neuroma in continuity: 70% specificity, 92% sensibility. Pseudomeningocele: 100% specificity, 85% sensibility.

Discussion: The pre-operative staging of brachial plexus is important to a better surgical approach, although the trustfulness of data obtained using imaging and electrical study are still questionable, requiring sometimes a more invasive approach to

confirm the extent of injury. The development of a new device, especially MRI, has motivated us to define how is the level of sensibility and specificity of the data obtained in patients with brachial plexus injury. The results obtained showed in general a good level of rights, especially concerning the root avulsion and presence of pseudomeningocele. The rates of rights in post-ganglionic and neuroma in continuity showed reasonable correlation, although not as good as the root avulsion and pseudomeningocele. This finding could be explained due to intra-neural injury requiring a more sensitive study.

Conclusion: Although the results obtained, so far, are not the ideal, they give us support for the use this kind of pre-operative exam to stage the brachial plexus. This associated with the surgical findings can help in the decision-making of reconstructive procedure of brachial plexus injury.

A-0313 Early results of the Scheker total DRUJ endoprosthesis, 1-year data from nine patients

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Purpose: Patients with combined DRUJ pathology and instability present a significant surgical challenge, especially if they already have undergone multiple procedures. The Scheker total DRUJ endoprosthesis (Aptis Medical, LCC, Louisville, Kentucky, USA) is a constrained type of implant which seems to offer a solution in situations of complex instability. To evaluate the early clinical and radiological outcome of this implant we analyzed the data from the follow-up visit in nine patients 1 year after arthroplasty.

Methods: The patients had the following conditions prior to the Scheker arthroplasty: DRUJ synostosis, failed Bower's procedure, failed Darrach's procedure, failed Sauvé-Kapandji procedure, longitudinal instability (Essex-Lopresti injury with both ulnar and radial head excised primarily), DRUJ arthritis with concomitant gross clinical instability. The mean number of previously failed procedures in these patients were 3 (range 0–7) The median time from the initial trauma or presentation of symptoms were 4 years (range 1–56). All patients were subject to a standardized pre- and postoperative assessment that included radiographic examinations, evaluation of pain by a visual analogue scale, evaluation of function by the DASH questionnaire, and measurements of range of motion as well as grip strength. Attempts were also made to measure torque and lifting capacity.

Results: All except one patient improved regarding pain. The group average went from 5.6 to 1.8 cm on a 10 cm scale and paired samples calculation with a 95% CI gave a p value of 0.003. There were also a significant ($p = 0.004$) reduction in DASH scores. All patients improved; the mean for the group decreased from 50 to 31. There was a strong trend indicating increased grip strength. There were small changes in ROM, lifting capacity, and torque. There were four adverse events: one tenosynovitis in the first dorsal compartment which was successfully treated by surgical decompression, two patients experienced symptoms of lateral epicondylalgia which resolved after conservative treatment, and one patient experienced transient carpal tunnel syndrome. Radiographic examinations have not revealed any signs of loosening.

Conclusion: Early results, in this small series of patients, shows that the Scheker arthroplasty dramatically reduces pain in severe disorders of the DRUJ. The patients report a significant improvement in function. The clinical measurements support these findings although the changes were not large enough for conclusion. Based on our short experience the Scheker implant seems to be a safe treatment option. Although the results are encouraging, we at first-hand recommend this arthroplasty as a salvage procedure due to the lack of reported long-term results.

A-0317 The treatment of distal radius fractures with volar plate fixation: analysis of complications

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Introduction: Locking-plate fixation for the distal radius and for other fractures has become increasingly popular across the developed world over the past 5 years.

Materials and Methods: In this retrospective study we reviewed all volar plating performed for distal radius fractures from January 2000 to June 2011 in a single trauma centre. We searched the electronic database using keywords of distal radius fracture or wrist fracture, plate fixation, identifying 315 patients. Their age ranged from 18 to 87, with a mean of 58 years; 122 patients were male, 193 female. Fractures were classified according to the AO classification system, as follow: A3 (32 cases), B3 (94 cases), C1 (79 cases), C2 (63 cases), C3 (47 cases). The implants used were the

following anatomically contoured locking plates: Acumed Acu-Loc (Acumed, Hillsboro, Oregon, USA), Synthes LCP (Synthes, Paoli, Pennsylvania, USA), Hand Innovations DVR (DePuy, Miami, Florida, USA), and Aptus (Medartis, Kennett Square, Pennsylvania, USA).

Results: Complications were observed in 15 patients (6.0%). Extensor tendon complications were the most frequent and were represented by 5 cases (1.6%) of extensor tendon synovitis and 3 cases (0.9%) of rupture of the pollicis longus (EPL). Flexor tendon complications were observed less frequently. In particular, two cases (0.6%) of flexor tendon synovitis and two cases of rupture of the flexor pollicis longus tendon (FPL) were reported. Loss of reduction after plate fixation was observed in 2 cases. In 1 case we observed loss of seal of the 2 proximal screws inserted in the diaphyseal cortex of the radius. The other case occurred in an articular fracture C2 type. The initial reduction and fixation were adequate. After 4 years of follow-up a CT scan was taken, showing that the distal peg of the DVR, sustaining the articular surface of the lunate fossa was exposed into the articular space. However, the clinical evaluation was good, with no pain and no substantial limitation in the range of motion. Finally we observed 4 cases (1.3%) of carpal tunnel syndrome. No cases of hardware failure were observed in our series.

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A-0319 Results of microsurgical treatment of 33 complete ring amputations

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Purpose: Ring avulsion injuries have long presented complex management problems. Controversy exists regarding whether replantation or revision of the amputation should be performed. Despite microsurgical advances, it is difficult to achieve good functional results in complete degloving injuries or amputations, and their management remains somewhat controversial. It is important to classify the injured finger, and various classification systems have proposed to provide a more rational approach in the management of ring avulsion injuries. The purpose of this work is to report our experience in the treatment of complete amputation of ring injuries based on our prognostic subclassification of Kay's class IV.

Methods: In total, 39 patients with class IV injuries according to Kay's classification were treated from 1986 to 2010. In this study we subdivide class IV injuries into those with "amputation distal to the insertion of FDS" (class IVd injuries: 28 cases), with "amputation

proximal to the FDS insertion" (class IVp injuries: 6 cases), and "with complete degloving injuries with intact tendons" (class IVi injuries: 5 cases). Replantation was done in class IVi and class IVd injuries (33 cases: 18 male and 15 female, age ranged from 22 to 54 years). In these cases the use of vascular transpositions or vein grafts may allow replantation. It was not always possible to suture the digital nerve damaged by ring avulsion injuries. Patients with class IVp injuries were treated by surgical amputation of the digit.

Results: In total, 29 cases were successfully revascularized. Mean ring finger total active range of motion was 200° (range 180–240°). Sensibility evaluated by static 2-point discrimination varied from 11 to 15 mm or more. Five patients reported cold intolerance. Range of motion is usually normal at the MP and PIP joints, but re-establishing sensibility is more difficult.

Conclusions: Modifications of the Kay classification system based on anatomic injury is more predictive of functional outcome. The division of class IV injuries based on the location of the amputation appears to be beneficial for the surgeon because the prognosis is different for different classes. The outcome of the cases in class IVi and class IVd (with a functional PIP joint and with an intact flexor digitorum superficialis tendon) treated by microsurgical reconstruction demonstrates that even under less than favourable conditions revascularization should be attempted. The results obtained are much better than what would be achieved by primary amputation. We conclude that complete ring avulsion amputations are salvageable with acceptable functional results in selected patient.

A-0322 A fast and reliable dynamic external fixation for PIP joint fractures, multicentre study of 93 cases

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Background: Although the technique is now well established, the principle of ligamentotaxis is still relatively underused in the treatment of digital joint fractures. Despite satisfying results reported, the technique is believed to be complex. Furthermore, available devices are sometimes cumbersome or difficult to handle. The aim of this study was to evaluate a miniaturized dynamic external fixator (Ligamentotaxor®) in the management of these fractures.

Material and Methods: A series of 93 fractures of the proximal interphalangeal (PIP) joint, involving 10 European departments of hand surgery is presented. The device was applied at the time of emergency.

The joint was left under distraction for 10–15 days. The patient was then instructed to lock and unlock the fixator and perform passive motion of the joint for 15 days. Thereafter, the patient was allowed to perform active motion under ligamentotaxis for another 15-day period. The fixator was removed 30–40 days after injury. The final follow-up averaged 15 months.

Results: 86 out of the 93 fractures were considered unstable. Two patients required PIP joint arthrodesis because of a bad outcome. Of the remaining 91 fractures, the active range of motion averaged 71.8°. Eighty-seven percent of patients were satisfied or very satisfied with the result, and 85.7% of them didn't have any trouble in their daily activities. No major complications occurred following the surgery.

Discussion: The results of this study are close to those reported in other series, considering that all the publications are not homogeneous on the fracture type. The device is easy to handle by surgeons and well tolerated by patients, as attested by the results of the different teams involved. Furthermore, the technique could be extended to other digital joint fractures and severe joint dislocations.

Conclusion: We think this is a simple and reliable technique to be of interest in the management of unstable fractures of PIP joints.

A-0323 Macroductyly — options and outcomes

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Introduction: Macroductyly is a rare congenital disorder of overgrowth affecting digits of the upper or lower limb. We report outcomes of 36 patients diagnosed with macroductyly. The goals of surgery are to control or reduce size, whilst maintaining sensibility and function.

Methods: Patient outcomes were measured using a postal questionnaire with the upper limb assessed using the Disability — Arm, Shoulder, Hand (DASH) score and Birmingham Children's Hospital Hand and Upper Limb Service Reach Out questionnaire. For the lower limb, the Pediatric Outcomes Data Collection Instrument (PODCI; Pediatric Orthopedic Society of North America, Rosemont, USA) was used.

Results: Average age at presentation was 46 months and there was an equal sex distribution; 82% were managed surgically and the remainder were managed conservatively. All of those managed conservatively had a static form of the disease, whereas all those with the progressive form were treated surgically. We had a 50% response rate and found no significant difference

in outcome (functional, cosmetic, psychosocial) between those managed surgically or conservatively. We believe this reflects the fact that surgery was only carried out in those with severe or progressive disease and conservative management was reserved for those who were less severely affected.

Conclusion: Macrodactyly remains a complex problem and plastic surgeons need to be aware of a large range of management options available for use. The need for repeated procedures must be recognized, particularly in progressive cases. In the vast majority of cases the functional and cosmetic outcome are good, with good patient acceptance.

A-0324 Entrapment of the median nerve in the elbow and the proximal forearm: a series of 31 cases and a review of literature

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Entrapment of the median nerve in the elbow and proximal forearm represents 7–10% of median nerve mononeuropathies. Literature distinguishes 2 different syndromes: pronator teres syndrome and anterior interosseous nerve syndrome. Differentiation and treatment of those syndromes remain a subject of controversy. From 1994 to 2011, 35 cases of proximal entrapment syndrome of the median nerve were seen among which 34 cases were operated on. These retrospective series includes a previous series of 13 cases assessed in 2001. All cases were evaluated by an independent examiner. Our series included 15 men and 20 women, with a median age of 56 years. The main reason for consultation was subjective symptoms (pain or paraesthesias) with or without weakness in the median nerve territory. Four cases presented an isolated weakness. Diagnosis was made on clinical assessment and a preoperative electroneuromyography study. In 14 cases a slowing of conduction velocity was present and 4 had a conduction block. In 17 cases neurogenic signs related to a pronator teres syndrome or a so-called anterior interosseous nerve syndrome were present. The median nerve was explored from the elbow region to the proximal forearm, and all nerve compressions were released. At surgery, in all the cases, a macroscopic compression was observed. Almost all sites of compression described in literature were seen, and in 4 cases 2 separated compressions were noted. All compressions were located on the median nerve: an entrapment of the anterior interosseous nerve was never observed. Four patients were lost to follow-up and 31 cases could

be assessed with a median follow-up of 69 month. Among the 13 cases which were evaluated in 2001, 9 were assessed in 2011. Twenty-eight patients said that surgery improved subjective symptoms. All but one objectively improved after surgery. The nine cases assessed in 2001 and in 2011 had better results in 2011. We found no correlation between the site of nerve compression and results of clinical examination or electroneuromyographic study. Thus, we concluded that there are no clinical, electroneuromyographic, and preoperative criteria that permit to differentiate a pronator teres syndrome from an anterior interosseous nerve syndrome. If no spontaneous improvement occurs, surgical treatment should be proposed and, during surgery, all potential compression sites must be assessed. Patients must be informed that improvement can take several years.

A-0327 Clinical evaluation of the Articulinx Intercarpometacarpal Cushion® in the thumb basal joint: a prospective study of 24 patients with osteoarthritis followed for 1 year

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Purpose: Osteoarthritis of the carpometacarpal joint of the thumb (CMC-I) is a common and debilitating condition of the hand. Patients with an early stage of CMC-I arthritis can have severe clinical symptoms with relatively mild radiographic changes. So far, there are no good surgical treatment modalities for patients with an early stage of CMC-I arthritis. Therefore, we tested a newly developed interpositional arthroplastic implant for early stage CMC-I osteoarthritis which can be implanted using a simple, minimally invasive technique without the need for resection of any tissue. The safety of the implant was previously presented in a feasibility study. The aim of this prospective study is to report the early results with the Articulinx Intercarpometacarpal Cushion®.

Methods: 24 patients (25 joints) with a mean age of 55.8 (43–68) years suffering from painful CMC-I osteoarthritis (Eaton–Littler stage I–III) were included in the study. All patients had unsuccessful prolonged conservative treatment previous to the operation. Perceived pain (primary outcome parameter) was recorded on a visual analogue scale (VAS) before treatment and after 3, 6, and 12 months. In addition radiographic findings and joint function were recorded pre- and postoperatively, using quick Disabilities of

the Arm, Shoulder and Hand (DASH), the Canadian Occupational Performance Measure (COPM) questionnaires, and measurements of pinch, tripod and grip strength.

Results: The surgical technique proved successful in 100% (25/25) of devices implanted with no intraoperative complications reported. Only local anaesthesia was used and the average procedure time was 24 minutes. No serious adverse events related to device or procedure occurred. Nevertheless, after 1 year the spacer was removed in 5 patients because of insufficient pain relief. These subjects elected to have an alternative surgical treatment at the time of explant. Among the remaining implanted subjects, mean change scores showed significant improvement at the 1-year visit compared to baseline: average VAS pain (-2.0 SD 3.1), QuickDASH symptom disability (-11.0 SD 17.7), QuickDASH work (-11.8 SD 38.1), QuickDASH Sport/Music (-14.1 SD 32.5), COPM-performance (+1.4 SD 1.8), and COPM-satisfaction (+2.7 SD 2.8), respectively. The mean values for both key pinch and tripod pinch remained unchanged, grip strength improved only slightly.

Conclusions: The study results clearly demonstrate the surgical feasibility and safety of the procedure, and 1-year clinical outcomes suggest the target population can experience pain relief and improved function. Based on these interim study results, additional larger-scale studies of the safety and performance of the Articulinx Cushion® were initiated with a modified device. Also, the inclusion criteria for this new study were modified slightly as the device is perhaps best suited for patients without extreme joint laxity and with Eaton-Littler stage I-II. In the current study group, pinch and grip strength measurements showed improvement trends at 1-year and, consistent with other surgical interventions in the CMC joint, further improvement in strength measurements is anticipated at the 2-year follow-up.

