A-0006 The association between cubital tunnel morphology and ulnar neuropathy in patients with elbow osteoarthritis

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**Purpose:** Morphological changes in the cubital tunnel during elbow motion in patients with elbow osteoarthritis have not been examined in vivo. We examined the changes in cubital tunnel morphology during elbow flexion and the characteristics of medial osteophyte development, to elucidate whether the cubital tunnel area and medial osteophyte size are factors contributing to cubital tunnel syndrome in patients with elbow osteoarthritis.

**Methods:** We performed computed tomography of 13 primary osteoarthritic elbows in patients with cubital tunnel syndrome (Group A) and 25 primary osteoarthritic elbows in patients without cubital tunnel syndrome (Group B) at full extension, 90° flexion and full flexion. Cubital tunnel area, humeral and ulnar osteophyte area and height, and the proportion of osteophytes within the cubital tunnel were analysed at each position.

**Results:** The humeral osteophyte area and height, and the osteophyte proportion within the cubital tunnel were larger at full and 90° elbow flexion than at full extension. These parameters were significantly greater in Group A than in Group B, at full extension and at 90° flexion. Anterior parts of humeral osteophytes were better developed than posterior parts.

**Conclusions:** Medial osteophyte size, not cubital tunnel area, is a factor contributing to cubital tunnel syndrome in patients with elbow osteoarthritis. Compression due to cubital tunnel narrowing and traction/friction of the ulnar nerve due to medial osteophytes during elbow flexion are causative factors for cubital tunnel syndrome.

**Clinical Relevance:** This study provided useful information regarding the pathology and surgical treatment strategies for cubital tunnel syndrome in patients with elbow osteoarthritis.

A-0023 Clinical results of percutaneous needle fasciotomy for Dupuytren’s disease – Is there any correlation between preoperative severity or Dupuytren’s diathesis and clinical results?

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**Purpose:** Recently there has been a resurgence in the popularity of percutaneous needle fasciotomy (PNF). It is generally thought that PNF is not effective for moderately severe and severe forms of Dupuytren’s disease (Abe or Tubiana Stages 3 and 4). Especially a contracture of > 60° in the proximal interphalangeal (PIP) joint (Abe Stage 4) is more difficult to correct, because it may be accompanied by shortening of the check rein and collateral ligaments, and attenuation of the central extensor slip, which cannot be treated by PNF. Many authors support the view that Dupuytren’s diathesis is a risk factor for recurrence or extension: the reported recurrence rates after PNF have been relatively high. The purpose of this study was to clarify the correlation between preoperative severity and Dupuytren’s diathesis and the clinical results of Dupuytren’s disease, following PNF.

**Methods:** There were 47 patients, with 99 fingers treated. The average age was 62 years (range, 39-90 y). Forty patients were men and seven were women; 31 left and 25 right hands, including one index, nine middle, 46 ring and 43 little finger rays underwent PNF. Forty-one patients indicated a diathesis score of < 4 and 6 patients demonstrated > 5 points in diathesis score. Thirty-four finger rays were in grade 1, 32 in grade 2, 18 in grade 3 and 15 in grade 4 of Abe’s classification. Preoperative metacarpophalangeal (MP) joint contracture averaged 35° (range, 30° to 65°), and the PIP joint, 45° (range, 15° to 85°).

**Clinical Relevance:** This study provided useful information regarding the pathology and surgical treatment strategies for cubital tunnel syndrome in patients with elbow osteoarthritis.

A-0023 Clinical results of percutaneous needle fasciotomy for Dupuytren’s disease – Is there any correlation between preoperative severity or Dupuytren’s diathesis and clinical results?
We performed PNF with a 25-Gauge needle, according to the Eaton and Van Rijssen’s technique. Immediately post-procedure and at least 12 months after treatment (range, 12-26 mol), we examined the correlation between clinical success defined as a correction to 5° or less contracture and Abe’s stage. We also examined the correlation between recurrence, defined as 20° or less over the original post-procedure corrected level and Abe’s diathesis score. We also reviewed the records for complications, excluding recurrence.

**Results:** PNF provided successful correction to 5° or less contracture immediately, in 100% of Grade 1, 94% of Grade 2, 54% of Grade 3 and 30% of Grade 4. At final follow-up, 89% improvement of the correction was maintained for MP joints and 66% for PIP joints. There was recurrence of 20° or less over the original post-procedure corrected level in 2% of MP joints and 33% of PIP joints. Recurrence occurs more often in Abe’s Grade 3 (50%) and Grade 4 (67%) fingers than in Grade 1 (4%) and Grade 2 (13%). The recurrence rate was also higher by over 5 points in the diathesis score group (33%) than the group with < 5 points (11%). Other complications: none, except for skin tears, which occurred in 18 digits.

**Conclusions:** PNF is effective for mild to moderate Dupuytren’s disease (Abe’s Stage 3 and 4). Our results showed that PNF can be better for patients with the mild-to-moderate form. Recurrence is higher in the severe form of the disease, but the procedure can be repeated. These features make this technique a valid alternative in treating the mild-to-advanced stages of Dupuytren’s disease.

**A-0028 Bilateral carpal tunnel syndrome: staged or simultaneous surgery?**

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Carpal tunnel syndrome presents bilaterally in up to 87% of patients. Whilst the condition can sometimes be successfully managed non-operatively, many require surgery. The surgical decision is whether to undergo either a staged or simultaneous decompression. A simultaneous approach requires only one period of recovery from surgery and therefore, reduced time off work and decreased costs; however, there are potentially increased functional difficulties, as they are without an un-operated hand to rely on. We aimed to quantify the difficulties during the initial recuperation from surgery. We wanted to ascertain what differences both groups had in functional difficulty, time to return to work, pain and overall satisfaction. Furthermore, we aimed to elucidate any factors that could help in selecting patients for either surgical approach. We included in this study 63 patients with bilateral carpal tunnel syndrome, diagnosed by history and examination. Patients were offered the option of simultaneous or staged (> 6 weeks) decompression. A staged decompression was undertaken in 33 patients (Group 1), whilst 30 underwent simultaneous decompression (Group 2). Patients completed a questionnaire regarding the functional difficulties during the initial 2-week period following surgery. This combined the Levine functional score, the Quick-Dash score, a visual analogue score for pain assessment, level of satisfaction, along with the time before returning to work. The functional difficulties were greater overall with simultaneous decompression. The main problems were in activities that required dexterity, strength or both hands, such as cutting food and washing. There was no difference in simple tasks such as the ability to hold a book or use the telephone. Patients undergoing simultaneous decompression also found it significantly harder to socialize, which is probably a reflection of the overall greater difficulty in functional activities in this group. There was no statistical difference in pain (p = 0.93), with means of 3.3 in both groups, nor in patient satisfaction, with means of 7.7 and 7.6 for Groups 1 and 2, respectively (p = 0.88); however, whereas 93.3% would undergo staged decompression again, only 80% would undergo simultaneous decompression again (p = 0.14). The 20% that would prefer a staged procedure cited functional difficulties as their concern, whereas the 6.7% that would change from staged to simultaneous surgery found it inconvenient to have two periods of recuperation. The only significant functional difficulty for the simultaneous group was in the ability to use the toilet. A significant decrease occurred in the total time off work in both manual and non-manual workers, with on average 2-3 weeks for simultaneous surgery versus 6 weeks for the staged decompression. Age, sex and pre-operative functional difficulties had no influence on the post-operative functional difficulties. Patients on medication for depression or anxiety were significantly more likely to report functional difficulties or dissatisfaction with simultaneous surgery (p = 0.008). Most patients are satisfied with a simultaneous decompression for patients, but they must be highly motivated and become aware of the short-term functional difficulties following surgery. It allows for an earlier return to work, with no increase in pain. We do, however, advise against the use of simultaneous decompression in patients with anxiety or depression.
A-0030 Paediatric toe to hand transfer: an assessment of outcomes and a systematic literature review

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Introduction: Children born with congenital differences can present as a surgical challenge to the hand surgeon. Toe-to-hand transfer is an acceptable option in children born with absent thumbs and digits. It can provide functionally useful digits. Previous series have shown the technique to be safe, with low donor site morbidity and high success rates (> 95%). We aimed to assess the outcomes of paediatric toe-to-hand transfer at our institution and to compare our results to the published literature.

Methods: Patients were followed up in hand clinic and assessed with both objective and subjective outcome measures. Motor evaluation was measured by assessing active and passive range of motion (ROM) and assessing grip. Sensory evaluation was assessed using static, 2-point discrimination. Secondary outcomes included the number of early re-explorations and secondary surgeries. Patient and parent satisfaction were also assessed, using standardized questionnaires. A systematic literature review using Medline/Embase with the search function ‘paediatric, toe-to-hand transfer’ revealed 79 papers: 22 were relevant to the review.