A-0329 Three-corner arthrodesis technique (3CA) instead of 4CA for salvage of the wrist

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Purpose: In a previous study, we compared two motion-preserving procedures for degenerative SLAC (scapholunate advanced collapse) wrist: four-corner arthrodesis (4CA) and proximal row carpectomy (PRC). Although pain relief and functional outcome were similar with both techniques, PRC has become our treatment of choice because it is technically easier and involves a shorter rehabilitation. 4CA had a

higher complication rate and a higher socioeconomic cost (hospital stay, sick leave). However, PRC is ill-advised in case of severe degenerative changes of the capitates, and concerns have been raised about secondary degenerative changes in the long-term following PRC in young patients. We therefore investigated whether three-corner arthrodesis (3CA) would be a valuable alternative to 4CA. The arthrodesis is essentially between the capitate and lunate following resection of the scaphoid and triquetral bones. Two headless compression screws (HCS), which are introduced from distal to proximal, provide for stable internal fixation and early controlled mobilization. We explored the possibilities of computerized preoperative planning to optimize the surgical technique.

Methods: In a prospective study of 12 patients, we evaluated the early results of 3CA after a mean follow-up of 3 years. In 4 patients of this 3CA cohort, we used computerized preoperative planning.

Results: Pain relief and functional gain were as good as in our previous study (PRC and 4CA cohorts) with an average DASH symptom score of 21.57, PRWE score 28.3, grip strength averaging 60% of the other side, and a flexion/extension range of 31/0/34. The socioeconomic cost for 3CA was considerably less than for 4CA as both the duration of the hospital stay and sick leave were reduced by 1/3 (to 2.4 days and 23.6 weeks, respectively). Also the number and severity of complications were much lower in the 3CA group (1 carpal tunnel syndrome and 1 delayed union). The use of computerized preoperative planning improved the postoperative alignment of the 3CA both on X-ray and CT scan.

Conclusions: In this 3 year follow-up study, 3CA appears to be a superior alternative to 4CA, when PRC is not an option. Computerized preoperative planning can be a useful tool in this procedure.

A-0331 Pyrolytic carbon proximal interphalangeal joint arthroplasty: results of about 32 prosthesis

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Introduction: Since 2002 we have chosen pyrolytic carbon implants for proximal interphalangeal (PIP) joint arthroplasty when bone density is sufficient. In cases of rheumatoid arthritis we generally prefer silicone implants. This study report is of our experience with PIP pyrolytic carbon implants.

Materials and Methods: Between November 2002 and April 2010, 32 prosthesis were implanted in 29 patients, mean age 59 years old. The involved fingers were the index in 4 cases, middle finger in 15 cases, ring finger in 11 cases, and little finger in 2 cases.

Indications for surgery included pain, stiffness, instability, and deformity. The pre-operative diagnosis included idiopathic osteoarthritis in 19 cases, post-traumatic osteoarthritis in 9 cases, rheumatoid arthritis in 3 cases with a good bone density. Pre-operative mean range of motion was 28°, 4 PIP joints were completely stiff. A dorsal longitudinal incision was used in 29 cases with a central extensor tendon flap according to the technique described by Chamay.

Results: 3 cases required revision surgery: one for proximal phalangeal implant migration, one for instability, and one for persistent pain. The revision procedures included replacement by a cemented prosthesis in the first case, by a silicone implant in the second case, and an arthrodesis was performed in the third case. In total, 29 prostheses in 26 patients were clinically and radiographically evaluated with a mean follow-up of 27 months (3–67 months). The average score for pain was 1.3 (0–5) of 10 on a visual analogous scale (VAS). Mean range of PIP motion was 48° (16–64°). Three prostheses were completely stiff, one with a swan neck deformity. Radiographic results showed 5 implant migrations with a peri-prosthetic loosening in 2 cases, 2 subsidences inferior to 2 mm, 2 peri-prosthetic ossifications with a stiff joint. A stable peri-prosthetic bone densification was observed in 12 cases.

Conclusion: Pyrolytic carbon proximal interphalangeal joint prosthesis offers a pain-free joint and functional range of motion with 27 months of follow-up. In cases of failure, the prosthesis can easily be removed because of the absence of osteointegration. Implant migration remains the main problem.

A-0336 Neuroplasticity and hand therapy: treatment of the “forgotten finger”

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Advances in understanding neuroplasticity show that the representation of body parts in the sensory and motoric areas of the cortex can be enlarged by special training. On the contrary, immobilization of the hand, e.g. by splinting, leads to a measurable shrinking of the normally in the homunculus quite large represented hand. This distancing effect starts after only 12 hours. Usually patients get over the rest reflex and reintegrate the parts of the body which were immobilized back into integrity. Sometimes patients remain in the rest reflex and fingers or even the whole hand stay “forgotten”. In contrast to the complex regional pain syndrome (CRPS)

these patients do not suffer from pain. They are in trouble with stiffness and daily activities. The fingers or hand feel strange and not their own, and therefore they are not used. Methods of treatment which have been established in the treatment of stroke patients are also well-suited to reintegrate “forgotten fingers” again. Techniques like recognize, mirror therapy, and motor imagery are used. Pictures and videos show examples. In conclusion, recognize, mirror therapy, and motor imagery help bring back the lost representation of fingers and hands in the cortex, especially when patients stay in a prolonged rest reflex after immobilization.

A-0340 Highly dosed tamoxifen as a neo-adjuvant treatment in minimal invasive surgery for Dupuytren disease in patients with severe fibrosis diathesis

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Background: Tamoxifen, a synthetic non-steroidal anti-oestrogen known to modulate the production of TGF beta, has shown its efficiency on fibroblast activity in vitro and in vivo. Clinical research was the main purpose of this study, to investigate a potential positive effect of tamoxifen on the outcome of surgery in Dupuytren’s contractures in patients with a strong fibrosis diathesis.

Methods: A prospective randomized double-blind study was set up with a protocol according to the CONSORT standards, to investigate the influence of tamoxifen on the healing process and the recurrence and/or extension of Dupuytren’s disease after subtotal fasciectomy in 30 patients with a severe fibrosis diathesis (graded 4 or more according to the scale of Abe). Tamoxifen was administered in high dosages (80 mg/day) during 6 weeks before until 12 weeks after surgery and patients were monitored for 2 years.

Results: The short-term surgical outcome after 3 months improved significantly in the group with tamoxifen as compared with the placebo group. Both the goniometrical correction of the contractures and patient satisfaction. However, this positive effect was slowly lost over a period of 2 years after the medication was stopped.

Conclusions: The study demonstrates that neo-adjuvant use of tamoxifen during 4 months may improve the short-term surgical outcome in Dupuytren’s disease in patients with a high fibrosis diathesis. Since this effect decreases within 2 years after surgery, the authors conclude that although highly dosed neo-adjuvant tamoxifen has

the potential to improve surgical outcome, an important rebound effect after the medication is discontinued causes a loss of the benefit in patients with fibrosis diathesis. A longer use of the medication may however carry severe risks for thrombosis and liver dysfunction. Therefore, although a positive effect on surgical outcome was established, the risk of extending the duration of high doses of tamoxifen, may outweigh the possible benefits in Dupuytren's disease.

A-0342 Arthroscopic resection arthroplasty for malunited intra-articular distal radius fractures

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Background: Presence of cartilaginous damage on the carpal bone is a formal contraindication for osteotomy in malunited intra-articular distal radius fracture, and an indication for partial wrist arthrodesis. We present our experience treating this combined articular damage by arthroscopic resection arthroplasty and report our early results.

Material and Methods: 10 patients (17–67 y) who suffered from intra-articular malunion of the distal radius with mirror erosion on the carpal bones were managed by resecting the offending radial fragment under arthroscopy. The original fracture occurred up to 17 months prior referral. In 2 patients the damage was located in lunate fossa anteriorly; in 3 predominated dorsally: in the scaphoid and the lunate fossa in 2, and the dorsal lunate fossa in 2; in the last patient the damage involved the scaphoid fossa volarly and the lunate fossa dorsally. Concomitant surgery was performed in 8: extra-articular osteotomy (1), hardware removal (4), excision of a nonunited ulnar styloid and CMC arthroplasty (1), and in the last patient the median nerve, that had been lacerated elsewhere, was microsurgically repaired. Range of motion was started immediately after the surgery in all.

Results: Up to 60% of the whole radial surface was resected in order to obtain a smooth surface (range 20–60%). Immediate relief of pain and improvement in ROM (particularly extension) was reported by all patients. At the latest follow-up (4 to 1 year) extension improved from 27° to 57°, pain from 8.5 to 1.5 (on a VAS), and grip strength from 48.5% to 84%. The worst result corresponded to the patient whose median nerve was repaired.

Discussion: The aim of the operation is to relieve patients' mechanical symptoms by providing a smooth, although fibrocartilaginous, surface for the

carpus to glide over the radius. The follow-up is short and the operation maybe short-lived but may provide a temporary alternative to partial wrist fusion with minimal morbidity for the younger patients and perhaps definitive for the less demanding patients.

A-0343 Free vascularized osteochondral autograft

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Background: Large chondral defects in the radius after trauma poses a phenomenal reconstructive challenge at the radius. The purpose of this study is to present the technique of vascularized osteochondral graft from the base of the metatarsal to reconstruct the radius. The midterm outcomes (8 years to 20 months) are presented.

Patients and Methods: The base third metatarsals were studied in the feet of 20 cadavers. It is pear-shaped, wider dorsally (12.6 mm) than plantarly (7.9 mm), and 19.2 mm maximum length on its main axis. Its cartilaginous surface is minimally concave or flat, and it is slightly slanted proximal-dorsal to distal-plantar and proximal-peroneal to distal-tibial. An accessory facet to the base of the fourth metatarsal, exist and is extremely useful at the time of reconstructing the sigmoid notch. Nutrient foramina were found in every case in the dorsum and both sides of the proximal shaft. At least one nutrient vessel could be tracked back to the dorsalis pedis in every dissected specimen. The operative technique and results in 7 patients who have been operated for major defects on the radius surface is presented. In 1 the scaphoid fossa was reconstructed while in the rest (6) the defect involved the lunate fossa. In 5 of these the sigmoid notch was also restored.

Results: At the latest follow-up (8 years to 20 months) improvement in ROM (average 70° improvement) and decreased in pain (from 9 preop average to 1.5 postop in a VAS). No complaints from the donor site were referred.

Discussion: Major defects of the articular surface of the radius can be presently treated only by arthrodesis. We have had very promising results in the midterm with this technique, which although complex allows transfer of a piece of living cartilage to restore the articular surface.

A-0348 Pressure distribution within the hand during cylinder grip

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Purpose: The aim of this study is to identify a high-resolution load distribution pattern of the hand when it is gripping cylindrical objects of different sizes.

Methods: Seventy-six healthy probands (38 male, 38 female) with a mean age of 32 years (range 18–65 years) were included in this study. Each proband performed grip force tests with the Pliance® manugraphy system. For this, three cylinders with 10-, 15-, and 20-cm circumferences were coated with calibrated, capacitive pressure sensor mats. These measured the applied load dynamically with a resolution of 2 sensors per cm². The probands performed three times a maximum force grip for 5 s consecutively with the three sizes of the Pliance® manugraphy cylinders. To avoid overlapping of the thumb with the fingers, cylinder grip with the small cylinder was performed without using the thumb. The tests were repeated at another 2 days to minimize the effect of temporal variation. The mean force over the middle 3 s interval was evaluated. The loading pattern within the fingers, thumb, and palm was analyzed and compared for the 3 different cylinder sizes. To compare the fingers to each other, the absolute applied load on the fingers was set at 100%.

Results: For the small cylinder, the load was distributed with 96.0% over the fingers, 2.7% over the thenar, and 1.3% over the hypothenar. For the middle cylinder, the local load was 12.8% for the thumb, 58.4% for the fingers, 17.9% for the thenar, and 10.9% for the hypothenar. For the large cylinder, the local load was 18.6% for the thumb, 53.4% for the fingers, 19.0% for the thenar, and 9.0% for the hypothenar. Using the small cylinder, the distribution over the fingers was 22.8% for the index finger (II), 27.6% for the middle finger (III), 28.7% for the ring finger (IV), and 20.9% for the little finger (V). For the middle cylinder, the applied load was found distributed by 33.1% for II, 33.9% for III, 21.4% for IV, and 11.6% for V. For the large cylinder, the load distribution was 32.5% for II, 33.2% for III, 22.5% IV, and 11.8% V.

Conclusion: Thenar and hypothenar play a minor role while gripping smaller objects. The load-bearing proportion of the thumb is higher in the large cylinder than in the middle one. Comparing the load distribution within the fingers, the little finger takes a higher portion of the load when gripping the small cylinder than when gripping the middle and large cylinders. The inverse tendency is seen in the index finger. Middle and ring finger take an important portion of the applied load in any cylinder size.

A-0350 The outcomes assessment of the Littler procedure plus MP joint release in the treatment of the stiffness in the post-traumatic extrinsic hand

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Purpose: To assess the outcomes of lengthening tenotomy of the extrinsic portion of the extensor apparatus on the dorsal of the proximal phalange (Littler procedure) associated with MP joint release (dorsal capsulotomy plus collateral ligament release) in the treatment of the post-traumatic extrinsic hand.

Materials and Methods: Study population. Inclusion criteria: 1. post-traumatic stiffness of the MP joint in extension, 2. Positive Littler manoeuvre. Exclusion criteria: associated flexor tendon lesion, 2. neurological motor impairment, 3. stiffness of the IP joint in flexion, 4. neurological pain or active CRPS. A total of 12 consecutive patients who followed the selection criteria constituted the sample study (7 men and 5 women) with mean age of 41, 33 years old. A longitudinal cohort study with measures before surgery and after surgery (mean follow-up measurement at 23, 08 weeks). Instruments and measures: the total active range of motion (TAM) of the digits and grip strength were used as outcomes variables. Statistical analysis: the treatment effect was analyzed based on the effect size (ES) and the standardized response means (SRM).

Results: The treatment improved the TAM in all fingers, being better in the ulnar digits (Index: 53.33; SD 30.62; ES = 1.32; SRM = 1.74) (Long: 55; SD 29.15; ES = 1.37; SRM = 1.88) (Ring: 67.08; SD 1.09; ES = 1.09; SRM = 1.57) (Small: 78.75; SD 49.13; ES = 1.33; SRM = 1.6). The grip strength outcome variable showed an improvement of 12.07 Kgr (SD 7.14) with an ES of 1.70 and a SRM of 1.68.

Conclusion: The Littler procedure plus MP joint release to treat the post-traumatic extrinsic hand is an effective procedure showing a large improvement in TAM and grip strength.

A-0352 Soft tissue regeneration with occlusive dressing in fingertip amputations and exposed bone

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Introduction: How perfect is the regeneration of a fingertip in an amputated distal phalanx with exposed bone when treated with occlusive dressing?

Methods: Between October 2009 and October 2010 we treated 24 cases of fingertip amputation with

exposed bone only with an occlusive dressing. Inclusion criteria were all amputations in the zone II–III according to Ishikawa. Six to 18 month after the accident, 17 patients (9w:8m, age 21–69 years) with 19 injured fingers could be evaluated. The thickness of the soft tissue was measured with ultrasound in distal and palmar directions. The sensibility was determined with the two-point-discrimination test. The regeneration of the fingerprint was documented with real finger prints and photos.

Results: The regenerated fingertip in palmar direction measured 5.9 mm (4.0–9.5 ± 1.6 mm) and on the not injured side 6.6 mm (5.0–9.5 ± 0.8 mm). In distal direction it measured 3.9 mm (2.5–9.3 ± 1.7 mm) and on the not injured side 4.4 mm (3.5–5.8 ± 0.8 mm). The two-point-discrimination was 4.3 mm (2–9 ± 1.8 mm) and on the not injured side 3.1 mm (2–4 ± 0.8 mm). The regeneration of the skin was widely scar free and the fingerprint regenerated. No infection occurs and no change of treatment was necessary.

Conclusions: Fingertip amputations with exposed bone are no contraindication for occlusive dressing treatment. The potential of the soft tissue regeneration was over 80%. The healing was nearly scar free.

A-0353 Wrist arthroplasties in a demanding patient group, 30 SNAC, and SLAC wrists followed 3.2 (1–6) years after implantation

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Introduction: No arthroplasty have demonstrated long-term satisfactory results in non-rheumatoid patients.

Patients and Methods: Since 2006 a newly developed arthroplasty (Motec wrist) has been offered to all patients with scaphoid non-union advanced collapse (SNAC, n = 16) or scapholunate advanced collapse (SLAC, n = 14) scheduled for wrist arthrodesis. The arthroplasty comprises a modular system with metal-on-metal ball and socket articulation, and titanium-alloy screw-shaped components for fixation in the distal radius and capitate/3 metacarpal. Thirty patients (20 men), 23 right and 23 dominant hands were included and followed up prospectively. The mean age at surgery was 52.4 (31.0–71.4) years. Twenty-two previous surgeries (fracture treatment, ligament reconstruction, bone resection or limited arthrodesis) had been performed in 13 wrists, more than one in eight of them. Five patients had bilateral osteoarthritis of the wrist and eight of the ipsilateral

distal radioulnar joint; one previously underwent the Darrach's procedure. Preoperatively and at follow-up the patients completed the DASH score, graded radial- and ulnar-sided wrist pain at rest and in activity using a scale from 0–10, 0 indicating no pain. Active and passive range of wrist motion (AROM and PROM) (flexion, extension, radial, and ulnar deviation) and forearm rotation were measured, as well as grip strength. Radiographs were evaluated for bone-implant fixation, CMC3 arthrodesis, and migration/loosening. The mean follow-up was 3.2 (1–6) years.

Results: Preoperatively (30 patients), after 1 (27 patients), 2 (18 patients), 3 (11 patients), 4 (7 patients), and 5 (4 patients) years are presented, *p < 0.05, no statistical comparison is performed at 5 years. One patient declined follow-up after cast removal. Two wrists were revised during the follow-up period, one due to infection/inflammation and one due to persistent pain (both arthrodesis). One patient has a radiologically loose arthroplasty, possible due to a haematogenous infection, scheduled for revision. In four patients additional surgery has been done — Darrach's procedure (1), removal of bone (3) (triquetrum, scaphoid, radial styloid) due to impingement. DASH: 41–19*–16*–20*–19*–23*; AROM: 105°–120°–123°–132°–135°–124°; supination: 83°–85°–87°–90°–91°–87°; pronation: 87°–82°–83°–85°–86°–85°; JAMAR (kg): 23–23–30–27*–25–23; pain radially at rest: 3.6–0.7*–1.1*–1.0*–0.4*–0.5; pain radially at activity: 7.4–1.9*–2.1*–1.9*–2.0*–4.3; pain ulnarly at rest: 2.1–0.8*–0.4*–0.5–0.3–0.0; pain ulnarly at activity: 4.2–2.3*–0.6*–1.2–1.1–0.5. None of the patients uses analgesic for wrist problems, and 27/29 would have chosen arthroplasty over arthrodesis knowing the outcome. 19/30 were working preoperatively, 18/30 at follow-up. Except for one wrist (loose), all implants demonstrate bone-implant contact, and no migration or loosening is observed.

Conclusion: Short-term results with the Motec wrist in a high demand patient group are encouraging with pain relief and good hand function. The ball-and-socket articulation was stable (no luxations have occurred) with a satisfactory range of motion. The arthroplasty can be a good alternative for the majority of destroyed wrists.

A-0354 The total distal radioulnar joint prosthesis (APTIS): functional outcome in seven patients

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Purpose: This study was designed to examine the early functional and subjective outcome after total

distal radioulnar joint (DRUJ) replacement with the APTIS endoprosthesis, as designed by L. Scheker.

Methods: Since June 2006, 7 patients (3 men and 4 women) presenting either a posttraumatic or a congenital deformity with secondary degenerative disease of the DRUJ were operated on by one single surgeon. They all had previously undergone multiple surgical treatments, sometimes with severe adverse effects. Four patients were operated for failure of a Herbert ulnar head prosthesis. The mean age at surgery was 43 years (24–57 years). Follow-up ranged from 1 to 5 years. The following questionnaires were completed: Patient-Rated Wrist Evaluation (PRWE), Disabilities of the Arm, Shoulder and Hand (DASH), visual analogue scale (VAS) pain score, a query concerning complications, activities of daily living (ADL), and overall patient satisfaction. The clinical examination included measurement of range of motion, grip strength, and strength of key pinch. Torque during pronation and supination was measured with use of the Baltimore Therapeutic Equipment (BTE). All measurements were taken on both the operated and the nonaffected side.

Results: DRUJ replacement surgery with the APTIS endoprosthesis and postoperative rehabilitation were uneventful in all patients. Two patients required further surgery for nerve or soft-tissue problems. Pronation and supination increased in all patients. Grip strength increased in all patients but to a variable extent. The weight-lifting capability showed only minor improvement. Four out of 7 patients still required chronic pain medication and had a VAS score for pain of 7 or more. Multi-operated patients who had a nonfunctional upper limb preoperatively did not have an excellent postoperative result but still considered the surgery as a major improvement. Patients who had few previous surgical procedures achieved the best results. The scores for patient satisfaction with total DRUJ replacement were very high and all patients would have the surgery again, if needed. Three patients returned to their previous job and one previously unemployed patient was able to start working. Two patients were still unable to work because of their DRUJ problem and one patient was incapacitated because of severe back problems.

Conclusions: The total DRUJ prosthesis improves the functional outcome in salvage operations for previously failed surgery and patient satisfaction with this procedure is high. The effect on pain is less predictable and chronic pain may not be resolved. Patients need to be aware that this is a salvage procedure with pre-set limitations in the functional improvement. The surgeon needs to be prepared to tackle secondary problems. Larger studies are needed to assess the clinical value of this procedure in salvage surgery of the DRUJ.

A-0355 Impact analysis of different definitions of recurrence of Dupuytren's disease by using one dataset of patients

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Purpose: To compare the effectiveness of treatment for Dupuytren's disease (DD), recurrence rates are important outcome measures. These rates vary between 0% and 100% in literature. However, this wide range may not be caused by differences in treatment effect. The lack of a consistent definition of recurrence could be an important problem. The purpose of this study is to show the impact of using different definitions of recurrence on study results.

Methods: All studies that described a definition of recurrence or a recurrence rate were identified by a systematic search on PubMed and Embase. Inclusion was based on English, Dutch, German, or French language, original datasets of at least five adult patients and publication between January 1985 and April 2011. In addition, a single dataset of 66 patients with 73 operated hands was used to perform an impact analysis on the use of different definitions for recurrence found in the systematic review. This dataset of the Dupuytren Rotterdam Trial contained the pre-operative, 2-week, and 6-month follow-up of passive extension measurements. Furthermore, questionnaires were completed by patients to evaluate satisfaction using a visual analogue scale (VAS).

Results: Of the 113 articles reporting recurrence rates of DD, 56 (49%) presented a definition of recurrence. We categorized these definitions into six groups: 1) nodules or cords in unspecified area; 2) nodules or cords in the operated area; 3) return of contracture in degrees; 4) nodules, cords or return of contracture; 5) recurrence self-reported by patients; 6) recurrent surgery. All definitions categorized in group 3 were applied on the dataset. This resulted in recurrence rates ranging between 1% and 78%, based on which definition was used. When the 2-week post-operative measurements were used as a baseline instead of the pre-operative measurements, recurrence rates ranged between 1% and 62%. Recurrence based on patient satisfaction ranged between 8% and 42%, depending on the VAS cut-off point for recurrence.

Conclusions: This impact analysis with one dataset of patients shows a dramatic influence in the use of different definitions on recurrence rates. The selection of the definition can make the difference between

low recurrence rates and high recurrence rates in a single dataset. Our study shows that it is difficult or even impossible to compare treatment outcome of studies that use different definitions and it is therefore clear that consensus on the definition of recurrence of DD is needed.

A-0358 Short-time results of anatomical reconstruction of the thumb metacarpophalangeal joint collateral ligaments with tendon grafts

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Purpose: Ligament reconstruction with free palmaris longus tendon graft through bone tunnels was found to be an unreliable procedure in our department and primary fusion became our standard method for treatment of symptomatic thumb metacarpophalangeal (MP) instability. A former study in our department revealed that the results with primary fusion were not always optimal, so we introduced anatomical ligament reconstruction as an alternative treatment. The aim of the study was to evaluate the short-term results of ligament reconstruction retrospectively.

Methods: 17 patients operated in Oslo University Hospital for clinically and radiologically verified ulnar or radial instability in the thumb MP joint between 2008 and 2010 were included, patients with basal joint pathology and Worker's Compensation Board claims were excluded. Nine males and eight females were included, 13 right and 4 left thumbs, 13 ulnar and 4 radial instabilities. A bone-tendon graft from the distal attachment of the extensor carpi radialis longus was used in 3 cases according to the technique of Fusetti. The bone block was fixed with a screw. The tendon graft was spread in a fan shape to reconstruct both the proprius and the accessorius collateral ligament, attached to the basal phalanx with a bone anchor and sutured to the palmar plate of the MP joint. In 12 cases a free palmaris longus tendon, and in 2 cases half of the flexor carpi radialis tendon were used in a similar configuration, but fixed proximally to the head of the metacarpal with a resorbable interference screw. The patients were followed-up for a minimum of 12 months. The Norwegian version of the Quick DASH score, range of motion (ROM) as percentage of the intact side, lateral angulation on stress X-rays, grip strength, key- and tip-pinch were registered both preoperatively and at the follow-up. The clinical outcome was graded according to Glickel's criteria. Complications were recorded as well.

Results: The mean (SD) Quick DASH score decreased significantly from 29 (13.7) to 6.3 (6.2). The lateral angulation on stress X-rays decreased from 34 (19) to 19 (16)°, the tip pinch increased from 60 (26) to 84 (37)% of the uninjured side. The ROM, grip strength, and key-pinch did not change significantly; however, these parameters were not much affected by the instability. Eleven patients graded excellent and six good according to Glickel's criteria. The reconstructed ligament failed in two cases: one after an adequate trauma and the other by bone resorption around the metacarpal interference screw; however, both patients graded good functionally, were satisfied with the result and did not want MP joint fusion. The inserter of the interference screw broke in one case, and was left in the middle of the screw; it did not affect healing and the patient achieved a good function. Seven patients experienced temporary paraesthesia of the thumb or dorsally on the second metacarpal; however, they achieved full recovery by the follow-up.

Conclusions: Our study demonstrates that anatomical collateral ligament reconstruction with free tendon graft is a reliable procedure, the functional results are satisfying, and the complications are few.

A-0359 Collateral ligament reconstruction with tendon graft exhibits better subjective results than fusion of the thumb metacarpophalangeal joint

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Purpose: Treatment of chronic collateral ligament injuries of the thumb metacarpophalangeal (MP) joint is controversial. Some authors advocate primary fusion and others prefer ligament reconstruction, reserving fusion as a salvage procedure for failed ligament reconstruction or secondary osteoarthritis. The aim of the study was to compare the subjective results of MP joint fusion with ligament reconstruction retrospectively.

Methods: Patients treated in Oslo University Hospital for clinically and radiologically verified ulnar or radial instability of the thumb MP joint between 2002 and 2010 were included; cases with basal joint pathology and Worker's Compensation Board claims were excluded. The fixation of the 21 fusions was carried out using K-wires or additional cerclage wires. Bony fusion occurred in all patients. We included 17 patients in the ligament reconstruction group: the palmaris longus tendon was used in 12, half of the extensor carpi radialis tendon in 3, and half of the flexor carpi

radialis tendon in 2 cases. The ligamentoplasty aimed at reconstructing both the proprius and the accessory collateral ligaments in a fan-shaped configuration. There was no significant difference between the two groups according to age, gender, side, dominance, distribution of ulnar and radial instability, and number of preoperatively painful joints. The evaluation was based on self-reported questionnaires. The Norwegian version of Quick-Dash score was completed and overall satisfaction, pain, stiffness, and impairment of ADL were measured with visual analogue scales (VAS) where 0 signifies the best and 10 the worst results. The patients were asked to specify difficulties in activities and if they would have undergone the same procedure again.

Results: The mean, range Quick DASH scores were 6.3, 0–18.9, and 11.9, 0–72.7 in the ligament reconstruction and the fusion groups, respectively, the difference being statistically insignificant. The overall satisfaction, pain, and impairment of ADL VAS scores were significantly lower in the ligament reconstruction group (0.5, 0–2.7; 0.9, 0–2.7 and 0.5, 0–3.7) than in the fusion group (2.6, 0–9.6; 2.3, 0–7 and 2.1, 0–7.1, respectively). The stiffness VAS score was statistically insignificantly lower in the reconstruction group (1.3, 0–5 and 2.6, 0–9.8 in the two groups, respectively). None in the reconstruction group regretted the operation whereas five in the fusion group did ($p = 0.031$). Seven in the reconstruction group and 17 in the fusion group specified difficulties in activities ($p = 0.011$).

Conclusions: Our study indicates superior subjective results and higher patient satisfaction after collateral ligament reconstruction compared with primary fusion in the treatment of thumb MP joint instability.

A-0360 Dorsal and volar arthroscopic reconstruction of the scapholunate ligament with the ligamentoplasty B-T-CT (bone-tenodesis-capsulotenodesis) technique

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The treatment of the scapholunate ligament injuries is complex and unreliable. Various open techniques have been described for its reconstruction including

capsulodesis, bone-ligament-bone transfers, tenodesis, etc. The development of wrist arthroscopy offers a new range of minimally invasive techniques including debridement, electrocoagulation, percutaneous fixation, and capsuloligamentous repair without opening the wrist. But arthroscopic wrist ligament reconstruction is yet very difficult. We have recently published an arthroscopic technique for the reconstruction of the dorsal portion of the scapholunate ligament call "arthroscopic ligamentoplasty bone-tendon-tenodesis". Our experience is quite good with this minimally invasive technique in dynamic or static instability without a DISI deformity, because the plasty prevents the dorsal conflict between the radius and scaphoid of the scapholunate instability as the bone flexion is corrected with the first tenodesis and the pronation with the second one, linking the dorsum of the proximal scaphoid and the lunate. However, this technique, as well as the majority of the open techniques, has two weak points. The first one is that reconstructing only the dorsal portion, it is very difficult to correct a DISI deformity because there is only one linking point and both the scaphoid and the lunate can rotate in the sagittal plane around this point. The second one is that despite of repairing the most important biomechanical portion, not doing the reconstruction of the volar portion could eventually result in an increase of the scapholunate gap (what frequently happens with open techniques) and the biomechanics of the scapholunate articulation won't be as perfect as it would be using a double reconstruction. In order to improve these weak points, we have added one more surgical step to our "B-T-T ligamentoplasty" based on a recently published technique about arthroscopically suturing the volar scapholunate ligament, by Dr. Piñal. This new step consists of doing the capsuloligamentous suture described in the paper mentioned, but leaving the strings out of the articulation, in the volar side and knotting them to the plasty, achieving what we have called a "capsulotenodesis". With this volar reinforcement, the scapholunate volar portion is reconstructed as well and a new linking point is obtained between the scaphoid and the lunate, which can prevent the lunate dorsal displacement. We have change the name of the technique attending to the fixation points of the plasty: bone (base of the second metacarpal) -tenodesis (in the scaphoid and lunate tunnels) -capsulotenodesis (in the volar capsule over the scapholunate volar portion). Our goal in this oral communication is to explain in detail this new arthroscopic technique, which is the first one (using an arthroscopic approach) achieving a double reconstruction (volar and dorsal) of the scapholunate ligament.