Results: A total of 17 children had 28 free second toe microsurgical transfers performed by a single surgeon (MAP). The mean age of these children at the time of the first operation was 45 months. We found that 70% (12/17) of children had symbrachydactyly, 6% [1/17] suffered from traumatic amputation, 12% [2/17] had transverse arrest and 12% [2/17] had constriction ring syndrome. The majority of cases were bilateral second toe transfers (46% or 8/17), followed by single toe transfer for 41% [7/17] and asynchronous second toe transfers for 12% [2/17]. Transplanted toes most commonly had end-to-end anastomosis of a single artery (76% or 13/17) and vein (83% or 14/17). Osteosynthesis was performed with a single Kirschner wire in 93% [16/17] of cases, with use of an interosseous wire in 1/17 cases. Intraoperative arterial revisions due to thrombosis were uncommon (2/17 or 12%). The re-exploration rate was 0%, with 100% survival of toe transfers. We found that 23% [4/17] suffered from minor complications, which mainly included superficial cellulitis secondary to the pin sites. These cases were managed with oral antibiotics. Total passive ROM was greater than total active ROM in all cases. AROM was poor in 65% [11/17] of cases; 41% [7/17] of patients had secondary surgery, which mainly included tenolysis (35% or 6/17). Post-operatively, tenolysis made little improvement in AROM in the transferred digit. Static 2-point discrimination was excellent (5 mm) in 70% [12/17] of cases. One case suffered complete absence of sensation after tenolysis. We could not assess 23% [4/17] of subjects, due to young age. No donor site problems were encountered.

Conclusions: Microsurgical toe-to-hand transfer is a safe and reliable technique that can provide useful function in children with congenital differences. Our series compares favourably with the published literature we identified in our systematic literature review. Secondary surgery should be undertaken with caution. We found tenolysis yielded disappointing results and failed to improve ROM in the transplanted digit. Tenolysis poses a risk to the neurovascular structures and can compromise sensibility.

A-0032 Pyrocarbon proximal interphalangeal joint arthroplasty: a medium-to-long term serial follow-up of a single surgeon

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Introduction: The Ascension pyrocarbon proximal interphalangeal joint (PIPJ) arthroplasty has been in use since 2000. The specific aim of this study was to assess the outcomes and complication rates of a consecutive (since 2001) single surgeon series of patients undergoing this arthroplasty.

Methods: This is a retrospective review of 72 implants in 48 patients. Clinical evaluation included range of motion (ROM), stability, deformity, grip strength measurement, visual analogue pain, a satisfaction scale assessment and the Patient Evaluation Method (PEM) questionnaire.

Results: The mean patient age was 60 years and the median follow-up was 6.2 years. The most frequent indication for surgery was pain secondary to osteoarthritis (52 cases). Infrequently, surgery was performed on rheumatoid (5) and trauma (10) cases. The median post-operative arc of motion was from 0° to 60° and the mean grip strength 13 kg. The median Visual Analogue Scale pain score was 0.6 out of 10, and the mean Patient Evaluation Measure score was 44. There were no complications for 43/67 patients. Fifteen had minor complications, four required early reoperation and five required implant removal. A total of 71% of the patients would definitely have had the
operation again. The Kaplan-Meier method estimated that the pyrocarbon joints in this series have a mean survival time of 10.7 years ± 0.7 years (CI 95%).

**Conclusions:** From this single surgeon series, we conclude that the majority of patients obtained a useful, pain-free range of PIPJ motion, following an Ascension pyrocarbon arthroplasty. Patient satisfaction was high and the implant had an acceptable longevity.

**A-0033 Functional outcome of arthroscopic synovial radial head plica resection in resistant tennis elbow: study of 453 patients**

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**Introduction:** Lateral elbow pain (‘tennis elbow’) is one of the most common conditions affecting the elbow. It causes disabling pain and loss of earnings. Various pathologies, including common extensor inflammation and degenerative tears of ERCB tendon, loose bodies, degenerative arthritis and humero-radial plica were documented. Our study’s foci were the cause of resistant lateral elbow pain and the existence of a humero-radial synovial plica. The aim of the study was to assess prospectively the functional outcome following the resection of a humero-radial synovial plica in chronic lateral elbow pain.

**Methods and materials:** We did a prospective study of 453 consecutive elbow arthroscopies for resistant lateral elbow pain, referred to us as ‘tennis elbow’. All patients were initially treated non-operatively before undergoing arthroscopy. Conservative treatment included rest, activity modification, physiotherapy ultrasound, bracing, non-steroidal anti-inflammatory drugs (NSAIDS) and local corticosteroid injection. The Modified Elbow Scoring system was used to evaluate the post-operative outcome. Patients were followed up in the clinic at 3 months, 6 months and 1 year; and their functional outcomes were assessed using the Modified Elbow Scoring system.

**Results:** In our series, 138 patients had isolated humero-radial plica. There were 105 males and 33 females, and the mean age was 38 years. All these patients had arthroscopic resection of the plica. All the patients were followed up in the clinic at 3 months, 6 months and 1 year; and their functional outcomes were assessed. The Modified Elbow Score was excellent in 97 patients (70%) at 3 months, 100 patients (72%) at 6 months and 110 patients (80%) at 1 year. Other arthroscopic findings were also documented.

**Conclusion:** This study addresses the fact that the causes of lateral elbow pain can be due to various pathologies. In cases of ‘resistant tennis elbow’, the existence of a radial head synovial plica is one of the significant causes of lateral elbow pain, and if present, treatment should be directed at this. We conclude that by resecting the synovial plica, more than 70% of the patients regained excellent elbow function. Because this was noted in the young, active age group, this could reduce their morbidity and time for rehabilitation, and will help these patients to return back to sports and jobs quicker.

**A-0034 Standardised technique for palmar plating of dorsally-displaced distal radius fractures**

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With the inauguration of fixed-angle plates, palmar plating has become a widely accepted way to treat dorsally-displaced distal radius fractures. Despite the high incidence of these fractures, there seems to lack standardisation in performing this procedure. The technique by which the plate is applied to the radius varies. Such plates may primarily be fixed either distally or at the proximal limbs. Both techniques are subject to pitfalls that may deteriorate the quality of reduction. Nevertheless, this procedure has to be learned by residents in their orthopaedic surgical training. The way osteosynthesis is conducted in our institution is safe and simple. We use the variable-angle 2.4 mm locking compression distal radius plate (VA-LCP Two-Column DRP 2.4, Synthes GmbH, Oberdorf, Switzerland). The plate is first fixed to the shaft. Reduction is temporarily maintained by K-wires that run through the plate’s distal margin. These K-wires are usually reliable in maintaining adequate reduction and are gradually replaced by locking screws in the distal row. For this retrospective study, we reviewed the surgical case data of 96 consecutive procedures in which the leading hand surgeon was involved. The duration of operation, the amount of fluoroscopy needed, and the intra-operative radiographic results were determined. According to the plain radiographs, there were 31 A3-, 42 C2-, and 23 C3-fractures, as defined by the AO classification. The hand surgeon himself treated 44 patients. In his hands, the procedure took a mean of 28 min (± 7.8). Pulsated fluoroscopy was needed a mean of 0.6 min (± 0.4), with a dose-area product of 3.7 cGy/cm² (± 1.9). The remaining 52 patients were treated by 14
different residents at various levels of orthopaedic surgical training. They needed a mean of 42.1 min (± 8.4) to carry out the procedure. The mean fluoroscopy time was 0.7 min (± 0.8) and the dose area product was 5.7 cGy/cm² (± 5.4). The intra-operative radiographs demonstrated anatomical reduction, with no difference in palmar (8.6° (± 3.5) vs. 8.8° (± 3.6)) or ulnar inclination (23.2° (± 2.8) vs. 23.7° (± 3.0)) of the radius between the procedures done by the hand surgeon himself and those done by the residents. Likewise, the length of the radius was sufficiently restored by the hand surgeon as well as by the residents, with a post-operative ulnar variance of 0.2 mm (± 1.0) and 0.3 mm (± 1.2), respectively. The results illustrate that in the hand of an experienced surgeon, the described technique is a smart and fast way to treat dorsally-displaced distal radius fractures. Even for less experienced surgeons, this technique is safe and consistently good radiographic results can be expected.

A-0039 Upper limb surgery in children with hemiplegic cerebral palsy: simple things that work

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Objective: Children with cerebral palsy almost always have upper limb limitations that present as a unique surgical challenge to surgeons. The decision process for surgical management can seem complicated; however, there are a few soft tissue procedures that provide small improvements with low risk in children with hemiplegic cerebral palsy. We present the outcomes on children treated in our local centre.

Design: Retrospective cohort study involving children with hemiplegic cerebral palsy treated at Starship Children’s Hospital.

Method: Twelve children with hemiplegic cerebral palsy (age range 5 to 18 years, mean 12 years) had received botox treatment and tendon surgeries. Most were high functioning (9 GMFCS1 and 3 GMFCS2), eight of them went to mainstream school (with normal intelligence), while four had learning/cognitive difficulties. These children were assessed pre-operatively and approximately 6 to 12 months after surgery, in a specialised rehabilitation centre. Non-parametric tests (e.g. active range of motion, patient/parent satisfaction scores and the assisting hand assessment [AHA]) were used for testing of the effect of surgical treatment.