A-0361 Delayed autogenous nerve grafting at forearm and hand: our clinical results

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Purpose: The most critical step in nerve repairs to achieve the best results is a tension-free end-to-end nerve coaptation. Optimal conditions may not be fulfilled at the forearm level nerve injuries. Hand surgeons have alternative reconstructive options for such conditions. Nerve autografts or allografts, autogenous vascular substitutes, synthetic conduits, and biological products are among the most applied methods.

Methods: Eleven patients, treated with autogenous nerve grafts regarding nerve injuries at forearm or hand level between 2009–2011 were included in our study. Mean age was 31.1 [8–60 years]. Average time between injury and repair was 43 days (1–300 days). Distribution of the involved nerves was as nine digital nerves in seven cases, three median nerves in three cases and one ulnar nerve in one case. Donor conduits were lateral antebrachial cutaneous nerve in six cases, sural nerve graft in three cases and in three cases and double-level injured and separated nerve itself. The average length of donor nerves was 2.3 cm. Average follow-up was 274 days.

Results: Q-DASH scale was determined to evaluate patients' hand functions. Pinch and power-grip functions were evaluated and Semmes-Weinstein monofilament test was performed for sensorial functional assessment. DASH scores ranged between 11.3 and 31.8. Sensory evaluation revealed successful recovery results except in two patients.

Conclusions: Our clinical results conclude that autogenous nerve grafts are leading method for restoration of nerve gaps at forearm and hand level. Lateral antebrachial cutaneous nerve is preferentially selected as nerve graft source in neglected nerve injuries of the hand.

A-0362 Mouse wrist

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Purpose: Repetitive daily use of a computer keyboard typically involves maintaining a posture in which the wrist is held in dorsiflexion and the volar part of the wrist and proximal palm rest on a desk, with the main

contact area being directly over the pisiform. We have identified a group of office workers who have presented with a tender callosity overlying the palmar surface of the pisiform which, we believe, is due to use of the computer mouse, hence, the term mouse wrist.

Methods: To date, three patients have presented with features of mouse wrist. All were office workers, aged between 29 and 42 years, who spent the majority of their day at a computer workstation. They all presented with a tender swelling over the pisiform which was interfering with their work. Radiographic examination was normal in each case.

Results: All three underwent surgical exploration through a short curved incision under brachial block anaesthesia. The findings at surgery were similar in each case. The skin overlying the pisiform was thickened and hyperkeratotic. There was an overgrowth of subcutaneous fibro-fatty tissue in keeping with a chronic inflammatory reaction. In each case, this tissue was excised and sent for histological examination. In two cases, this revealed multiple peripheral nerve bundles surrounded by thickened collagen bands, suggestive of a traumatic neuroma. Tissue from the third case revealed a single peripheral nerve bundle surrounded by fibrous tissue and thickened collagen bands. All three patients were successfully treated by excision of this fibrous subcutaneous tissue and were able to return to work, pain free, after 2 weeks.

Conclusions: Repetitive daily use of a computer keyboard or mouse, at home or in the workplace, can lead to a painful swelling over the pisiform which we have called mouse wrist. Histological examination identified a chronic inflammatory response associated with peripheral nerve bundles, suggestive of traumatic neuroma. Surgical excision of this abnormal tissue results in cure.

A-0363 Coverage of neuroma in continuity of the median nerve with vascularized soft tissue

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Purpose: Treatment of median nerve neuromas in continuity still poses many problems. Total or partial neuroorrhaphy to the median nerve after cut injuries may be associated with painful tumefaction at the wrist and a markedly positive Tinel's sign, even when it is accurately performed by means of microsurgical technique. The purpose of such treatment is to

minimize pain and preserve the residual function of the median nerve. Surgical treatments include neurolysis with median nerve transposition for most of the cases, while reconstruction with grafting is the accepted procedure only in those cases with very poor sensory and motor recovery. During the recent years, particular attention has been focused on coverage of neuromas using different local flaps or free flaps. The purpose of this study is to review the results obtained covering neuromas in continuity of the median nerve using four different local flaps.

Methods: 21 patients (14 of whom were males and 7 females, mean age 37 years) with post-traumatic neuromas in continuity of the median nerve, and who had unsuccessfully undergone medical conservative treatment procedures, were treated over a 15 year period. The surgical procedure included the neurolysis of the neuroma in continuity and coverage of the nerve with the pronator quadratus muscle flap (7 cases), Becker fascio-subcutaneous flap (7 cases), radial artery perforator subcutaneous fascial flap (5 cases), and Wulle synovial flap (2 cases). Clinically, all of the patients presented with wrist pain, associated with positive Tinel's sign in response to percussion over the site of the presumed neuroma. A sensory deficit was always observed at the site of the median nerve: 15 patients achieved a Hightet scale rating of S3 and 6 of S3+. Motor function of the thenar muscles was preserved in all of the subjects, totally (M5) in 10 cases and (M4) in the remaining 11 cases.

Results: All of the patients were reviewed at a mean follow-up of 42 months after surgery. Clinical study showed pain relief in 16 cases. Tinel sign had regressed in 17 cases while a more modest sign occasionally persisted in 4 cases. Recovery of sensory function was achieved after surgery only in four cases, where it improved from S3 to S3+ according to the score of Hightet. Postoperative motor function of the thenar muscles according to the British Medical Council scale was unchanged.

Conclusions: Vascularized soft tissue coverage of painful median nerve neuromas seems to be an effective and attractive method of treatment. We do not believe that a free flap has been any particular advantage over a well vascularised local technique. For this reason we prefer local flaps of vascularized fascia (Becker or Radial Perforator flaps) to protect median nerve. The major inconvenience of the pronator quadratus muscle flap is represented by the limited distal excursion, which prevents its application in case of injuries to the median nerve at the wrist flexion fold and beyond.

A-0369 Primary repair of crush nerve injuries by means of biological tubulization with muscle-vein combined grafts (MVCG)

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Introduction: Primary nerve repair with nerve graft in crush injuries could be a risk because the extent of resection might be difficult to judge in case of nerve laceration/contusion; sometimes it is better to avoid primary repair because of the conditions of the surrounding tissues. In these circumstances, it may be advisable to identify and suture the nerve ends in order to avoid retraction, and then looking forward to a secondary reconstruction when definitive graft repair can be performed. The aim of this study was to assess the clinical outcome in a group of 16 patients who underwent a primary repair for crush injury of sensory and mixed nerves of the upper limb with biological tubulization, namely the muscle-vein combined graft (MVCG).

Patients and methods: From 1995 to 2008, 16 patients with crush nerve injuries located at the upper limb were treated in emergency by means of MVCG. The segments involved were sensory digital nerves in eight cases and mixed nerves in another eight cases (four median – four ulnar nerves). The length of nerve defect ranged from 0.5 to 4 cm (mean 1.9 cm). The follow-up ranged from 24–60 months. Sensory functional outcome was assessed by Semmes–Weinstein monofilament test and by static two-point discrimination test according to the criteria of the British Medical Research Council modified by Mackinnon–Dellon. The criteria of the BMRC were also used to assess motor function recovery for mixed nerves. Statistical analysis was carried out by Mann–Whitney U-test comparing motor and functional outcome in digital, median, and ulnar nerves, respectively. Statistical significance was established as $p < 0.05$.

Results: Fifteen out of 16 patients showed some degree of functional recovery. Six patients showed diminished light touch (3.61), six had protective sensation (4.31), and three showed loss of protective sensation (4.56) using Semmes–Weinstein monofilament test. All the patients who underwent digital nerve repair had favourable results graded as S4 in one case, S3+ in six cases, and S3 in one case. With respect to mixed nerve repair,

we observed two S4, two S3+, two S3, one S2, one S0 sensory recovery. Less favourable results were observed for motor function with three M4, one M3, two M2, and two M0 recovery.

Conclusions: Altogether, the results of this retrospective study demonstrates that tubulization nerve repair in emergency, in case of short nerve gaps, may restore the continuity of the nerve avoiding secondary nerve grafting. In our experience no patient underwent secondary nerve reconstruction and therefore the procedure proved to be definitive in all the cases. Anyway, in theory, the possibility for secondary nerve reconstruction was not precluded and in case of failure secondary nerve graft repair is expected to be easier to be carried out since the anatomical continuity was restored. Therefore, an indication for muscle-vein combined nerve reconstruction is represented by clinical situation when doubts exist about primary autograft reconstruction due to various reasons, such as bad conditions of nerve stumps and surrounding tissues, lack of informed consent for harvesting a healthy nerve, local plexus anaesthesia

A-0371 Two extension block Kirschner wire technique for mallet finger fractures

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Background: Extension block pinning, which consists of a dorsal extension block Kirschner-wire and a second volar wire to hold the distal interphalangeal joint in extension, was described in 1988 by Ishiguro et al. This simple and reliable method has been modified by several authors. We consider that more accurate reduction and stable fixation is achieved when two small extension block K-wires are used, thereby producing a more favourable outcome. The aim of this study was to describe our refinement of Ishiguro's technique using two small extension block K-wires and to present the outcome.

Patients and Methods: We reviewed 32 consecutive patients with a mallet fracture of a distal phalanx treated by our modified technique. There were 22 males and 10 females with a mean age of 28.1 years (17–47). The indication for operation was a displaced mallet finger fracture involving more than one-third of the articular surface, with or without volar subluxation of the distal phalanx. Comminuted or open fractures were excluded. The mean joint surface involvement was 38.4% (33–50%), and 18 patients (56%) had associated subluxation. The mean follow-up was 49 months (25–84). The procedure was

generally performed under digital block anaesthesia with image intensifier control. With the distal and proximal interphalangeal joints held in maximum flexion, a 0.9 mm K-wire is introduced just behind the fragment and driven proximally into the head of the middle phalanx at an angle of 30° to its long axis. A second K-wire is inserted 2–3 mm apart from and parallel to the first. Closed reduction is achieved by extension of the distal phalanx along with dorsal translation when there is volar subluxation of the distal phalanx. A third 0.9 mm K-wire is inserted from the volar side across the distal interphalangeal (DIP) joint to maintain extension and reduction.

Results: All fractures united at a mean time of 6.2 weeks (5.1–8.2). Congruent and satisfactory joint surfaces (anatomical or intra-articular step-off of < 1 mm) were present in all patients, and no arthritic changes were observed at final follow-up. The mean active flexion of the DIP was 83.1° (75–90°) and the mean loss of voluntary extension was 0.9° (0–7°) at final follow-up. Nail ridging occurred in three cases but disappeared at a mean 8 months (6–10) with normal growth. There were also two cases of transient nail deformity. No finger had a prominent dorsal bump or recurrent mallet deformity. All patients were satisfied with function and cosmesis. According to Crawford's classification, the outcome was excellent in 22 (68.8%), good in eight (25.0%), and fair in two (6.2%) patients. The K-wires were removed at a mean of 44 days (36–58) post-operatively.

Conclusion: We have found that two-extension block K-wires, when correctly applied, produces good radiological and clinical outcomes by achieving anatomical reduction and stable fixation with relatively few complications.

A-0373 The natural history of paediatric trigger thumb: minimum 5-year follow-up study

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Background: Paediatric trigger thumb is due to deformed flexion of the interphalangeal joint. We previously reported that paediatric trigger thumb can spontaneously resolve in > 60% of patients at the median follow-up of 48 months. The purpose of this study was to determine whether there were any more cases of resolution with a follow-up of more than 5 years and whether any residual deformities remain, hence confirming the natural history of paediatric trigger thumb.

Methods: We prospectively followed 87 thumbs in 67 patients with paediatric trigger thumb without any treatment, such as passive stretching, splinting, or surgery. The date of first visit ranged from April 1994 to March 2005. The patients were evaluated every 6-months prior to resolution and annually after resolution. The median duration of follow-up was 87.3 (60–156) months.

Results: Of the 87 trigger thumbs, 66 (75.9%) resolved spontaneously. The median time from the initial visit to resolution was 49.0 months (95% CI, 41.1–56.9). There were no residual deformities which resolved beyond 48 months. Although complete resolution did not occur in the remaining 21 thumbs, flexion deformities did improve in all thumbs. There were no other differences between the two groups besides the average duration of follow-up. There was no difference in resolution based on gender.

Conclusions: Paediatric trigger thumb can spontaneously resolve in > 75% of cases after a follow-up period of at least 5 years. Operation may be delayed or avoided in the majority of cases. This may help both families and surgeons make decisions regarding treatment of paediatric trigger thumb.

A-0375 Increase in wrist fractures in young soccer players in the Netherlands between 1998–2009; possible relation with the introduction of artificial turf fields

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Purpose: In a recent study, we have shown that the incidence of distal radius and carpal fractures in children and adolescents increased between 1997 and 2009. One of the major causes of these fractures was soccer playing. In this study, we examine trends in soccer-related wrist fractures in children and adolescents, and relate these changes to a major change in soccer in the Netherlands in the same time period, which is the introduction of artificial turf fields.

Methods: Data on wrist fractures during outdoor soccer were obtained from the Dutch Injury Surveillance System and the National Hospital Discharge Registry. The number of soccer participants aged 5–19 years old

and the number of artificial turf fields were obtained from the Royal Netherlands Football Association. Rates were expressed as the number of wrist fractures per 1000 youth soccer players.

Results: During the study period, wrist fracture rates per 1000 young soccer players increased significantly from 4.3 (95% CI, 4.1–4.5) to 6.0 (95% CI, 6.2–6.4) between 1998 and 2009 ($p < 0.001$). This increase was accompanied by a rapid rise in the number of artificial turfs in the same time frame, from 17 in 2001 to 962 in 2009.

Conclusions: This study showed that soccer-related wrist fractures increased in youth soccer players aged 5–19 years, after adjustment for the rising number of soccer participants. While a direct causal relation cannot be shown, the increase in these fractures coincided with a steep increase in the number of artificial soccer fields in the Netherlands.

A-0377 Trapeziectomy or total joint arthroplasty in primary carpometacarpal osteoarthritis of the thumb: results of 1-year follow-up

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Purpose: The purpose of the study was to compare the (functional) outcome of two surgical procedures, trapeziectomy and total joint arthroplasty, in patients suffering from primary carpometacarpal osteoarthritis of the thumb (CMC-I OA).

Methods: A single-centre randomized controlled trial was set up in Isala Hand Centre Zwolle, the Netherlands. Female patients, at least 40 years of age, suffering from CMC-I OA (Eaton and Glickel's classification II and III) were included in the study. Patients were randomly assigned to group 'A' or 'B'. In group 'A' a trapeziectomy was carried out; group 'B' received a total joint arthroplasty with a GUEPAR prosthesis. Surgical procedures, immobilization periods and hand therapy treatments were performed according to standardized protocols. Primary outcome measure consisted of the Patient Rated Wrist/Hand Evaluation (PRW/HE). Secondary outcome measures were the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), grip strength, key-, two- and three point pinch, range of motion, return to work, patient satisfaction, and adverse effects. Patients were assessed before, 3, and 12 months after surgery.