Results: Our preliminary results demonstrated that not only the active motion increases after upper limb surgeries, but also there is significant improvement in bimanual hand function, as shown by the AHA scores. The AHA score improved from 58.5% (range, 38 - 67) pre-treatment to 65% (range, 41 - 70) post-surgery. There is consistently high satisfaction post-surgery, amongst patients and families.

Conclusion: Upper limb surgery improves the ability to use the hemiplegic hand in bimanual activities, amongst children with cerebral palsy. A simple algorithm was developed to allow inexperienced surgeons to safely manage these children.

A-0044 The risk factors for subluxation of distal interphalangeal joint in mallet fracture

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Background: Surgical fixation is recommended when there is involvement of more than one-third of the articular surface of the distal phalanx in mallet fracture. This recommendation originated from the idea that involvement of more than one-third of the base of the distal phalanx would bring subluxation of the distal interphalangeal (DIP) joint. The purpose of this study was first to confirm whether involvement of more than one-third of the articular surface of distal phalanx would bring subluxation of the DIP joint and second, discover what are the risk factors that lead to subluxation of the distal phalangeal joint in mallet fracture.

Methods: We enrolled 85 patients with mallet fracture of 86 fingers with involvement of more than one-third of the articular surface of the distal phalanx in this study. We classified the patients according to the presence of subluxation of the DIP joint, as No Subluxation Group and Subluxation Group. We compared the age, sex, fracture size, fracture displacement, delay in medical attention, and initial extension lag of the DIP joint between groups. Backward step-wise multiple logistic regression analysis was performed, to evaluate the risk factors of subluxation of the DIP joint, as No Subluxation Group and Subluxation Group. We compared the age, sex, fracture size, fracture displacement, delay in medical attention, and initial extension lag of the DIP joint between groups. Backward step-wise multiple logistic regression analysis was performed, to evaluate the risk factors of subluxation of the DIP joint in mallet fracture. Receiver operating curve was used to calculate the optimal cut-off points of risk factors.

Results: We found that 43 patients had a subluxation of the DIP joint and 43 patients showed no subluxation of the DIP joint. There was a significant difference in terms
of the fracture size and delay in medical attention between groups; however, there was no significant difference in other parameters. The risk factors for the subluxation of the DIP joint were: fracture size and delay in medical attention. The optimal cut-off values for the development of DIP joint subluxation were: 48% in fracture size and 12.5 days in delay of medical attention.

Conclusion: Just one-half of patients with involvement of more than one-third of the articular surface of distal phalanx in mallet fracture showed a subluxation of the DIP joint. The risk factors for subluxation of the DIP joint were fracture size and delay in medical attention.

A-0054 Is the median nerve transfer to the biceps a viable option for the ulnar nerve transfer in partial brachial plexus injuries? Prospective analysis of 25 consecutive patients with C5-C6 and C5-C7 injuries

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Objective: The objective of this study was to observe if the results of median nerve transfer to the biceps are equivalent to the more classical ulnar nerve transfer, in terms of elbow flexion recovery and donor nerve morbidity. In addition, we also checked the feasibility of median nerve transfer in C5-C7 injuries with well-preserved median nerve motor function.

Methods: We prospectively evaluated 25 consecutive patients, operated between March 2007 and July 2013, in terms of elbow flexion strength and donor nerve morbidity. They were divided in two groups, according to the donor nerve used: Group 1: ulnar nerve (n = 8) and Group 2: median nerve (n = 15). Two patients with a follow-up < 3 months were excluded from the analysis.

Results: Both groups were similar regarding the time elapsed between lesion and surgery (p = .371) and the follow-up period (p = .639), but the mean age was significantly higher in the median nerve group (p = .032). Anti-gravity elbow flexion (BRMC ≥ 3) was achieved in 87.5% of the patients in Group 1, versus 93.3% of the patients in Group 2 (p = .999). Excellent biceps strength (BRMC ≥ 4) was achieved in 50% of the patients in Group 1, versus 73.3% of the patients in Group 2 (p = .371). There was no permanent donor nerve impairment in any of the 23 study patients. The level of injury (C5-C6 or C5-C7) did not affect biceps strength recovery in both groups (ulnar nerve p = .5307 and median nerve p = .5927).

Conclusion: The median nerve transfer to the biceps is a viable alternative to the ulnar nerve transfer, even in C5-C7 injuries with clinically preserved motor function of the median nerve.

A-0055 Strategies for the treatment of macrodactyly: staged epiphysiodesis for young children

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Macrodactyly is a very rare congenital hand anomaly with a bizarre growth of the bone, joint and ligaments, secondary to hypertrophy of the digital nerve and surrounding soft tissue. A growth inhibition procedure or size-reducing surgery is usually performed, along with soft tissue debulking, but an objective surgical outcome has not yet been established. Epiphysiodesis was performed in cases where the length of the affected finger is more than 75% that of the same sex parent’s finger and growth potential still exists. We sequentially estimated the relative size of the affected finger, compared to that of each phalanx and metacarpal bone of the normal side, in patients whom received epiphysiodesis in all of their three joints simultaneously. They were followed up for 12 months or longer. Five (male: 2; Female: 3) out of 45 macrodactyly patients received simultaneous epiphysiodesis in all finger joints. The size discrepancy between the normal and affected side increases from the proximal to the distal phalanx. The metacarpal bone does not differ much in length, when compared to the normal side. Longitudinal growth is suppressed postoperatively for up to 3 months and is maintained afterwards, while circumferential growth remains relatively constant, regardless of surgery. Epiphysiodesis has a positive effect on the control of longitudinal growth and in maintaining the proportionality of the fingers. Well-planned strategies are required, according to the condition and growth potential of each patient.

A-0057 Factors associated with Complex Regional Pain Syndrome Type I in patients with surgically-treated distal radius fracture

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Background: Wrist fracture is considered a typical initiating trauma for Complex Regional Pain Syndrome Type I (CRPS I); however, few studies have comprehensively evaluated the factors associated with the occurrence of CRPS I after the surgical treatment of a distal radius fracture. This study was performed to evaluate the factors associated with the occurrence of CRPS I after the surgical treatment of a distal radius fracture.

Methods: We enrolled 477 patients with a distal radius fracture whose had been treated surgically and in whom CRPS I was diagnosed, using the modified criteria of the International Association for the Study of Pain (IASP). The factors assessed for an association with the development of CRPS I were: age, gender, body mass index (BMI), fracture type, combined soft tissue injury, number of trial reductions, type of surgery and duration of immobilization. Multivariate logistic regression analysis was used to identify the independent predictors of the occurrence of CRPS I.

Results: Of the 477 patients, 42 (8.8 %) patients satisfied the IASP criteria within 6 months of surgery. Female patients developed CRPS I more frequently. Patients who developed CRPS I were older, and more frequently had a comminuted fracture or soft tissue injury. Multivariate analysis revealed that a female gender, severe fracture type and combined soft tissue injury contributed to CRPS I development (p = 0.02, 0.01 and 0.01, respectively).

Conclusions: We concluded that the severity of distal radius fracture is associated with the occurrence of CRPS I after surgical treatment, and that female gender and combined soft tissue injury are important risk factors for the development of CRPS I. Identifying patients at high risk for developing CRPS I after distal radius surgery may help physicians initiate early and adequate treatment for CRPS I, and so facilitate patient recovery.

A-0064 Korean-type distal radius anatomical volar plate system: a preliminary report

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Background: Distal radius fracture is the most common fracture in the upper extremity. About 60,000 distal radius fractures occur per year in Korea. Internal fixation with anatomical volar locking plate is widely used in the treatment of unstable distal radius fractures; however, most of the currently used distal radius anatomical plate systems were designed based on the anatomical characteristics of Western populations. Recently, the Korean-type distal radius anatomical volar plate (K-DRAVP) system was designed: it was invented based on the anatomical characteristics of the distal radius of Koreans. The purpose of this study was to evaluate preliminary results from the new K-DRAVP system, and to compare the radiologic and functional results with those of other systems.

Methods: From March 2012 to October 2012, we enrolled in this study the 46 patients with acute distal radius fractures whom were treated with the K-DRAVP system at three hospitals in Korea. Standard posteroanterior and lateral radiographs were obtained to assess fracture healing, and then three radiographic parameters (volar tilt, radial inclination and radial length) were assessed to evaluate radiographic outcomes. The range of motion and grip strength, the Gartland and Werley scoring system, and the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire were used to assess clinical and functional outcomes.