Results: In 26 patients (mean age 59 years, SD 8) a trapeziectomy was carried out and 29 patients (mean age 61 years, SD 9) received a total joint arthroplasty. Compared to the situation before

surgery, 3 months after surgery the PRW/HE scores improved significantly in both groups with 31 points (SD 23) in group 'A' and 42 points (SD 20) in group 'B'. In addition, 12 months after surgery these improvements progressed to respectively 40 points (SD 29) and 51 points (SD 21). Three months after surgery increased improvements in the prosthesis group compared to the trapeziectomy group were reported on key- and three-point pinch and 12 months after surgery on DASH. Average patient satisfaction scores were 8 points (out of 10) in both groups at 3 and 12 months after surgery.

Conclusions: Until this study, no comparison of the outcome of trapeziectomy was made with total joint arthroplasty in a randomized controlled trial. This study shows that both surgical procedures result in good outcomes and patient satisfaction. In addition, the study suggests that 1 year after surgery patients with a prosthesis show more improved results compared to the group after a trapeziectomy. However, to obtain more power a larger sample size would be preferred. In order to assess the long-term superiority of one procedure this study will be continued with measurement at 60 months after surgery.

A-0378 Prospective randomized evaluation of the local anaesthetic pain when using buffered or unbuffered lidocaine for open bilateral carpal tunnel decompression

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Background: Open carpal tunnel decompression under local anaesthesia is routinely performed by many surgeons and is effective with high range of patient satisfaction. However, the preoperative local anaesthesia is painful. To reduce injection pain, several methods have been used. This prospective, double-blinded, randomized study to determine whether there was any difference in the pain during local anaesthesia using plain lidocaine with normal saline versus the buffered lidocaine with sodium bicarbonate.

Methods: Twenty-five patients undergoing bilateral open carpal tunnel decompression received and all of them had applied topical lidocaine cream before local anaesthesia, and in randomized manner, 1% lidocaine with 8.4% sodium at bicarbonate in a 10:1 ratio in one hand and the same local anaesthetic solution with normal saline at a 10:1 ratio in the other hand. Pain was evaluated on a visual analogue scale.

Results: The mean pain score in the hand with buffered lidocaine was 4.6 ± 1.5 on VAS and 6.5 ± 1.5 in the hand with unbuffered lidocaine. Pain was reduced significantly with the buffered solution.

Conclusion: When infiltrating local anaesthetic solution into the palm and wrist for open carpal tunnel decompression, the routine application of the topical lidocaine cream preoperatively and the use of buffered lidocaine could reduce the pain.

A-0380 Is it possible to quantify dart throwing motion of the wrist in normal volunteers?

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Most routine activities in daily life involve coupled motions at the wrist with variable combinations of radio-ulnar deviation and flexion-extension rather than a single plane of motion. Dart throwing is a coupled motion that moves through an arc from radial deviation and extension to ulnar deviation and flexion. But quantification of this movement has been difficult and requires complex cross-sectional radiological technique 10 healthy volunteers were assessed with flexible biaxial electrogoniometry in standard position of wrist for kinematic assessment of movement to quantify the coupled effect in the dart thrower's motion. Full range of flexion-extension, ulnar-radial deviation, dart throwing, and circumduction was measured by analyzing the digital output producing a visual display of the results as Lissajous figures. This allowed mathematical measurement of total arc of motion in dart thrower's plane and comparison with flexion extension and ulnar-radial deviation plane. The mean arc of motion in dart throwing plane was 102° (range $58-135^\circ$). This is three-fourths of the maximum arc of motion in the flexion extension plane (mean of 142°) (range $110-172^\circ$). The arc of motion in dart throwing plane is nearly double the range in ulnar-radial deviation plane (mean 68°) range $54-86^\circ$. The dart throwing plane axis lies at a mean angle of 14° anticlockwise to the flexion extension plane for right hand and clockwise for the left hand. The use of this technique can be extended to measurement of changes in dart throwing plane in diseased hands.

A-0382 Analysis of rotation torque of the forearm in Korean people

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Purpose: The purpose of this study was to investigate rotation torque of the forearm by using torque gauge in healthy Korean people.

Materials and Methods: From third decade to seventh decade, 100 people per each decade, 500 healthy people were tested by using torque gauge (Tohnichi®, Japan). There were 217 males and 283 females. When the elbow was flexed at 90° and the forearm was in neutral position, tests for pronation and supination torque of the both forearm were performed twice with 5 minutes interval between tests. We recorded the torque of right, left, dominant, and non-dominant side separately and choose the higher torque of the two tests.

Result: The average rotation torque was 26.42 kgf-cm for supination and 25.63 kgf-cm for pronation. The peak torque was obtained in the 30–39 age group (35.95 kgf-cm for supination and 34.63 kgf-cm for pronation). The supination and pronation torque of dominant side were stronger than that of the non-dominant side ($p < 0.05$).

Conclusion: The supination and pronation torque of Koreans peaked in the 30–39 age group. The difference of torque between the supination and pronation had no statistical significance ($p > 0.05$). Right-handed people have a stronger rotation torque (supination and pronation) than the left.

A-0387 Long-term results of dorsal intercarpal ligament capsulodesis for the treatment of chronic scapholunate instability

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Background: The purpose of this study was to assess clinical and radiographic outcomes of dorsal intercarpal ligament capsulodesis for the treatment of static SL instability after a minimum follow-up of 4 years.

Methods: Fifty-nine patients who underwent capsulodesis due to static SL instability were included in a retrospective analysis after a mean of 99 months (range 52–144 months). Eight patients were excluded from further clinical analysis because of salvage procedures after a mean of 28 months. Evaluation of the remaining patients included radiographs of both wrists, measurements of range of motion and grip strength, and determination of DASH and Mayo wrist scores. SL and radiolunate (RL) angles, SL gap, and the carpal height indices were compared with radiographs obtained preoperatively and on the second postoperative day by Wilcoxon signed-rank tests. Spearman's correlations were calculated to identify relationships between radiographic and clinical parameters. A Kaplan–Meier analysis was performed

to determine the average time from primary operation to salvage procedure.

Results: At follow-up, range of motion averaged 88° (71% of contralateral side) for extension/flexion and 38° (92% of contralateral side) for ulnar/radial deviation. DASH and Mayo wrist scores averaged 28 and 61, respectively. After significant ($p < 0.01$) improvement immediately postoperatively, SL and RL angles demonstrated deterioration to 70° and 8°, respectively, so that they were not significantly different from the preoperative angles ($p = 0.6$, $p = 0.4$). The carpal height index decreased significantly ($p < 0.01$) from 1.48–1.53, indicating the progression of carpal collapse; 40 patients (78%) had radiographic evidence of degenerative arthritis. Kaplan–Meier analysis revealed a mean of 128 months until a salvage procedure was necessary.

Conclusions: Carpal reduction cannot be maintained over time by capsulodesis. As a consequence, early arthritic degeneration cannot be prevented. Nevertheless, most patients maintain acceptable wrist function without further surgical interventions. If salvage procedures are necessary, they are typically performed within the first 2 years after the operation.

A-0388 Treatment of proximal interphalangeal joint intra-articular depressed fracture by intradigital static traction with external fixator. A new method

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Introduction: Comminuted and depressed intra-articular fractures of middle phalangeal bases are difficult injuries to treat. Traction devices such as the pin and rubber traction system (PRTS) serve to reduce fractures by the ligamentotaxis principle and helps nutrition of articular surface and prevents joint stiffness. But, the PRTS has many problems such as inconstant traction and shaking at pin-bone interface, so we developed a new technique of static intradigital traction to achieve constant traction and present the result.

Materials and Methods: From 2006–2010, we performed this method in 5 patients of depressed intra-articular fracture of middle phalangeal base including pilon fracture. There were 3 men and 2 women with a mean age of 55.2 years (47–61). The involved fingers were 3 ring fingers, one long finger, and one small finger. Smooth K-wire was inserted transversely to rotational axis point of proximal phalangeal head. Two pins were inserted transversely at middle

phalangeal head and shaft and external fixators are assembled and fixed after reduction by ligamentotaxis and/or limited open reduction of the articular fragments. After operation, active range of motion exercise was started immediately. At postoperative 6 weeks, external fixators were removed.

Results: In all patients, we have achieved bony union and congruous joint. Active ROM of PIP joint was averaged 87° (45–110). Evaluation of the result by Phair's standard was 3 excellent, 1 good, and 1 poor.

Conclusion: Intradigital static traction by external fixator and early mobilization is very useful method in treatment of intra-articular depressed fracture in proximal interphalangeal joints.

A-0389 Restoration of injuries to the sensory branch of the radial nerve: prevention and treatment of neuromas with the aid of Neurotube®

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Purpose: The successful treatment of neuromas following injuries to the sensory branch of the radial nerve remains a difficult objective. Various techniques have been described for the prevention and treatment of such painful neuromas, including bandaging of the proximal nerve stump, interventions in the muscles and bones, injection of corticosteroids and other chemical substances; however, none of the aforesaid has had wide acceptance thus far. The aim of this study was to present our experience with regard to the treatment of 20 cases of radial-nerve-sensory-branch injury with the use of Neurotube® in order to prevent neuroma formation.

Methods: Our study material comprised 16 men and 4 women, aged 16–65 years (mean 27 years). All 20 patients had reported injuries located in the radial aspect of the wrist, namely 12 from a mechanical saw, 4 from glass, 2 owing to a traffic accident, and 2 from a knife. Amongst our 20 patients, only 12 were treated primarily in our hospital, while 4 patients had also sustained concomitant extensor-tendon lacerations in the first and second wrist extensor compartment. Based on the applied surgical technique, there were 3 distinct patient groups. In the first group, in which patients were treated by means of end-to-end neurorrhaphy, the level of neurorrhaphy and part of the nerve proximal and distal to it was covered with Neurotube® and then with soft tissues. In the second group, in which the patients had sustained a nerve injury in continuity, the entire injured region was

covered with Neurotube® and soft tissues. In the third group, which consisted of patients with a segmental nerve deficit or delayed treatment, the resulting nerve gap was bridged with the aid of Neurotube®. Postoperatively, the hand was placed in a well-padded, forearm-wrist-digital splint for 2 or 4 weeks (the treatment of concomitant extensor-tendon lacerations required prolonged immobilization); subsequent splint removal was consistently followed by a light physical therapy program. The average duration of patient follow-up in terms of this retrospective case series was 4 years.

Results: All 20 patients reported on a high level of satisfaction immediately after the operation, with a marked reduction of Tinel sign and hypersensitivity, and they were all able to return to their previous employment. In the course of time, the situation continuously improved; in addition, partial sensory re-innervation was recorded in the majority of our patients. The presence of hypaesthesia created a "feeling of weight" in the hand, but did not restrict the patients' participation in their work or their activities of daily living.

Conclusions: According to our clinical experience, the use of Neurotube® for the prevention and treatment of painful neuromas after injuries to the sensory branch of the radial nerve gives very good results, with a high level of patient satisfaction and quick return to their previous work.

A-0392 Experiences with the free femoral condyle graft in reconstructive surgery of the scaphoid

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Purpose: To evaluate our experiences using a free femoral condyle graft in reconstructive surgery of difficult scaphoid non-union.

Methods: From 1.9.2008 to 31.3.2011 we performed a scaphoid reconstruction using a free femoral condyle graft in 49 patients. Indications were long-standing non-unions, avascularity of the proximal pole, extensive humpback deformity, multiple previous operations, or a combination of these. After a mean follow-up time of 1 year (range 4 months to 2 years 4 months) we could re-examine 30 of these patients clinically including DASH score and modified Mayo wrist score, and radiologically with conventional X-rays.

Results: The clinical results were good with a mean modified Mayo wrist score of 74 (range 40–98) and a DASH score of 20 (range 0–50). Radiologically we

found bony consolidation in 19 cases and non-union in 11 cases. Osteoarthritic changes of varying degrees including minimal changes around the scaphoid were seen in 21 cases; as a specific complication ossification of the pedicle was seen in 4 cases. In 3 cases the screw was either loosened or too long. Further complication was a femoral fracture after heavy trauma 3 months postoperatively; one patient needed a radial styloidectomy and another one an additional osteosynthesis as a consecutive surgery.

Conclusions: The free femoral condyle graft is a fascinating tool as it combines ideal bony substance with blood supply by microsurgical means. Nevertheless despite good clinical results in our patients with difficult scaphoid non-unions the radiological outcome is poor in a considerable amount of cases. We believe that the reasons therefore are that operative technique is demanding with regard to correct positioning, contouring, and fixation of the graft without compromising the vascularity. Despite these problems in our opinion the free femoral condyle graft is our method of choice in difficult cases of scaphoid non-union.

A-0394 Bone-ligament-bone and dorsal capsulodesis reconstruction for chronic scapholunate instability. A mid-term review

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Background: Since 1997, reconstruction of the SL ligament by a bone-ligament-bone graft and a scapholunate capsulodesis has been used in our centre to treat chronic scapholunate instability. The aim of the study is to assess the mid-term results of this technique.

Patients and methods: From 1997–2010, 27 patients were operated on. 23 patients could be fully reviewed with clinical examination, X-rays, as well as quick DASH and PWRE questionnaires. In four patients, the last clinical and radiological examinations were analyzed, two of them filling out the questionnaires. The mean follow-up period was 7.8 years (1–13 years). Patients were sorted using the Wolfe's classification. Average age at surgery was 46 years (22–64) and the time from injury to surgery, 9.6 months (6 weeks to 17 months). All patients presented with pain and 15 complained of lack of strength. X-rays were evaluated for carpal instability and signs of arthritis.

Results: Five patients required a subsequent partial wrist fusion (18%). Subjective result show that 16/27 (60%) patients had no pain, 6/27 (22%) had non-incapacitating pain to various extend, and 5/27 (18%) constant pain. Overall, 20/27 (75%) were satisfied and

7/27 (25%) not satisfied. Average preop extension was 64° (91% of contralateral side) and flexion 62° (86% of contralateral side). Preop grip strength was 70% of the contralateral side. After surgery, mean extension was 50° (74% of contralateral side) and flexion 48° (73%). Average grip strength was 87% of the contralateral side; 8 patients (30%) regained more than 95% of contralateral side grip strength. Radiologically, the SL angle was corrected from 79° to 69° in the postop period, but returned to a mean 78° at FU. The radiolunate angle improved from 23° to 15° initially and continued to improve to 11° at FU. The lunocapitate angle improved from 12.5° to 9°. Clenched fist SL gap was significantly corrected from 5 to 3.4 mm and maintained at FU. The static SL gap measured 2.8 mm preop and 2.0 mm at FU. 70% had some degree of degenerative changes, mostly at the midcarpal joint. A high inter-observer variability was noted in the assessment of degenerative changes on the X-rays. Complications included one EPL tendon rupture and one chronic pain at the donor site. The average modified DASH score was 9.6/100 and PWRE 9.4/100.

Conclusions: The results of this series show that the technique offers comparable results with other methods. It is not yet clear in which situation this reconstruction is the most appropriate, but it seems to offer a good solution in static SL dissociation. The dorsal capitulum subluxation could be an indicator that the SL reconstruction alone is not sufficient to prevent degenerative changes at the midcarpal level and that a further reconstruction is required on the palmar ligaments to increase the rate of success of this technique.

A-0397 Effect of the ulnar styloid fracture on wrist and distal radio ulnar outcomes after a volar plate fixation of the distal radius

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Purpose: The purpose of this study is to evaluate the effect of an ulnar styloid fracture in the functional outcomes of wrist and distal radio ulnar joint (DRUJ), in patients with fracture of the distal radius and a volar plate.

Methods: Prospective and comparative cohort study of patients with distal radius fracture operated with a volar locking plate, with and without ulnar styloid fracture (N = 38 vs 25). Patients with acute DRUJ instability and other upper limb injuries were excluded. The most common fracture types according to AO classification were: C2 (44.7%) and A3 (31.5%) in the group of patients

with ulnar styloid fracture, and A3 (44%) and C2 (20%) in patients without an ulnar styloid fracture. With respect to the ulnar styloid fracture, 21% were at the tip, 16% at the middle zone, and 63% at the base; 74% of the styloid fracture were displaced > 2 mm. Patients were evaluated at 12 months by only 4 surgeons after injury considering range of motion, grip strength, and specific DRUJ outcomes: tenderness of the ulnar styloid (0–10), pain with ballottement of DRUJ (0–10), and DRUJ instability (dorsal or volar). The functional scores DASH and PRWE were applied to each patient.

Results: At 12 months evaluation we did not find statistically significant differences between groups in the mean range of motion: flexion (62°/56°), extension (62°/60°), pronation (86°/88°), supination (88°/89°), or grip strength (82%/74%). For the specific DRUJ evaluation we did not find any statistically difference in tenderness of the ulnar styloid (0.47 vs 0.29), pain with ballottement of the DRUJ (0.37 vs 0.29), and in the presence of DRUJ instability (5% vs 8%). There were no differences in the mean DASH score (19 vs 21) and neither in the PRWE score (20 vs 27).

Conclusions: The presence of an ulnar styloid fracture in association to the fracture of the distal radius treated with a volar plate does not affect the function of the wrist neither the DRUJ (pain and stability).

A-0400 Management of distal metaphyseal and diaphyseal radius/ulna fractures in children: a retrospective analysis

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Purpose: To evaluate the outcome (in terms of redisplacement and residual deformity) of displaced distal metaphyseal and diaphyseal radius/ulna fracture treatment in paediatric age group: manipulation under anaesthesia (MUA) with plaster cast versus surgical stabilization (pinning).

Methods: Retrospective analysis from case notes (Blue Spier electronic patient data record system) and radiographs of 170 children aged 0–16 years with displaced distal metaphyseal and diaphyseal radius/ulna fractures.

Results: Overall, 33% of distal metaphyseal radius fractures redisplaced with majority (72%) in MUA with cast group. Almost all redisplacements had associated ulna fracture; 43% of these displaced fractures underwent another procedure for correction of deformity; 15% of diaphyseal radius fractures redisplaced with majority (90%) in MUA with cast group. Almost all redisplaced diaphyseal radius fractures had associated ulna fracture. 10% of these displaced fractures underwent

further procedure for correction of the deformity. Complication rate with pinning was very low (< 1%). No long-term complication was encountered with pinning.

Conclusion: It is advisable to do pinning rather than MUA with cast only for displaced distal metaphyseal and diaphyseal radius/ulna fractures requiring intervention.

A-0402 Finger metacarpal shaft fractures: K-wires vs plate screw fixation

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Purpose: Metacarpal shaft fractures may be conservatively or surgically (by K-wires or plate-screw fixation), but there is no consensus on the best method. The aim of this study was to compare the clinical outcome of metacarpal shaft fractures treated by K-wires or plate-screw fixation.

Methods: A retrospective analysis of 61 consecutive fractures treated operatively at our hand centre. The notes were reviewed for information relating to the procedure and the outcome, including length of follow-up, rate of recovery of movement, and complications.

Results: There were 23 patients in the K-wire group and 38 in the internal fixation group. The mean operative time for plate-screw fixation was significantly longer than for K-wiring (57 +/- 4 min (mean +/- SEM) vs 39 +/- 4 minutes (mean +/- SEM); $p < 0.01$). The K-wire group had a significantly delayed return to full range of movement compared to the plate-screw group (8 +/- 2 weeks vs 6 +/- 1 weeks; $p < 0.05$). There was no significant difference in complications ($p = ns$).

Conclusions: When operative reduction and fixation of metacarpal fractures is necessary, K-wire fixation is faster than to plate-screw fixation but delays return to work.

A-0404 Nikolaus Rüdinger (1832–1896): from apprentice barber to anatomy professor and his first description of innervation in 1857 as a prerequisite of modern joint denervation techniques

A Gohritz

Selective joint denervation has proven to be a highly effective palliative treatment for joint pain of various

causes, especially in the wrist, but also for example on the shoulder, elbow, thumb carpometacarpal, knee, and ankle joint. The requirements of this surgical procedure were laid by the Munich anatomist Nicolas Rüdinger (1832–1896), who in 1857 meticulously described the “Articular nerves of the entire human body.” This article presents the extraordinary biography and scientific career of this largely unknown researcher and the development of modern joint denervation. Born in 1832 as the last of 12 children of a farmer, Rüdinger made a truly unique career from apprentice barber for military surgeons and internationally renowned professor of anatomy in Munich. He authored about 90 scientific papers, probably being the first to use photographs (of the Bavarian court photographer Joseph Albert) in an anatomy atlas. Rüdinger was very gifted manually and technically and invented the preservation of corpses using carbolic solution and enriched the anatomical collection with numerous then unique preparations, e. g. of the peripheral nervous system. He performed early topographies sawing frozen corpses in slices. Among students in Munich, Rüdinger’s plastic paper maché model of the trunk with inner organs sliced in eight sagittal sections was famous as “Scheiben-Toni” (“sliced Toni”) and used until recently. Rüdinger in 1886 led the autopsy and embalming after the enigmatic death of the “fairy-tale” King Ludwig II of Bavaria (1845–1886). The paper also compares the anatomical studies by Rüdinger with modern techniques for selective joint denervations which were developed primarily by Albrecht Wilhelm (*1929), Lee Dellon (*1944), and their students. In conclusion, the observation of the life and work of Rüdinger offers an inspiring insight into the evolution and tradition of our surgical specialty in the 19th century and exemplifies the value of descriptive functional anatomy, even if the practical surgical application may be realized not until a century later.

musicians and artists who are particularly dependent on intact hand function. Based on famous examples, the effect of hand disease on the biography and artistic performance in musicians and painters is analyzed. The pianist Clara Schumann (1819–1896) probably suffered from a focal dystonia of the right hand, like her husband, pianist and composer Robert Schumann (1810–1856), whose right middle finger function was severely impaired — probably also by posterior interosseous nerve compression. It is believed that violinist Nicolo Paganini (1782–1840) and composer and pianist Sergei Rachmaninoff (1873–1943) suffered from Marfan syndrome, the resulting arachnodactyly allowing an exceptional grip span. Jazz guitarist Django Reinhardt (1910–1953) developed special techniques to compensate burn scar contractures of his fingers. Hungarian pianist Count Géza Zichy (1849–1924), Viennese pianist Paul Wittgenstein (1887–1961), and drummer Rick Allen (born 1963) of Def Leppard suffered traumatic upper arm amputation, but continued their career due to discipline, one-handed compositions, and special equipment, such as pedals. Painters lost their grasp almost completely due to chronic diseases — Paul Klee (1879–1940) by scleroderma, Peter Paul Rubens (1577–1640) and Auguste Renoir (1841–1919) by rheumatoid arthritis — the guiding of the brush was sometimes only possible with special bandages. In conclusion, the examples of famous musicians and painters illustrate the importance of a then often unknown treatment of hand disorders. They also show that even severe functional deficits may be compensated by will power and imagination, which can be an inspiration and serve as role models today.

A-0409 Effects of hand-diseases on the life and work of famous musicians and painters

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Limitations of hand function significantly affect everyday life and work of those affected, especially

1. Retrospective evaluation of complications in my first 50 hand and wrist arthroscopies

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Purpose: Hand and wrist arthroscopy is an excellent technique for the treatment of joint disease, and its indications are becoming more numerous. Increasingly, hand surgeons are learning and using this technique. However, the learning curve can be long and difficult, and iatrogenesis can be serious. This is the analysis of the complications occurred after my first 50 wrist and hand arthroscopies.

Materials and methods: We performed a retrospective study of the 50 first hand and wrist arthroscopies performed at our centre. We analyse the diseases treated, surgical techniques employed, complications per and postoperative registered: tendon and nerve injuries, joint instability, insufficient bone resection, recurrence, etc. We compare our complications with the international literature.

Discussion: Learning correct surgical technique is the responsibility of the surgeon. There are currently several cadaveric courses, publications and discussion forums for the technique of hand and wrist arthroscopic surgery. With all of them, new surgical techniques can be learned from the personal experience of the teachers. This technical training does not, however, teach the therapeutic indications for arthroscopy in the pathology of the hand and wrist, and it does not guarantee that surgery will be free of complications. The analysis of the complications encountered during the learning curve is an exercise in self-improvement and education.

Conclusion: Therapeutic indications for arthroscopy in the pathology of the hand and wrist are increasing,

and new techniques are being developed. Although the learning curve can be disconcerting, we must master its indication and technique to solve intra-articular pathologies.

2. Evolution of arthroscopic classification in scapholunate complex lesions

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Introduction: Arthroscopy of the wrist has opened a new field in the understanding of carpal ligament injuries. Under arthroscopy it is possible to visualize intrinsic ligaments, a great amount of extrinsic ligaments, to test carpal bone stability, to evaluate cartilage damage. One of the most important carpal instabilities is the scapholunate instability because of its frequency, and because it can lead to degenerative arthritis of the wrist (SLAC) in the late stages. Several arthroscopic classifications have been developed within the last two decades, mostly describing acute injuries only, while we know that chronic injuries can be severe and more challenging for the surgeon to treat. A development of the previous classifications has been developed by the EWAS group with the aim of having a better definition of acute and chronic injuries, understanding partial and complete lesions of scapholunate, scapholunate complex and STT injuries.

Materials and methods: From the study of 20 cadaver specimens that were studied under arthroscopy sectioning, the different parts of the scapholunate ligament and of extrinsic ligaments, and from data from 80 patients affected by scapholunate lesions examined under arthroscopy and treated, the following classification has been proposed.

Discussion and conclusions: The development of this classification is useful to classify a variety of acute

and chronic scapholunate injuries. The aim is not only to have a better understanding of the lesions, but also to define or improve treatment in the different stages.

3. Arthroscopic interposition associated to arthroscopic dorsal capsuloligamentous repair and wide styloidectomy in SLAC 2

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Introduction: In late chronic scapholunate ligament dissociation, when arthritis has appeared (SLAC 2–SLAC 3), treatment often involves heavy palliative techniques such as resection of the first row or four-bone fusion. We propose a simpler technique of arthroscopic interposition of a poly-lactide implant (PLA) or palmaris longus tendon, combined with a wide styloidectomy of scaphoid fossa of distal radius and a dorsal capsuloligamentous repair to stabilize the scapholunate dissociation.

Material and methods: All patients were operated on in 1-day surgery under local regional anaesthesia. Resection of the scaphoid fossa of the radius was performed arthroscopically. PLA implant or palmaris longus tendon were then placed between the radius and the first row, set at the radial styloid and TFCC. After reduction of scapholunate space, if necessary, a dorsal capsuloligamentous repair was performed by arthroscopy. We operated on 12 patients: nine men and three women, whose average age was 57 years (between 41 and 74). The initial trauma was unknown in nine cases. The patients had arthritic lesions limited to the radiocarpal (SLAC 2) in 10 cases and (SLAC 3) in two cases. In all cases X-rays showed a dorsal intercalated segmental instability (DISI) deformity.

Results: Our mean follow-up is 21 months (range 12–39 months). The pain disappeared in most cases, remaining moderate in two cases. Mobility, muscle strength and DASH were improved in 11 cases. Eight patients developed temporary inflammatory reactions. The preoperative DISI was improved in all cases, with persistence of a gap SL in two cases. We have only one failure in patient SLAC 3.

Discussion: Arthroscopic interposition associated with a wide styloidectomy and a dorsal capsular ligament repair to stabilize the scapholunate dissociation gave us encouraging results in patients with SLAC2–3. The technique is very convenient for the patient and does not burn bridges for other operations. A longer follow-up will be necessary to check if it is a simple process of waiting, or if it can be considered as a new treatment option.

4. Long-term results of arthroscopic replacement of the necrotic proximal pole with APSI prosthesis

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Introduction: Treatment of necrosis of the proximal pole of the scaphoid is difficult and risky, especially in the elderly. We report the long-term results of arthroscopic replacement of the proximal pole with a pyrolytic carbon implant.

Materials and methods: Patients were operated on in 1-day surgery under local regional anaesthesia. The scope was introduced through 3–4 radiocarpal, 6R radiocarpal and radial mid-carpal portals. The 3–4 radiocarpal portal is extended only about 1 cm in order to place the implant. Mobility was started immediately, leaving the patient to choose their own range of mobility according to their postoperative pain. We operated on 15 patients under 65 years of age using this technique, and 14 have been reviewed with a long follow-up (over 6 years). The average age was 53 years (between 40 and 65). They all had a complete necrosis of the proximal pole, making reconstruction impossible, and all had kept a good preservation of cartilage of other bones that made us hesitate to choose a more incapacitating palliative technique. All patients had significant decreases in mobility and muscle strength, and pain that was disabling in all cases.

Results: Our mean follow-up was 8.7 years (range 6–11 years). Mobility was improved in all cases. The pain completely disappeared in 10 cases and was significantly decreased in two cases. These 12 patients are no longer bothered by their wrist and do not want other interventions. X-rays showed a notch in the capitate head, which appeared in six cases without functional impairment. We had an volar dislocation of the implant after surgery that necessitated immediate replacement and had no other problems after 10 years of follow-up. We had two failures in bad indications (wrist fracture), treated by four-bone fusion.

Conclusion: This salvage procedure seems simple and useful, and very comfortable for patients. It allows a painless, mobile wrist, avoiding palliative procedures such as four-bone fusion or first row carpectomy. At first we considered it as an interesting waiting therapeutic option in these young patients, but these long-term results show that this technique, provided it complies with good indications (proximal pole necrosis), can be considered as a real therapeutic option.

5. Arthroscopic radial styloidectomy with interpositional arthroplasty

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Purpose: Excision of the radial styloid was reported for treatment of scaphoid nonunion by Barnard and Stubbins in 1948. The procedure has since been advocated to address radioscaphoid arthritis developing from variety of injuries, including previous fractures of the radial styloid and scaphoid, and arthritis related to posttraumatic scapholunate instability. However, there have been different results in the literature concerning this treatment method. We have combined arthroscopic radial styloidectomy with interpositional arthroplasty. The aim of the study is to evaluate the outcome of this new technique.

Methods: From August 2009 to April 2010, three radioscaphoid arthritis were treated with the arthroscopic technique. The average age of patients was 50 (range 40–56). The average follow-up was 18 months (range 12–24 months). The visual analogue scale decreased from an average of 4 points to 2 points postoperatively. One patient reported no residual pain, and two patients described only mild, occasional pain. The Mayo wrist score increased from an average of 60 points to 85 points in the final follow-up. No neurovascular complication was encountered.