Results: Bone union was achieved in all fractures, with a mean time of 42 days. All radiologic parameters were restored to normal ranges, and maintained without any loosening or collapse at the time of final follow-up. Grip strength was restored to 84% of the value for the unaffected side. The mean range of motion of the wrist at final follow-up was: 56.2° extension, 51.3° flexion, 15.6° radial deviation, 25.9° ulnar deviation, 81.0° pronation and 79.6° supination (77-95% of the value for the unaffected side). According to the Gartland and Werley scoring system, there were 16 excellent, 26 good and 4 fair results. The mean DASH score was 8.4 points. There were no complications after surgery.

Conclusions: This new K-DRAVP system was able to restore and maintain good anatomical parameters, providing good clinical outcomes with low complication rates. This system is a promising surgical option for distal radius fractures in the Korean population.

A-0066 Factors associated with night pain in patients undergoing carpal tunnel release

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Purpose: Night pain has important diagnostic and prognostic values in patients with carpal tunnel
syndrome (CTS). We hypothesized that night pain may be associated with certain patient characteristics; and thus, investigated the factors potentially associated with night pain in patients undergoing carpal tunnel release.

Methods: We recruited 75 women with the mean age of 54 years whom were scheduled for carpal tunnel release. Diagnosis of CTS was made based on both the clinical symptoms and the results of electrophysiologic studies. Patient characteristics investigated as factors potentially associated with night pain were: age, body mass index (BMI), symptom duration, comorbidities such as diabetes mellitus (DM) and other peripheral neuropathies, electrophysiologic severity of CTS, and sleeping position. We conducted a logistic regression analysis to examine the relationships between the presence of night pain and the different patients’ demographic and clinical variables. We also examined the correlations between the severity of night pain and the variables.

Results: Absence of night pain was associated with increased age [odds ratio (OR), 0.918; CI 95% (0.851; 0.99)] and presence of DM [OR, 0.196; CI 95% (0.046; 0.835)]. The other variables assessed were not found to be associated with night pain. There was no significant correlation between the severity of night pain and the variables investigated.

Conclusions: This study found that in women undergoing carpal tunnel release, older patients or those having DM are less likely to have night pain. As night pain is an important prognostic factor for CTS, future studies in elderly or diabetic patients may need to consider night pain as a potential confounder that can affect the outcomes of carpal tunnel release.

A-0068 Anatomical landmarks for peripheral neural blocks of the forearm and the wrist: a cadaveric study

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Purpose: Peripheral neural blocks are an important diagnostic tool for the treatment of pain associated with neuroma formation. A failed block may have a great impact on therapy; and therefore, on the development of chronic neuropathic pain syndromes. Literature still cannot provide sufficient data to ensure a standardized technique for peripheral neural blocks, according to anatomical landmarks.

Methods: This study was performed on five formalin-preserved cadaveric upper limbs. We dissected the superficial branch of the radial nerve (SBRN); the dorsal branch of the ulnar nerve (DBUN); the lateral, medial and dorsal antebrachial cutaneous nerves (LACN, MACN and DACN); as well as the palmar branch of the median nerve (PBMMN). Serving as reference points: the ulnar and radial styloid process, the Lister tubercle, and the medial and lateral epicondylus of the humerus. The distance between the above-mentioned nerves related to the reference points was measured with a digital caliper, while keeping the wrist and the elbow in a fixed position.

Results: For the SBRN, the mean distance on a straight line from the Lister tubercle to the medial epicondylus was 85 mm. Measuring from the styloid process of the radius to the lateral epicondylus, the DBUN was found on a mean distance of 27 mm. On a line between the medial and lateral epicondylus, the LACN was located at a mean distance of 50 mm. The DACN was located at a mean distance of 32 mm from the epicondylus lateralis to the medial one, while the MACN could be found 14 mm radial from the medial epicondylus. For the PBMMN, the measurement included a mean distance of 45 mm from the radial styloid to the medial epicondylus, and from this point perpendicularly, a mean distance of 21 mm.

Conclusion: Due to landmarks identified by skin surface palpation combined with simple measurements, the precise location of a peripheral neural block can be optimized.

Clinical Relevance: The precise neural block of a certain peripheral nerve is of prime priority for distinct diagnosis and treatment of pain associated with neuroma formation.

A-0071 Injury patterns: acute thumb ulnar collateral ligament injuries

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Introduction and aims: Thumb ulnar collateral ligament (UCL) is a strong joint stabiliser. Inadequately treated UCL injuries can lead to significant disability, including chronic pain, reduced pinch grip and risk of early arthritis. The aim of this study was to determine acute UCL injury patterns and long-term outcomes.

Materials and methods: This study is a 4-year retrospective case-note review (May 2007 to December 2011) of patients referred to our department. The decision to operate was based on clinical and plain x-ray assessments. Bones anchoring sutures, K-wires or both were used for UCL repair. Post-operatively,
thumbs were immobilised for 3 - 5 days, followed by in-line and protected mobilisation for 4 - 6 weeks.

Results: We identified 123 acute thumb UCL injuries: 64/123 had an end-point requiring splintage only, 59/123 were explored for equivocal or no end-point, 9/59 had a partial injury or isolated volar plate/dorsal capsule rupture, 50/59 had complete UCL injury (14 with isolated stener lesions, 5 with stener lesion and dorsal capsule injury, 1 with stener lesion and proximal rupture, 22 with distal avulsions/fracture avulsions without stener lesion and 8 proximal UCL injuries). Four patients had complications, but none required re-operation. All patients were discharged when their thumb pinch grip was pain free.

Conclusions: This series shows good clinical outcomes following surgical UCL repair and supports the use of early active in-line mobilisation. We advocate operative exploration for patients with equivocal or no end-points. Injury patterns vary widely. Proximal UCL injuries are more common than previously reported. An operative algorithm to restore normal anatomy is considered, based on intra-operative findings.

A-0076 Volar locking plates: locking screws versus locking smooth pegs in distal fixation. Biomechanical study in cadaveric models

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Introduction: Internal fixation using volar plates has become the treatment of choice for distal radius fractures. Meanwhile, there were some models presented with the option of locking screws (LS) and locking smooth pegs (LSP) in distal fixation.

Objective: Perform a biomechanical comparison in cadaveric models between LS versus LSP, in extra-articular distal radius fractures.

Methods: We reproduced extra-articular dorsal comminuted fractures (AO - A3) in 12 cadaveric radii. We divided them into two groups, according to the use of LS or LSP in distal fixation. Biomechanical tests were conducted evaluating the changes in the rigidity of the systems, after performing an axial load.

Results: Final static testing in systems with LS generated an average reduction in the height of the osteotomy of 1.07 cm to 0.45 cm, with an average difference of 0.62 cm. The angle of the gap of the osteotomy decreased by an average of 18.5°, consequently producing a significant alteration in the tilt of the articular facet in the lateral radiograph, varying from 16.6° (volar) to -11.6° (dorsal). We observed, in addition, an average dorsal deformation of the plate of 28.5°. In systems assembled with LSP, we found an average variation in the height of the osteotomy of 0.98 cm to 0.75 cm, with a difference of 0.23 cm; and with a resulting decrease in the angle of the gap of an average of 10.8°. The orientation of the articular facet in the lateral view changed an average of 16.8º (volar) to 5.5º (volar), with an average difference of 11.3º. Regarding the plate deformity, we found an average of 17.1º of discrepancy, dorsally. The differences between pre- and post-failure were statistically significant when comparing pegs versus screws (p = 0.03). Moreover, the maximum tolerated load in the systems with LS was 1659N; and it was 1905N in those in which we used LSP.

Conclusions: Both plates showed the same tendency in the evaluation; however, when the failure is generated, the system with LS showed greater plate deformity (higher stress), and this pushed the bone to dorsal, bringing about a major decrease in the height and angle of the osteotomy, which led to greater dorsal deviation of the articular facet on the lateral radiograph. There was a separation of the plate from the bone in the systems fixed with LSP during the dynamic testing. Therefore, we found a load transfer in two stages, in those models with locking smooth pegs. A first stage, in which the load transfer was from the epiphysis to the shaft through the volar plate (bone-plate-bone), bypassing the fracture (as in the systems with LS); but in the second stage, the plate was removed from the system, due to back slippage of the locking smooth pegs from the bone, allowing a transmission directly from the distal to the proximal fragment (bone-bone). This new transfer generated in all cases an incomplete and longitudinal fracture of the volar cortex, but stopped the plate deformity, which allowed keeping the angle of the osteotomy and consequently the volar tilt of the articular facet.

A-0077 Periprosthetic osteolysis after total wrist arthroplasty: incidence, evolution and histopathology

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Introduction: Periprosthetic osteolysis (PPO) after total wrist arthroplasty (TWA), with or without frank implant loosening, is a known phenomenon, but is not very well described nor understood. The aim of our
studies was to investigate its incidence, consequences and possible causative factors.

**Methods:** We obtained a crude estimate of the occurrence of PPO, by analysing data from seven centres in the International Remotion TWA registry. Motivated by these results, we performed a closer analysis by reviewing the serial (annual) radiographs from two centres, using the Remotion TWA. Only cases with at least 2 years’ follow-up were included. Cases with frank loosening were excluded. Two senior hand surgeons, in close collaboration, measured the evolution of the width of PPO in defined spots on plain radiographs. In view of evaluating the possible causes of PPO, one author analysed the biopsies from the bone-implant interphase in 13 consecutive wrists from one centre, as well as blood samples collected from those patients. The histopathological findings were compared with the radiographic findings.

**Main results:**

1. In the registry, signs of implant loosening were reported in 6 of 52 cases seen at follow-up, 5 - 9 years after operation, and there was PPO without implant loosening in another 11 cases.
2. On the serial radiographs of 44 wrists, we found signs of carpal loosening in 5 cases and radial loosening in 1 case. In 30/38 remaining wrists, the width of radiolucent lines at the metaphyseal part of the radial component was 0 - 2 mm and seemed to remain stable over time. At the carpal component, this was the case in 33 wrists. In the remaining cases, osteolysis was more progressive, but without involving the stems of the implants, and without causing loosening of the components.
3. The histopathological analysis revealed the presence of metallic debris in 19/24 specimens and polyethylene particles in 12. There was no correlation between the amount of debris and the width of the radiolucent zones. Even in cases with pronounced radiolucency, there could be no polyethylene particles at all and in cases with a relatively high amount of debris, there could be no visible osteolysis. Neither was there histopathological evidence of infectious or rheumatoid activity in any of the specimens or blood samples. PPO was not related to a specific diagnosis.

**Conclusions:** PPO is a relatively common occurrence. In most cases, it seems to be stable and of no concern, in terms of implant loosening. In some cases it may be progressive. Polyethylene wear, wear due to metallic debris, and infectious or rheumatoid activity were not correlated to PPO.
Objectives: The aim of this re-audit was to assess if clinicians at our hospital had learnt from the presentation of the results from the first audit cycle. In a similar fashion to the previous audit cycle, radiographs were assessed for the parameters that have been suggested to best estimate functional outcome and to identify our most frequent complications.

Methods: This is a hospital-approved re-audit, with a retrospective analysis of prospectively collected patients. They were identified from daily review of the PACS digital imaging system and trauma theatre logs. Revision cases were excluded. Demographic details recorded included the grade of surgeon operating and the type of supervising consultant, i.e. non-upper limb, locum or upper limb specialists. For each patient, we examined radiographs from pre-op through to the latest follow-up for certain parameters of fracture reduction (radial length, intra-articular displacement and carpal alignment). Radiographs were assessed by two blinded observers. We also recorded any obvious implant-related abnormalities, or those with the potential for complication (i.e. plate placement). Results were compared to those from the first cycle of audit.

Results: Despite an overall smaller sample size, there was a similar general demographic distribution. There is a tendency for these injuries to be operated on by upper-limb specialists. Overall, we have improved or maintained our ability to achieve good fracture reductions in all the parameters measured that can predict a good functional outcome. This cohort was 4.5 times less likely to suffer from any type of complication when operated on by upper limb specialists. Patients were also less likely to have a complication if their surgery was performed by a middle grade and supervised by an upper-limb specialist. We did demonstrate an increased awareness of the risk for placement of intra-articular screws. One of the other metalwork-related issues that we need to address further is the length of the proximal shaft screws.

Conclusions: Compared with the first audit cycle, we have improved our practice for fracture reduction to meet radiographic criteria that should help our patients regain good long-term function. The tendency for these operations to be performed or supervised by upper limb specialists seems to be of benefit to patients, as they are less likely to suffer a complication. This audit provided the foundation for formal research into patients’ functional outcomes, according to radiographic findings.

A-0082 How to evaluate wrist conditions: a critical evaluation of the QuickDASH, PRWE and MHQ, in terms of validity, reliability and responsiveness after total wrist arthroplasty (TWA)

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Background: Patient-rated outcome assessments are increasingly emphasized in hand surgery, as it has in other medical specialties. The field has progressed from outcomes defined by objective measurements like joint motion, grip strength and bony union, to standardised assessments of function and disability completed by the patients. To be useful, these questionnaires must be validated in the specific context in which they are intended to be used. The purpose of this study was to investigate to which extend the QuickDASH, PRWE and the ADL section of the MHQ questionnaires could be useful and valid for clinical practice and research related to total wrist arthroplasty (TWA).

Materials and methods: We investigated a consecutive group of patients whom had a TWA operation at Gentofte Hospital, Denmark, or were scheduled for a TWA, or had been seen for follow-up or a second opinion after a TWA performed elsewhere for a total of 112 consecutive wrists.

Results: The correlation between the QuickDASH scores and the PRWE was very strong: Spearman’s rho 0.90. The correlation between the QuickDASH-scores and the ADL-part of the MHQ was not quite as strong, but still strong: Spearman’s rho -0.671. The PRWE scores were approximately 10 points higher than the QuickDASH scores in the upper end of the scale [worse hand function], while they were approximately 5 points lower in the lower end [better hand function]. The MHQ/ADL scores were approximately 5 points more favorable in the middle of the scale, but in the extremities of the scale the scores were very comparable with the QuickDASH-scores.

Interpretation: All three questionnaires appeared to be approximately equal, valid and useful. A main advantage of the QuickDASH is that it is a generally well-known questionnaire, due to its generic and widespread use and to its multiple validated translations.

A-0083 Carpal tunnel syndrome: is the Internet providing comprehensive patient information?

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Introduction and aims: Patients suffering from carpal tunnel syndrome (CTS) actively search the Internet for medical information. The World Wide Web represents the main source of patient information. Very little is known regarding the quality of patient information on the Internet. The aim of our study was to assess the quality of patient information about CTS on the Internet.

Materials and methods: The qualitative and quantitative assessment of the websites was performed with the modified 36-item Ensuring Quality Information for Patients (EQIP) tool. We identified 500 websites containing information on CTS treatment procedures through Google, Bing, Yahoo, Ask and AOL.com. Duplicate and irrelevant websites were excluded.

Results: The 110 websites were assessed. Only 5 websites addressed > 20 items. The scores tended to be higher for encyclopedias, educational and scientific sites, as compared to websites developed by the industry and physicians. The median number of items from the EQIP tool was 15 (IQR 13 - 17) and the quantitative postoperative morbidity risk estimates were available in 25%. Major complications, such as median nerve injury, were reported in only 30% of the websites.

Conclusion: This analysis demonstrates several significant shortcomings in the quality of the information provided to patients suffering from CTS, according to the EQIP-instrument. To the best of our knowledge, assessment of available information for CTS and its treatment has never been performed with a validated tool. There is an acute community need to be provided an interactive, informative and educative website for CTS surgical procedures. The website should be compatible with international quality standards for plastic and hand surgery procedures.

A-0084 Restoration of profundus tendon function in digits with good active flexion in the proximal interphalangeal joint

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Introduction: Capability of good middle phalanx flexion does not mean that the superficialis tendon is really intact. In the course of late reconstructive surgery, we often realize that true anatomy of flexor tendon laceration within the finger has no adequate clinical manifestation. This problem has not often been discussed in literature.

Purpose: We would like to share our surgical experience with the treatment for flexor tendon injuries, in cases with good proximal interphalangeal (PIP) flexion.

Materials and methods: A single hand surgeon treated 254 patients with the so-called isolated deep flexor tendon laceration in 287 digits. Clinically, all patients revealed good enough involved finger proximal interphalangeal (PIP) active flexion and full absence of distal interphalangeal (DIP) flexion. While 98 patients underwent surgery during the first 24 hours after injury, 156 patients were operated at a time from 3 weeks to several years after the laceration. Flexor digitorum profundus (FDP) tendon advancement in the acute setting was performed in 95 fingers where the distal stump length was less than 12 mm; in 18 of these cases the half-damaged FDS was excised. In 11 fingers, primary FDP tendon grafting in the acute setting was performed, because distal stump length was 13 - 16 mm. As for late reconstructive surgery, FDP tendon advancement was carried out in 63 favorable cases with the distal stump length less than 12 mm. Single-stage free FDP grafting was performed in 32 fingers for its long-standing Zone 1 laceration (within 12 mm to the insertion), with poor proximal tendon end condition. Single-stage free FDP grafting was also performed in 36 fingers with isolated Zone 2 FDP injury, with more than 12 mm distal stump length. Special focus was on a series of 30 fingers called the ‘false isolated FDP laceration group’. At preoperative clinical examination, these patients demonstrated full PIP active flexion, but in the course of the procedure, both flexor tendons’ long-lasting injury was discovered and both tendons’ proximal end adhesions had been providing good middle phalanx flexion. In 30 such cases, single-stage free FDP grafting was performed and the superficialis tendon was used as a source of graft. Two-stage FDP reconstruction with silicone rod insertion was indicated in 20 superficialis-intact cases with a condition having a poor distal part of the flexor tendon bed.