Results: The final outcomes of radial styloidectomy are undoubtedly multifactorial. An incomplete radial styloidectomy may be problematic, with persistent complaints of radial-sided wrist pain. Excessive bony resection is potentially disastrous, resulting in ulnar translation of the carpus and symptoms of wrist joint instability. We combined the radial styloidectomy with interpositional arthroplasty on radioscaphoid arthritis. This can avoid residual radial-sided wrist pain and excessive bony resection.

Conclusion: Arthroscopic radial styloidectomy with interpositional arthroplasty was an effective treatment method for well-selected radioscaphoid arthritis.

6. Arthroscopic analysis of the extrinsic ligaments' role in the proximal row's stability: a prospective study

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Introduction: The interosseous ligaments are the most important to assure the intracarpal stability, but they are probably not alone. Previous cadaveric studies suggest the role of the extrinsic ligaments as secondary stabilizers. Can this hypothesis be confirmed on the living wrist?

Materials and methods: Between 2009 and 2011, 81 arthroscopic tests have been performed, concerning each accessible extrinsic ligament. We correlated the interosseous instability with the lesions of the extrinsic stabilizers.

Results: Scapholunate instability is correlated with the importance of the looseness of the extrinsic stabilizers ($p < 0.001$), and is correlated with the lesion of the mediocarpal part of the radio-scapho-capitate ligament (RSC) ($p < 0.05$). It is correlated with the isolated lesion of the radial scapho-trapezial ligament (PRST) ($p < 0.05$), and is correlated with the isolated lesion of the dorsal intercarpal ligament (DIC) ($p < 0.01$). Triquetrolunate instability is not correlated with the severity or the number of the looseness of the extrinsic locks (long and short radio lunate, triquetro-hamato-capitatum, dorsal radiocarpal ligaments). Only the isolated lesion of the DIC is correlated ($p < 0.05$).

Conclusion: This arthroscopic and statistical study confirms the responsibility of the extrinsic ligaments as secondary stabilizers of the proximal row. The grade of the looseness seems more important than the number of loosened extrinsic ligaments. The importance of each extrinsic lock is probably different, and the DIC ligament is probably the most important secondary stabilizer.

7. Dorsal radiocarpal ligament tear responsible for chronic wrist pain: a new link in the history of scapholunate instability?

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Purpose: The natural history of ligamentous lesions leading to scapholunate instability remains controversial. Recent anatomic studies have revealed the major role of dorsal radiocarpal ligaments in the development of a dorsal intercalated segmental instability (DISI). Whether radiocarpal ligaments tears may be isolated lesions or lesions of pre-instability of the scapholunate complex is still not elucidated. The aim of the study is to describe the clinical and radiological features of radiocarpal ligament tears.

Methods: We reviewed 17 patients suffering from chronic wrist pain refractory to conservative measures. Clinically the patients had wrist stiffness in extension and radial deviation (respectively 66 and 65% of the contralateral side). On the wrist lateral radiographs, five of the 17 patients showed a DISI posture. Magnetic resonance imaging of wrists revealed pseudo-cystic images on the dorsal capsule in five cases. A diagnostic arthroscopy showed a dorsal radiocarpal ligament wrenching from the scapholunate ligament in all cases. A scapholunate

instability was always associated: 10 incongruencies (stage 2 and 3 of Geissler classification) and seven partial tears of the interosseous scapholunate ligament without incongruency. A tear of the triangular fibrocartilage complex was associated in 11 cases (always quoted as grade 1B of Palmer classification). All the patients were treated by an arthroscopic-assisted dorsal capsuloplasty.

Results: At the final follow-up examination (17.2 months mean), the range of motion had improved in all directions, with flexion and radial deviation reaching, respectively, 87% and 97% of the unaffected wrist. Pain relief (visual analogue scale less than 2) occurred in 13 cases. The grip strength moved from 56% to 97.5% of the unaffected side. DISI posture was no longer seen on radiographs.

Conclusion: Recognition and repair of dorsal radiocarpal ligament injuries is crucial to improve patients' wrist function, and potentially to prevent secondary destabilization of the scapholunate complex. A longer follow-up is necessary to know if the scapholunate stabilization is long lasting.

8. Early experience with (dry) arthroscopic four-corner arthrodesis: from a 4 h operation to a tourniquet time

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Purpose: Scaphoidectomy and four-corner arthrodesis (4CA) is an effective procedure for treating several degenerative conditions of the wrist. Recently, the arthroscopic approach to this operation was described. Although conceptually appealing, certain aspects make its application difficult. We present our technique for dry arthroscopic scaphoidectomy and 4CA, which reduces the operative time to less than 2 h.

Methods: Four consecutive patients underwent scaphoidectomy and 4CA. In each case the operation was performed with a dry arthroscopic technique using cannulated screws for rigid fixation. Bone graft from the distal radius was performed in two patients and from the scaphoid itself in the other two. The relevant operative details are the use of a 'scapholunate' portal (SL), the resection of the scaphoid with a pituitary rongeur, and the placement of bone graft in a dry arthroscopic environment. Range of motion exercises started 2–3 weeks after the operation.

Results: The first operation took 4 h. The last two were completed in 1 h and 45 min and 1 h and 55 min, respectively. No complications occurred. None of the operations were converted to an open procedure.

Conclusions: Although the operation has a steep learning curve, it is conceptually appealing. It is too early to prove that the arthroscopic procedure has better results than the open 4CA; however, in our opinion it represents the future of wrist surgery.

9. Early results after arthroscopically assisted four-corner fusion

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Introduction: Influenced by the presentation of PC Ho from Hong Kong to perform the partial fusion of the wrist or treatment of the pseudoarthrosis of the scaphoid arthroscopically, we started to move from a completely open procedure to a partially open procedure in four-corner fusion of the wrist in March 2011.

Technique: From March 2011 to December 2011, we operated on eight patients with SLAC or SNAC2–3 a four-corner fusion, arthroscopically assisted. We resected the midcarpal joint arthroscopically, then through a small open incision excision of the scaphoid was achieved. This was followed by reposition and temporary transfixation with K-wires. Final osteosynthesis if performed used compression screws. The postoperative treatment consists of a cast for a total of 6 weeks, with movements out of the cast from the third week.

Results: All four-corner fusions showed bone healing in time. The operation time ranged between 180 and 120 min. From our point of view the reposition of the carpal bones, transfixation and final osteosynthesis is most time consuming.

Conclusion: There are a lot of questions remaining: is it possible to reduce operation time? Does a special instrument for reposition and osteosynthesis exist, or should such a device be developed? Do we get an earlier bone healing, and do we need less time to wear a cast? Can we send our patients back to work earlier than we do at present? Do we get less stiffness after this arthroscopically assisted procedure?

10. Development of computer-assisted videosurgery system using augmented reality: application to wrist arthroscopy

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Introduction: In videosurgery, and particularly arthroscopy, one major problem is the positioning of

the camera and instruments inside the patient. The concept of computer-assisted videosurgery has already been applied in ENT, gynaecology, and even hip arthroscopy. But these systems rely on optical or mechanical sensors, which are proving cumbersome and restrictive.

Purpose: The purpose of our study is to develop and evaluate the accuracy of a computer-assisted videosurgery system, based on electromagnetic sensors.

Materials and methods: We used the tracking system Aurora[®] electromagnetic (NDI, Canada) to track the movement in space of the camera and instruments. We have developed a dedicated Python application, using the VTK library for graphical display, and the OpenCV library for distortion correction.

Results: A prototype was produced and evaluated for wrist arthroscopy. It displays the theoretical position for arthroscopic instruments with a useful accuracy.

Conclusion: The augmented reality view is a valuable aid when the surgeon tries to position the arthroscope or find instruments. It makes the action more intuitive, allowing a gain in comfort, time and concentration.

11. Arthroscopic resection of scaphoid pseudoarthrosis – preliminary report

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Purpose: Open scaphoid pseudoarthrosis resection and graft interposition in a nonvascularized or vascularized manner is an established method of treatment of scaphoid pseudoarthrosis. Arthroscopy of the wrist, with its technical progress and development of complicated surgical procedures, opens an alternative perspective to the treatment of this frequent problem. The mini-invasive approach preserves blood supply to scaphoid fragments, and the techniques of approaching bone graft via arthroscopic portals and the possibility for a stable fixation under arthroscopic control fulfil criteria which are required for scaphoid reconstruction. All these facts have persuaded us to start with this demanding method.

Methods: From November 2010 to September 2011, nine consecutive cases of scaphoid pseudoarthrosis were chosen for arthroscopic resection, cancellous graft interposition and stabilization by HBS mini screw or fine K wires. As there is no precise recommendation of what type of pseudoarthrosis is indicated for this surgery, only pseudoarthrosis of the proximal pole or proximal-middle third of the scaphoid without big bone defect were chosen for

the procedure, due to the supposed better approach via dorsal arthroscopic working portals. A low arm cast was applied for 6 weeks postoperatively, with removable protective splint and hand therapy for another 6 weeks. Unprotected wrist activity was then allowed.

Results: All nine patients were managed in the arthroscopic manner. Two cases were stable and seven were unstable pseudoarthrosis. In two cases concomitant neglected scapholunate lesions of various degrees was identified. The pseudoarthrosis in eight patients was resolved, and one remains in stable fibrous nonunion situation without wrist effusion. In two cases of K wires, osteosynthetic removal of the wires was performed as a secondary procedure. All cases have motion limitation at 3 months postoperatively, with slow improvement with time as seen with the initial operated cases.

Conclusion: There are some differences in the technique compared with open procedures. Arthroscopy gives a different view on the anatomy of the pseudoarthrosis, which may change surgeons' preoperative reading of X rays. It clarifies scapholunate injury, which has an impact on the vascularity of the proximal pole of the scaphoid. Also, healing of the defect packed with cancellous bone chips is different to a solid interpositional bone block. Arthroscopic treatment of scaphoid pseudoarthrosis is a demanding, time consuming but reliable way of treatment for indicated cases, with a learning curve that may be shortened by setting up a precise algorithm of the procedure.

12. Wrist ganglion: treating the cause and not the effect

AS Albarracin

Purpose: To evaluate the frequency of associated intraarticular pathology of the wrist and ganglions in this anatomical area.

Methods: In this prospective study we include sixteen patients who underwent arthroscopic wrist surgery for many disabilities, but in all wrists there was a ganglion, even if this was not the main complaint. We performed surgeries to systematically evaluate the joint, in order to find out if there is feasible cause that would produce a ganglion of the wrist, whether anterior or posterior. In seven cases, where the ganglion was not the reason to undergo an arthroscopy, we decided to treat only the injury and we did not perform any procedure to the ganglion. In all these cases the ganglion has disappeared.

Results: In all cases we found an intraarticular injury.

Conclusions: Based on these preliminary results, we report but cannot confirm that ganglions in the area of the wrist are secondary to an intraarticular injury.

13. Arthroscopic classification of Palmer 1B peripheral tear

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Introduction: Peripheral superficial (distal, ulnar) detachment of the triangular fibrocartilage complex (TFCC) tear is recognized as a Palmer 1B tear. In this type tear, the TFC (triangular fibrocartilage) is detached from the ulnar to dorsal capsule of the ulnocarpal joint. This tear usually occurs independently, but occasionally it is associated with foveal detachment. We examined our clinical cases for this type of injury and sub-categorized them as (1) ulnar, (2) ulnar + horizontal and (3) ulnar + dorsal (large ulno-dorsal) tears.

Materials and methods: Twenty-four wrists from 24 cases, who underwent arthroscopic capsular repair with at least 1 year follow-up, were included in this study. There were 17 males and seven females, with an average age of 28 (range: 13–56). There were 15 right wrists and nine left. Cause of TFCC tear was traffic accident in seven, sports activity in seven, fall in five and unknown in five. Periods between the initial injury to surgery were on average 15 months (range: 2 weeks–5 years). Ulnar variance was +2 mm in three wrists, +1 mm in one, 0 mm in 17, -1 mm in one, -2 mm in one and -4 mm in one. Ulnar variance of +2 mm wrists underwent ulnar shortening before arthroscopic repair. Diagnosis of TFCC tear was done by MRI, arthrogram and arthroscopy. Average follow-up was 17 months (range: 12–48). Details of the ulnar tear were recorded and clinical results, suturing methods, number of stitches, and clinical results were analysed.

Results: We recognized simple ulnar avulsion (classic Palmer 1B) in 10 wrists. A combination of ulnar tear with horizontal TFC tear was noted in six wrists. Ulnar avulsion continuing to dorsal 1/2 of the TFC was recognized in eight wrists, including complete dorsal avulsion of the TFC from the capsule. Combination of ulnar tear with horizontal tear was also associated with degenerative tear in three wrists. In ulno-dorsal tear cases, 1A tear, 1D tear and coronal tear at the radioulnar ligament was associated in each. Horizontal mattress suture was done in 10 wrists, while longitudinal 1 stitch was set in three, 2 stitches in 10 and 3 stitches in one wrist. In 18 wrists, pain disappeared, while pain decreased in four and remained in two. There was no loss of

range of pronosupination. Preoperative distal radioulnar joint (DRUJ) instability was recognized as \pm in three, + in 16 (dorsal in two, palmar in 14), ++ in five wrists. Postoperative DRUJ instability remained in three wrists. We obtained 18 excellent, three good and three fair results.

Discussion: Palmar 1B tear is recognized as simple ulnar detachment of the TFC from the ulnar component of the TFCC or capsule. In this study, some of the 1B tear was extended to a horizontal or dorsal tear, thus it is sub-classified as (1) classic ulnar tear, (2) ulnar + horizontal tear, and (3) ulnar + dorsal tear.

14. Incidence of partial or total foveal tear of the TFCC on DRUJ arthroscopy

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Introduction: Distal radioulnar joint (DRUJ) arthroscopy has been little reported compared with radiocarpal or midcarpal joint arthroscopy. We describe the incidence of foveal tear of the triangular fibrocartilage complex (TFCC) on DRUJ arthroscopy.

Technique: The portal was made on a very distal area of the DRUJ, just proximal of the TFCC surface. The 1.9 mm oblique view arthroscope was used. Bended blunt mosquito forceps was firstly inserted to the DRUJ through this portal and the arthroscope was then introduced. The ulnar head, sigmoid notch of the radius, proximal surface of the TFCC, radioulnar ligament (RUL) origin at the fovea, and DRUJ capsule were observed via DRUJ arthroscopy. To check the condition including tension and tear area of the RUL, the 23G needle was used.

Patients: Since 2000, we have performed DRUJ arthroscopy in 196 wrists of 194 cases. There were 108 males and 86 females, with an average age of 32 (range, 15–63). There were 109 right, 85 left, and one bilateral. All cases indicated moderate to severe DRUJ instability. Among these cases, foveal observation was completed in 170 wrists. We checked the condition of the RUL through DRUJ arthroscopy.

Results: Conditions of the RUL were the absence of the RUL with (15)/without (43) scarring in 58 (34.1%), the partial avulsion of dorsal portion of the RUL in 35 (20.5%), the partial avulsion of the palmar portion of the RUL in nine (5.3%), relaxed RUL in 32 (18.8%), partial tear on the RUL surface in 20 (11.8%), normal RUL in 16 (9.4%; may be related to the horizontal type tear of the TFCC). This means total avulsion (absence of the RUL) was noted in 56.9%, while partial RUL tear was in 43.1% (dorsal 79.6%, palmar 20.4%).