Results: In 238 cases, the functional outcomes were clinically evaluated at follow-up examination 6 months after surgery. The overall outcome was excellent in 177 digits (74.4%), good in 33 digits (13.9%) and fair in 12 digits (5%). The contracture rate was 2.5% (6 digits) and the rupture rate was 4.2% (10 digits).

Conclusion: In the course of preoperative planning for flexor tendon injury cases with good PIP active function, it is reasonable to keep in mind that the final extent of procedure depends on FDP distal stump
length, on the FDP proximal end, FDS and tendon bed condition, i.e., on features only purely evident in the course of surgery. This understanding is rather useful when indicating surgery in such patients and provides a real opportunity for perfect finger flexion restoration with relatively low complication rates.

A-0085 Arthroscopic-assisted arthrodesis of the trapezio-metacarpal joint: indication and surgical technique

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Arthroscopic-assisted surgery of the trapezio-metacarpal (TMC) joint has been described before for the treatment of TMC joint arthritis, including debridement, partial or total trapezeectomy and interpositional arthroplasty, but its use for fusion is not reported. TMC joint arthroscopy is a novel technique for arthrodesis, which aims to maintain joint stability and strength. We successfully used this technique to perform fusion of the TMC joint. We believe that arthroscopic-assisted fusion presents several advantages over the open one, including direct visualization of the articular cartilage that permits accurate assessment of the extent of the curettage, thus avoiding the possibility of leaving remnants of the articular cartilage, which may contribute to pseudoarthrosis, minimal discomfort at the site of intervention and good patient satisfaction, with a minimally invasive procedure and rapid return to training and competition. We also think that using this technique would offer the possibility of expanding the indications for TMC joint arthroscopy.

A-0089 Three-year activity report of the Replantation Service for Amputation of the Hand in Poland

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A permanently on-call service for hand amputations was established in 2010 at the initiative of the Council of the Polish Society for Surgery of the Hand. It is run by three qualified hand centres in Trzebnica, Poznań and Szczecin. The paper presents a summary of the almost 3-year activity of this service. Over this period, a total of 435 cases of total and subtotal amputations were referred, as well as other severe, complex injuries to the hand. Of these, 290 referrals (67%) were accepted and 141 (33%) rejected. Among those accepted, there were 100 total (34%) and 113 subtotal (39%) amputations; 81 patients had other severe hand injuries, such as crush, degloving and excessive wounds involving all tissues. Young and middle-age males constituted the majority of patients, with a mean age of 42 years (range, 2 - 82). The most common injury was amputation of several digits (including thumbs) in one patient (141 cases or 48%), followed by amputations from the metacarpal to the proximal forearm level (115 or 39%) and elbow/arm level (9 cases or 3%). Multi-level amputation or injury of the involved extremity occurred in 19 (6%) patients. Replantation of the completely amputated extremity was performed in 83 patients (28%), revascularisation in 95 (32%) and in 59 (20%), primary repair of the complex injuries. In 23 cases, coverage of the tissue defects was done by flaps, mostly with the greater omentum. Survival rate was of 84% for the replantations and 88% for the revascularisations. Establishing of the Replantation Service constituted significant progress in organisation of the management of the severest upper limb injuries.

A-0091 Arthroscopic reduction and soft tissue management for young adult patients with distal radius fractures

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Introduction: Many studies reveal soft tissue lesions are a relatively common finding in young adult patients with distal radius fractures and arthroscopy appears to facilitate diagnosis. If these soft tissue lesions are untreated, they may be the cause of complications for the long-term outcome and have inferior score results.

Objectives: This presentation used percutaneous or open plating techniques, augmented by simultaneous wrist arthroscopy, to visualise the fracture and thus confirmed the fracture alignment and reduction; it also assessed the concurrent associated ligament injuries.

Methods: Arthroscopy was used to help reduce distal radius fractures and assess soft tissue injuries in 59 cases (38 male and 21 female). The average age of the patients was 28.2 years (range, 19 - 40). The fractures were treated by reduction under arthroscopic control.
and percutaneous or open fixation with implants. In our series, soft tissue injuries in wrist fracture are common. The soft tissue lesions also treated at the same operation include debridement, suture repair ing or Kischner wire tranfixation.

**Results:** Eleven (18.6%) of the patients had scapholunate (SL) ligament injuries. Fourteen (23.7%) of the patients suffered lunotriquetral (LT) ligament injuries and received ligament debridement or Kischner wires, fixation of the LT joint and splinting. A further 20 (33.8%) of the patients exhibited chondral fractures. Additionally, the triangular fibrocartilage complex (TFCC) was torn in 23 (39.0%) of the patients. Finally, 17 (28.8%) of the patients suffered volar carpal ligament injuries. All fractures healed without mal-union or non-union, and at follow up (> 48 months), most patients (92%) displayed excellent and good results, based on the Mayo modified wrist scores.

**Conclusion:** We believe that arthroscopic reduction may be considered for distal radius fractures, because this approach can use a minimal operation to achieve acceptable restoration of fractures, as well as assessment and management of soft tissue lesions.

### A-0092 Plate osteosynthesis versus intramedullary nailing for both forearm bone fractures

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**Purpose:** Given the continuing improvements in nail implants, intramedullary nailing could become an alternative treatment option to osteosynthesis for the treatment of fractures in both forearm bones, with the proper indication. The aim of this prospective study was to evaluate and compare the results of plate osteosynthesis and intramedullary nailing for the treatment of diaphyseal fractures in both forearm bones.

**Methods:** We divided the 67 patients (mean age, 41 years; range, 22 - 76 years) of this prospective study into two groups, according to treatment, randomly: the ORIF Group (plate osteosynthesis) and the IMN Group (intramedullary nail). The results were assessed on the basis of the time to union, functional recovery (range of motion and functional outcomes (Grace and Eversmann rating system and DASH)), restoration of the ulna and the radial bow, operating time, exposure time to fluoroscopy, complications and patient satisfaction. The ratio of the magnitude of the maximum radial bow on the injured side to that on the contralateral side (i.e. the ratio of the contralateral side) was determined to evaluate the effectiveness of radial bow restoration between groups.

**Results:** The time to union and the exposure time to fluoroscopy were significantly shorter in the ORIF Group than in the IMN Group. The presence of the butterfly segment and severe displacement were factors leading to the increase in the time of union in the IMN Group. No inter-group differences were observed in the restoration and magnitude of the maximum radial bow on the injured side; however, the ORIF Group showed a significantly improved ratio of the contralateral side, compared to the IMN Group. In terms of the location of maximum radial bow and ratio of the contralateral side, significant differences were found between groups. The functional outcomes did not significantly differ between the two groups, irrespective of the time of assessment. All patients achieved union in both groups, with the exception of a single case of non-union in the IMN Group and one case of re-fracture after implant removal in the ORIF Group.

**Conclusion:** Based on the significant differences in the ratio of the contralateral side, plate osteosynthesis resulted in a more excellent extent of restoration to the conditions prior to the injury. Nevertheless, such significant differences in the restoration of the bow had no effect on the final clinical outcome. Our results suggested that intramedullary nailing can be an acceptable and effective treatment option for fractures in both forearm bones, if the indication is properly selected.

### A-0093 Complications following palmar plate fixation of distal radius fractures: a review of 434 cases

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Palmar plate fixation of unstable distal radial fractures is quickly becoming the standard treatment for this common injury. This study reporting complications consists mainly of isolated case reports or small case series. Between February 2004 and December 2012, palmar plate fixation was performed in 434 cases. There were 312 male patients and 122 female patients in our series. The mean age was 51.2 years (range, 18 - 74) The overall complication rate was 11.3% (75 complications). Revision surgery was necessary in 10% (65 procedures). Seven patients experienced post-operative median nerve compression. There were 23 patients who had loss of
reduction. Eighteen patients experienced a distal radioulnar joint (DRUJ) problem or ulnolunate impaction. There were five patients who had screw penetration. Post-traumatic compartment syndrome of the forearm, requiring fasciotomy, occurred in four cases. There was one case of infection and one of hematoma. Non-operative treatment was necessary in five patients, who developed a complex regional pain syndrome. Hardware removal was performed in 130 (30%) cases. Palmar plate fixation of distal radius fractures is a safe and effective procedure. Nevertheless, complications necessitating a second intervention are relatively common. A proportion of these complications is iatrogenic and can be avoided by improving the surgical technique.

A-0098 Chondroplasty under risk during radiofrequency probe application in wrist arthroscopy

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Background: The safety and benefit of using radiofrequency energy (RFE) for chondroplasty of the wrist remains unclear. The purpose of this study was to investigate the subchondral temperature profile during radiofrequency energy (RFE) application for chondroplasty in an arthroscopic setting.

Methods: A chondroplasty of the lunate fossa was performed during an arthroscopy setting for 14 arms of seven deceased patients. Continuous irrigation was ensured by using saline 0.9% solution and gravity-assisted outflow through an 18-gauge needle. Chondroplasty was carried out on seven wrists with a bipolar device (VAPR II 2.3 mm, side effect electrode, Depuy Mitek, Westwood, MA, USA) or with a monopolar device (OPES ablator small joints, 45° REF AR-9601SJ-45 OPES Ablator AR-9600, Arthrex, Naples, FL, USA). The temperature was recorded simultaneously from seven predefined anatomical landmarks.

Results: We observed an increase of the temperature corresponding to the time of applied energy. The highest subchondral measured peak temperature was 49.35°C (monopolar) and 69.21°C (bipolar) in the lunate fossa. Measured temperature did not exceed 50°C when using the monopolar system. For both systems, the mean temperature did not reach more than 30°C at all measured points, except for the lunate fossa. In addition, both radiofrequency (RF) devices showed a proportional decrease of temperature, regarding the distance of the sensors to the RF-probe.

Conclusion: It remains questionable whether RFE can be safely used for performing chondroplasty in wrist arthroscopy under continuous irrigation and constant movement, to reach the requested sealing effect; however, the bipolar device should be applied with more caution, because peak temperature in the lunate fossa almost reached 70°C, even under continuous irrigation.

A-0101 Surgical treatment of congenital upper limb deficiency using pollicisation with different modifications

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Purpose: Reconstruction of bilateral grasp for patients with congenital deficiency of the thumb, combined with deficiency of the upper limb.

Materials and methods: Since the period from 2000 in our clinic, we treated 70 patients aged 6 months to 18 years, on whom were performed 83 pollicisations. The classical method of pollicisation was used in 22 cases, for 21 patients. In all other cases, pollicisation was performed with different modifications, which depended on the deficiency of upper limb.

Results: We classified all unusual variants of pollicisations for 4 groups:

1) Surgeries which corrected combined hand deficiencies: pollicisations with correction of clinodactily or contracture deformities of a transposed finger, pollicisations with simultaneous correction of syndactily deformity of a pollicised finger, pollicisations with correction of triphalangeal or polydactily thumb, pollicisation of a hypoplastic thumb;
2) Surgeries which corrected combined forearm deficiencies [clubhand]: pollicisations with simultaneous centration of hand, pollicisation with hand centration after preliminary correction using the distraction method;
3) Pollicisations after preceding earlier thumb reconstruction;
4) Pollicisation without pollicisation.

Conclusions: Using pollicisation modifications in the correction of combined congenital upper limb deficiency allows to correct simultaneously all components of deformities and to reconstruct bilateral grasp.
A-0102 Clinical results after using bioabsorbable plates for treating upper extremity fractures: efficacy and limitations

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Introduction: Previously, we reported that bending strength, stiffness and torsional strength of novel bioabsorbable plate constructs are comparable to those of titanium plates. The clinical results of the two plates are not significantly different. Furthermore, we reported that these plates show good clinical results; however, several issues are associated with the clinical use of bioabsorbable implants for fractures.

Purpose: The aims of this study were to demonstrate the clinical results of novel bioabsorbable plates (Super Fixorb MX40, Takiron Co., Kobe, Japan), comprised of 40% hydroxyapatite and 60% poly-L-lactide, for upper extremity fractures and to detect complications, as well as to investigate the efficacy and limitations of the implant.

Materials and methods: The study included 70 upper extremity fractures of 62 consecutive patients whom were treated with bioabsorbable plates. The subjects' mean age was 49.6 years (15 - 89); 34 were male and 28 female subjects. In all, the patients had 39 metacarpal fractures (32 cases), 20 distal ulnar fractures (19 cases), 5 distal radius fractures and cases (using the dorsal side), and 6 proximal radius fractures and cases.

Results: The bone union rate was 97.1% (68/70 fractures). The implant was removed in three cases, because of range-of-motion disturbance in one patient and screw back-out in two patients. Others complications included the rupture of the extensor pollicis longus and mild complex regional pain syndrome. These two complications were not due to the use of bioabsorbable plates.

Conclusion: Using bioabsorbable plate fixation for upper extremity fractures showed good outcomes, but its use for proximal radius fractures and joint fractures (cancellous bone) should be paid attention to. In conclusion, this novel bioabsorbable plate was useful for upper extremity fractures, but its use had limitations; therefore, we should pay careful attention while using these plates.

A-0106 Cancellous bone graft and headless screw fixation for the middle one-third scaphoid non-union

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Introduction: The middle one-third scaphoid is the most common fracture site and non-union of this area has several surgical treatment options, such as inlaying a bone graft, cortico-cancellous graft, vascularized bone graft and additional K-wire or screw internal fixation. We performed cancellous bone graft from the iliac crest and headless compression screw fixation for symptomatic non-union in the middle one-third scaphoid. The purpose of this study was to determine whether this procedure is sufficient to achieve bone union.

Materials and methods: We retrospectively reviewed the medical records and radiographs of the patients who had surgical treatment for scaphoid non-union. A total of 38 patients who underwent cancellous bone graft and headless compression screw were included in this study. There were 36 men and 2 women, with a mean age of 34.2 years (16 - 63) and a mean delay to surgery of 14.7 months (6 - 96). The average follow-up duration was 34.5 months (13 - 62). Authors analysed preoperative radiographs for classification of non-union, the follow-up radiographs for evaluation of bone union and the Mayo wrist score for clinical results.

Results: There were 22 stable and 16 unstable non-unions on the pre-operative radiographs. All stable non-union and 14 unstable non-union cases achieved bony union and a total of 36 patients (94.7%) showed union at the last follow-up radiographs. Average Mayo wrist score at the final follow up was 85.2 in all patients, and 87.2 in stable and 82.5 in unstable patients. Stable non-union patients showed the tendency for relatively better results, but there was no statistically significant difference, compared to the results of unstable non-union patients (Fisher’s exact test, P > 0.05).

Conclusion: Cancellous bone graft and headless screw fixation provided reliable results and can be one of the effective treatment options for the middle one-third scaphoid non-union.

A-0113 Morphological associations between the distal radioulnar joint and the lunate bone: a radiographic study

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Introduction: The distal radioulnar joint (DRUJ) and the lunate bone have well-defined physiological morphology variations that can be measured on standard radiographs. The ulnar variance is the relative length of the ulna, compared to the radius. DRUJ can also be categorised in three types, according to the angle between a line parallel to the long axis of the ulna and a line parallel to the apposing joint surfaces. On its
radiocarpal side, Type 1 lunate has a proximal and medial aspect converging in a prominent proximal apex. Type 2 shows a flat proximal aspect, more parallel to the midcarpal border of the lunate. Type 3 has a V-shaped proximal aspect. On its midcarpal side, Type 1 lunate has a single distal facet, articulating with the capitate; Type 2 lunate has an additional (medial) hamate facet. The aim of this study is to determine if there are some associations between the morphology of the distal radioulnar joint and the lunate morphology.

Methods: We retrospectively reviewed 100 posterior-anterior wrist radiographs for DRUJ and lunate morphology variations.

Results: There were 51 female and 49 male subjects, mean age 51.2 years old (range, 21 - 94). We found a statistically significant association between the morphology of the DRUJ and the morphology of the radiocarpal side of the lunate (p < 0.001). The mean values of ulnar variance change according to the morphology of the DRUJ and the radiocarpal side of the lunate (p < 0.001), but not with the midcarpal side of the lunate. There was no significant association between the morphology of the DRUJ and the midcarpal side of the lunate, nor between the midcarpal and radiocarpal morphology of the lunate.

Conclusions: The present study showed a statistically significant association between the morphology of the DRUJ, the ulnar variance, and the morphology of the radiocarpal side of the lunate. But the morphology of the midcarpal side of the lunate doesn’t show any association with its radiocarpal side, neither with the ulnar variance or the DRUJ.

A-0116 Effects of manual traction on the movement of the radiocarpal and midcarpal joints

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Introduction: Passive range of motion (ROM) exercise of the wrist joint under traction is generally believed to reduce the load on the joint surface and stretch the soft tissues of the periarticular joint; however, reports on the effects of traction on the movement of the wrist joint are limited. In this report, we describe the effects of manual traction on the movement of the radiocarpal and midcarpal joints, using dynamic radiography.

Materials and methods: The subjects were 20 healthy men (20 hands) without any history of wrist trauma or disorder. Their age range was 25 to 35 years (mean, 30.5 years). The hand and forearm of the subjects were held using a fixed examiner. The wrist was subjected to a 60° palmar flexion, to a 60° dorsiflexion for 5 seconds. Dynamic radiography was conducted while creating wrist passive movements, by using traction and non-traction. The traction power was set at 2.5 kg. To reduce errors, traction power was confirmed using a spring scale at each measurement. We created 20 graphs from the results of 20 hands, using the wrist angle as the x-axis and the radiocarpal angle or the midcarpal angle as the y-axis. Regression lines were calculated from each graph, by using the least-squares method between the neutral and the maximum palmar flexion and the maximum dorsiflexion. Furthermore, comparative analysis was conducted on the trend of traction and non-traction.