Conclusion: In DRUJ instability cases, total or partial avulsion of the RUL was noted in 60%. Other causes of DRUJ instability were relaxed RUL, partial tear on the RUL surface and possible horizontal tear. Total avulsion was more often than partial tear of the RUL. In partial RUL tear, majority was dorsal portion avulsed.

15. Further experience with arthroscopically assisted transosseous reinsertion of the deep part of TFCC to the fovea of the ulna head for unstable distal radio-ulnar joint

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Introduction: In a first study, the results of 39 patients operated on using this technique for instability of the distal radio-ulnar joint (DRUJ) from 2001 until 2007 have been satisfactory overall. It is not yet clear, however, after what time a reinsertion is still possible, if the results are influenced by ulna variance or degenerative changes of the TFCC.

Method: In a retrospective study the results of further use of this technique were evaluated with reference to these questions. Pre and post-operatively, the Mayo Wrist score, the DASH score, pain as estimated on the visual analogue scale (VAS) and stability of the DRUJ as assessed clinically were recorded. These results were correlated to (i) the time from trauma to surgery; (ii) the arthroscopic status of the TFCC and ulnar wrist regarding degenerative changes; (iii) ulnar variance. The need for further procedures and complications are reported.

Results: We added 41 patients operated on between 2007 and 2009, with an average follow-up of 42 months, minimum 12 months. Of the 41 patients, 35 have been re-examined; 18 were completely and 17 partly satisfied with the procedure. Stability of the DRUJ has been completely restored in 23 cases, partly in 12. Mayo wrist score (pre-OP 55, post-OP 90), pain on VAS (pre-OP 6.6, post-Op 1.4) and DASH score (pre-OP 52, post-OP 14) improved significantly. No correlation was found to the time from trauma to operation. In two cases stability was not fully satisfactory because of loss of substance of the TFCC due to degeneration. Three cases needed additional ulna shortening. A therapeutic algorithm to categorize patients with painful instability of the DRUJ for appropriate treatment was attempted. The severity of clinically assessed instability, the presence of general laxity, the arthroscopically assessed suitability of the deep fibres of the TFCC for repair, and arthroscopical and clinical signs of ulnar impaction syndrome were taken into account.

Conclusion: Arthroscopically assisted transosseous reinsertion is possible even after a long time has elapsed from the trauma. The presence of additional degenerative changes or ulna impaction problems make the results less predictable.

16. Comparison between open and arthroscopic TFCC bony repair for post-traumatic DRUJ instability

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Purpose: The aim of the study was to compare the results of open (group 1) versus arthroscopic (group 2) triangular fibrocartilage complex (TFCC) foveal re-fixation for distal radioulnar joint (DRUJ) instability due to type 1B complete or proximal lesion.

Methods: From 2002 to 2009, 85 cases of post-traumatic DRUJ instability were operated. All patients had pre-op and post-op clinical (Mayo Wrist Score) and imaging (X-ray and MRI) evaluations. DASH questionnaire and patient-rated wrist evaluation were also administered in order to evaluate the subjective result. Wrist arthroscopy was performed in all the cases, especially for group 1 to confirm the quality of TFCC tear and associated lesions. Both surgical techniques were performed with the forearm in vertical position. In total, 44 cases had open surgery (group 1) and 41 arthroscopic repair (group 2) of the TFCC. In both groups the TFCC was re-fixed at the fovea using suture anchor/screw. A standardized post-op protocol was used in all patients, including immobilization for 4 weeks and rehabilitation for the following 8 weeks.

Results: The two groups were evaluated at a mean follow-up of 5 and 6 months, respectively. Only 51 cases were available for the comparison: 23 patients (14 women and nine men), mean age 30 years (range, 13–58 years) were treated with the open technique from 2004 to 2007 and 28 patients (14 woman and 14 men), mean age 33 years (range, 13–69 years) were operated on with the arthroscopically assisted technique from 2006 to 2009. Stability of the DRUJ was obtained in all cases but four. Pain decreased significantly ($p = 0.05$) in both groups: from 7 (pre-op) to 4 and 3 (post-op), respectively for group 1 and 2. Wrist flexion-extension improved slightly. Compared with pre-op evaluation, arc of motion in prono-supination decreased in group 1 and increased in group 2. Grip strength increased in both groups. Mayo score and DASH questionnaire showed a significant improvement ($p = 0.05$) in both groups. Comparison of post-op

results of two groups showed no difference except the DASH questionnaire that had a significantly better result ($p=0.05$) for the arthroscopic surgery. No surgical complications were reported by the patients in this study. Recurrences occurred in four cases (8%): three occurred in the open technique cases and one in the arthroscopic cases. In two cases, secondary treatment failed again. In group 2, one case required reoperation for ECU tendonitis.

Conclusions: Both techniques were demonstrated to be extremely valid in the treatment of the TFCC type B1 lesion in terms of pain relief and restoration of DRUJ stability. However, compared with arthroscopy, open technique were shown to leave residual limitation of forearm rotation, probably due to the wider surgical exposure. On the contrary, arthroscopy was shown to be extremely precise in localizing the level of lesion (fovea) and consequent TFCC repair, permitting suturing of both branches (volar and dorsal radio-ulnar ligaments) at the same time. Moreover, arthroscopy proved to be less painful in the post-op period, allowing an easy rehabilitation and a better final result in terms of wrist motion.

17. Lunotriquetral ligament tears as cause of persistent ulnar-sided wrist pain

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The lunotriquetral (LT) interval is often part of a spectrum of ulnar-sided wrist pathology. LT ligament injury can be associated with triangular fibrocartilage complex (TFCC) tears, with ulnar positive variance, with concomitant scapholunate (SL) ligament tears (floating lunate) or as an isolated lesion. Because the lesions are often dynamic, not static, a high index of suspicion must be maintained during both clinical, and arthroscopic examinations. Diagnostic imaging has frequent false negatives, while radiocarpal arthroscopy often does not demonstrate the lesion.

Midcarpal arthroscopy is critical to diagnose a LT ligament tear, and an understanding of normal variants is important in order to not overdiagnose the lesion as well. Associated findings such as volar-sided synovitis and dorsal capsular avulsion, revealing a triquetral 'bare spot', are helpful in elucidating the more subtle lesions.

LT ligament tears must be given high consideration when evaluating the patient with persistent and occult ulnar-sided wrist pain.

18. Partial arthroscopic trapeziectomy with or without ligament reconstruction to treat primary thumb carpometacarpal osteoarthritis

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Purpose: Partial trapezial excision with ligament reconstruction has proven to be effective technique for treating primary osteoarthritis of the thumb. To determine whether ligament reconstruction affects the objective and subjective outcome, we compared the mid-term outcomes of two procedures performed under arthroscopy in similar patient groups.

Methods: In total, 83 patients, divided into two consecutive groups, were included to undergo partial arthroscopic trapeziectomy, the former without ligament reconstruction and the latter with ligament reconstruction using the abductor pollicis longus. Some 34 patients treated without ligament reconstruction (group 1) and 49 patients with concomitant ligament reconstruction (group 2) were evaluated after a mean follow-up of 44.4 months. The outcomes were assessed with the quick DASH and the Nelson hospital score. The objective results were analysed according to mobility and strength. Radiographs were evaluated to determine the recentering of the metacarpal at rest and under stress.

Results: Postoperatively, the quick DASH was 20.28 in group 1 and 15.86 in group 2. The Nelson hospital score was 12.95 in group 1 and 11.04 in group 2. Group 2 had significantly better mean score for stability and willingness to undergo the surgery again under similar circumstances. The mean score for pain, strength, mobility, delay of recovery did not differ significantly between the groups. Both groups had satisfactory results with regard to cosmetic appearance and overall satisfaction. With the number available the amount of medial metacarpal re-centering at rest and under stress did not differ significantly between the groups.

Conclusion: Ligament reconstruction affects the outcome after partial arthroscopic trapeziectomy.

19. Autologous Chondrocyte Transplantation for the treatment of thumb CMC joint degenerative arthritis: preliminary results

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Introduction: Degenerative osteoarthritis of the thumb is particularly common in middle-aged or

post-menopausal women. Synovitis and initial cartilage damage nevertheless start earlier, and then progressive degenerative arthritis develops leading to osteophyte formation, joint narrowing with progressive exposure of subchondral bone, subluxation, deformity, involvement of surrounding joints. The aim of this study is to evaluate the outcome of the first treated cases using autologous chondrocyte transplantation at the trapeziometacarpal joint.

Materials and methods: Ten cases of thumb carpometacarpal (CMC) arthritis stages II and early stage III were treated by arthroplasty of thumb CMC joint with autologous chondrocyte transplantation by open or arthroscopic technique. All patients had persistent pain unresponsive to different kinds of non-operative treatments. Ethics committee approval of our Institute has been obtained. Fragments of 3–4 mm² of cartilage were harvested under arthroscopy or by open technique in the wrist joint or elbow joint. Cartilage cells were sent to the laboratory to grow on a collagenous biphasic matrix. After 3 weeks it was possible to reimplant the chondrocyte-augmented scaffold in the trapezio-metacarpal joint using fibrin glue, or to freeze it to perform the operation at a later date. Ten joints in eight patients aged 42–68 years (mean 53) have been treated. All were females. The dominant hand was treated in six cases, and two patients had a bilateral operation. In the cases operated using the open technique a ligament reconstruction procedure was associated to stabilize the TM joint.

Results: Patients were examined at a mean 20 months follow-up (3 months–4 years). Impairing pain disappeared in all patients, and three cases had still occasional pain. Full range of motion was obtained in all cases and grip increased in all cases. No complications at the CMC joint nor at the donor site occurred postoperatively.

Conclusions: Tissue reconstruction is theoretically the optimal treatment for cartilage damage. The preliminary results are encouraging, but we do not know if the implanted cartilage will last, or for how long. The potential advantage of this technique is to postpone more aggressive procedures at the TM joint to an older age. In cases with instability we think it is necessary to add a ligament stabilization procedure to avoid subsequent damage to transplanted cartilage. A longer follow-up and a greater number of treated cases are necessary to establish the usefulness of this procedure, which has the advantage of being completely biological but has high costs.

20. Percutaneous approach with platelet gel and bone morphogenetic protein with arthroscopic assistance in avascular necrosis of the lunate

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Purpose: We have limited experience in three cases of disease that could be called avascular pre-Kienböck.

Methods: The technique consists of starting with arthroscopy, which highlights the articulation and cartilaginous texture of the radio-lunate and lunocapitate in its entirety. The presence of both such pathological features leads to a change in treatment. In some cases we had to perform a synovectomy, in view of the large synovial reaction. Once the validity of the cartilaginous bone structure is verified, it is passed out and under radiological control we introduce a K-wire, which must reach the affected area; this is because not all of the lunate is affected by the disease. A gap of about 3mm in the joint's completely avascular area is opened using a cannulated drill. Then with a spoon, cleaning the area, always using the K-wire, a catheter is introduced and with it, the wire is removed, and we introduce the mixture, a previously prepared platelet gel and bone morphogenetic protein (BMP). Immobilization is maintained for 3 weeks, then mobilization is started. From 45 days MRI control can be done.

Results: The results from these three patients were very interesting because there was a reconstruction of the bone without collapse of the structure. In some cases sufficient decompression has been seen, and therefore it is unknown whether this good result is due to decompression or stemming associated with platelet gel and BMP.

21. Which portal-related complications occur during a wrist arthroscopy workshop?

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Introduction: Wrist arthroscopy is a novel minimally invasive technique with a learning curve. Standard portals have been described to introduce the camera and instruments. The dorsal aspect of the wrists contains important anatomical structures: tendons, nerves, arteries and veins. The introduction of portals is done in percutaneous blind fashion. The aim of this study is quantitate possible complications of the portals.

Methods: Nine arms were analysed that had been utilized by participants during an international wrist arthroscopy workshop. The level of experience varied from beginners to intermediate level. After completion of the course, the arms were dissected and analysed for complications. The portals were identified by small needles as markers inserted in the portals. The dissections were performed in a layer-by-layer fashion. Firstly, the skin was removed. Subsequently, the cephalic and basilic veins were identified. Then the lateral antebrachial cutaneous nerve (LACN), the superficial branch of the radial nerve (SBRN) and the dorsal branch of the ulnar nerve (DBUN) were identified. All these structures were analysed for damage. The fatty tissue was removed and all the tendons were checked for damage. Finally, the dorsal branch of the radial artery was identified and checked for damage. All findings were photographed.

Results: In five out of nine arms the cephalic vein had been damaged. In three arms nerve damage was present: damage to the nerves occurred to the SBRN and DBUN. In five arms we observed tendon damage: two extensor pollicis longus, two extensor digiti minimi, one abductor pollicis longus. We did not observe damage to the dorsal branch of the radial artery.

Discussion: The damage to the cephalic vein can be explained by the fact that they are less visible in cadaveric arms. In vivo, damage to the nerves could lead to loss of sensibility or neuropathic pain. During insertion of the scope and instruments tendons may be damaged easily. This small series shows a higher number of complications than previously reported. In vivo complications after wrist arthroscopy may be underestimated and underreported.

Conclusion: Although the locations of the classic portals for wrist arthroscopy have been well defined, wrong portal placement by inexperienced surgeons still leads to avoidable complications.

22. The role of intercarpal pin fixation and capsulodesis in the management of predynamic and dynamic proximal carpal row injuries

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Purpose: Currently, there is limited information regarding the clinical outcomes following percutaneous

pinning of proximal carpal row injuries. The purpose of this study was to compare percutaneous pinning and capsulodesis of predynamic or dynamic proximal carpal instability versus pinning alone.

Methods: A retrospective chart review from was conducted of all patients with carpal instability from 1998–2008. Patients with predynamic or dynamic scapholunate ligament injury treated with percutaneous pinning alone or in conjunction with dorsal capsulodesis were identified. We excluded all patients who had sustained perilunate lesser arc or greater arc injuries. Pre- and postoperative radiographs were evaluated for scapholunate diastasis, radioscapoid, and scapholunate angles. Pre- and postoperative Mayo Wrist Scores (MWS) and Visual Analog Scale (VAS) were obtained.

Results: In total, 61 patients with predynamic and dynamic injuries were identified with an average follow-up of 22.3 months. Postoperative immobilization averaged 6.6 weeks. Some 27 patients were treated acutely with percutaneous pinning of the proximal row with or without open ligament repair and had pre- and postoperative VAS and MWS of 5.8 and 54.7, and 1.6 and 74.4, respectively; 34 patients treated at greater than 6 weeks had pre- and postoperative VAS and MWS of 4.9 and 67.3; and 2.4 and 70.5, respectively.

The 38 patients treated with pinning alone had a pre- and postoperative MWS of 64.7 and 71.3 and the 24 treated with pinning and capsulodesis had pre- and postoperative MWS of 61 and 73.3. The patients treated with pinning alone for an acute injury had pre- and postoperative MWS of 58.9 and 63.3, while those treated for a chronic injury had MWS of 67.3–70.7.

The 11 patients with concomitant distal radius fracture had significantly higher MWS (81.9, $p=0.02$), than those without (70). The average pre- and postoperative scapholunate intervals measured 1.9 mm and 2.1 mm for all patients. The average pre- and postoperative scapholunate angles were 58.6 and 62.5°, respectively.

Conclusions: These results suggest that percutaneous pinning of predynamic and dynamic proximal carpal row injuries does not significantly improve clinical outcomes, except in the case of concomitant distal radius fracture. Neither injury acuity nor addition of open capsulodesis significantly improves results.



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