Results: In terms of the radiocarpal angle, the slope of the regression line was higher in both wrist palmar flexion and dorsiflexion with traction, than that with non-traction, whereas in terms of the midcarpal angle, a decrease was observed. These results suggested that with the addition of traction, the angle of movement of the radiocarpal joint increased and the angle of the midcarpal joint decreased, in the full ROM of the wrist joint.

Discussion: Currently, the application of a ‘dart-throwing motion’ for rehabilitation, which involves the dominant movement of the midcarpal joint and the wrist from a radio-dorsiflexion position to an ulnar-palmar flexion position. The results of our study showed that because passive ROM exercises with traction mostly involve movement of the radiocarpal joint, ROM exercises for specific pathological conditions are, thus, possible with appropriate use of these wrist movements. For example, in cases with scar formation in the radiocarpal joint secondary to the distal radius intra-articular fracture, good results can be expected with passive ROM exercises with traction. In the future, we hope to analyse the effects of passive ROM exercises with traction in clinical cases.

Conclusion: The effects of manual traction on the movement of the radiocarpal and midcarpal joints in a living body were evaluated using dynamic radiography. The addition of manual traction resulted in an increased angle of movement of the radiocarpal joint and a decreased angle of movement of the midcarpal joint, during the full ROM of the wrist joint. ROM exercise with manual traction can be used in an advanced rehabilitation program for specific pathological conditions.
A-0120 The choice of donor area for reconstruction of elbow flexion in patients with amyoplasia

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Purpose: The purpose of this research was to find out the optimal donor area for restoration of elbow flexion in children with amyoplasia.

Methods: From 2010 to 2013, we performed restoration of active elbow flexion in 118 cases of children with amyoplasia. The age of patients was from 1 - 14 years. We carried out clinical, radiology, electrophysiology, ultrasound and neurology examinations.

Results: All patients with amyoplasia are characterised by multiple joint contractures, muscle weakness and fibrosis, and spinal cord disruption. The patients with amyoplasia differ from each other by the level of damage of the spinal cord (C6-C7, C5-C7, C5-T1) and have different clinical presentations. We compared the results of the transposition of different muscles to biceps brachii and found out that the best results had patients with latissimus dorsi muscle transposition, good results with pectoralis major muscles, good and satisfactory results after caput longum of triceps brachii and poor results after triceps to biceps brachii transfer. We performed correlations between the level of damage of the spinal cord and the structure of the donor muscles. The patients with C6-C7 spinal cord disorders had the best structure of muscles (latissimus dorsi, pectoralis major, caput longum of triceps brachii), the worst structure was in the children with the level of damage of the spinal cord at C5-T1.

Conclusion: Preoperative examination of patients with amyoplasia, with allowance of the level of damage of the spinal cord helps to choose the optimal variant of treatment and restore daily activity to children with this pathology.

A-0121 Treatment of highly comminuted distal radius fractures with temporary distraction plate: case reviews

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Introduction: Support of highly comminuted distal radius fractures in elderly patients with poor bone quality or in young polytrauma patients need a surgical technique in order to rebuild an anatomical alignment. The aim of this study was to show post-operative results in 14 patients treated with temporary bridge plate and complementary osteosynthesis, instead of an external fixator.

Methods: A retrospective review was performed in 14 patients with comminuted distal radius Type C3 by the AO classification, that had had a temporary distraction plate placed in our service since 2011. All patients had pre- and post-operative x-rays and a pre-operative computed tomography (CT) scan. We obtained a data base with radiological, surgical and clinical information.

Results: We treated 14 patients with a mean age of 57 years. Apart from the fracture, 2 patients had an acute carpal tunnel syndrome. Concerning ligament injuries, we had one TFCC lesion, one DRUJ instability associated with ulnar styloid fracture, and 3 radio-triquetral lesions. All patients had one single dorsal incision from the distal radius to the third metacarpal. We used a locking compression plate of 3.5 mm. Three screws were placed in the distal radius and 3 in the third metacarpal. All patients had a supplemental fixation to complete the radio-carpal reduction with: pins in the radial styloid in 10 patients, anterior VA plate in three patients and screws in five patients. Five patients had a bone graft on the radius. Only three patients needed an additive ulna treatment: one Darrach, one plate and one DRUJ stabilization with TFCC reinsertion. Concerning radiological findings, the mean post-operative results were: ulnar variance of + 0.7 mm, radial inclination of 18° and radial length of 9.7 mm. All patients had a CT scan before removal of the material, in order to see the distal radius articular surface and congruous position. All patients had the plate removal. After this second operation, the mean post-operative range of motion after 8 months follow-up was F/E: 30/0/45° and P/S: 65/0/75°. All patients had a short arm removable cast placed until the end of consolidation.

Conclusion: A temporary bridge plate is indicated in highly comminuted distal radius fractures in elderly patients with poor bone quality and in young polytrauma patients. The plate acts like an external fixator, but is internally close to the bone, maintaining radial length. Due to intrinsic stability, the patient can perform activities of daily life, so this is an advantage compared to the external fixator. This kind of fractures can be associated with ligament injuries. Visualisation and repair of these injuries are permitted through one single dorsal incision. In our study, we noticed we always had to add an osteosynthesis on the radius with a pin, screw or additive plate. One disadvantage of this technique is the need of a second operation to remove the plate. This second operation
in the elderly might be a risk factor that should be kept in mind and explained to the patient before surgery.

A-0122 Elbow debridement arthroplasty using a novel four-dimensional pre-operative simulation system

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Introduction: A four-dimensional (4D) pre-operative simulation movie can be created by computer aided design, adding the joint axis to the 3-dimensional (3D) computed tomography (CT) images; however, functional multi-positional CT images are required to calculate the axis appropriately. The number of CT scans and the amount of radiation exposure may be problematic, especially for young patients. The purpose of this study is to develop a 4D pre-operative simulation system, using the 3D CT scan data of the affected arm in one position, by adding the anatomical axis for elbow debridement arthroplasty.

Materials and methods: We included 10 patients who had impingement pain at the extremes of motion due to moderate or severe elbow osteoarthritis in this study. Institutional review board (IRB) approval was granted before initiation of the study and patients gave informed consent for participation. Eight male and two female patients, aged an average of 62 years old (range, 48 - 72 years) at the time of surgery, had symptoms due to limited elbow flexion-extension. CT scan images of the affected elbow in one position were taken pre-operatively and stored in stereolithography format for subsequent processing. Solid models were created in 3D from CT scans, using ZedView software (LEXI Corporation, Tokyo, Japan). The elbow flexion-extension axis was calculated with the best fit method of the distal humerus (method used to calculate the flexion-extension axis of the elbow by converting the surface of the trochlea and capitellum of the humeral into a pillar). The axis was examined for the impingement and alignment, and then compared with the clinical information. After the accurate axis was identified, we completed a 4D simulation movie showing the optimal range of motion and the impingement area that should be excised. Patients were treated by open or arthroscopic debridement arthroplasty, according to the surgeon’s preference and 4D pre-operative simulation. The range of motion of the elbow, numeric pain scale and patient-rated questionnaire Hand20 were assessed pre- and post-operatively. Data analysis was performed using the Student t-test. We considered P < 0.05 as statistically significant.

Results: The surgeon and assisting surgeon could see the movie and check the arthroplasty procedure both pre- and intra-operatively. The surgeon could easily identify the bony impingement lesion and the debridement arthroplasty was performed until the appropriate elbow range of motion was achieved. Patients were advised to move their elbow and hand beginning on postoperative day 2, under hand therapist supervision. The mean elbow flexion-extension arc was significantly improved from 95 ± 25 to 128 ± 9 degrees. Mean numeric pain scale was significantly reduced from 6.4 ± 2.1 to 2.8 ± 1.7, and mean Hand20 score was significantly improved from 53 ± 23 to 21 ± 17 at final follow-up. We observed no major complications, including neurovascular compromise or infection.

Conclusion: A 4D pre-operative simulation can be made by adding the axis to the one position 3D CT image of the affected arm alone. Pre-operative 4D simulation was useful for elbow debridement arthroplasty.

A-0124 Comparison of early versus delayed treatment results of mallet finger injuries

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Purpose: This study analysed the results of nonsurgical treatment for closed and pure tendinous mallet finger injuries, comparing the cases that were admitted in the first 2 weeks and the cases admitted between 2 - 4 weeks after injury.

Methods: This retrospective study evaluated the patients received between March 1992 and May 201. Graphs taken before the treatments were used to create this homogeneous isolated group. The patients that had any size of bony fragment (bony mallet) were excluded from this study and 45 patients (45 fingers) met these criteria. The patients admitted within 2 weeks of the trauma (28 patients, Group 1) and the patients that had a delayed treatment between weeks 2 and 4 (17 patients, Group 2) were observed and followed up by the same surgeon for 6 weeks, with a modified Stack splint that keeps the distal interphalangeal joint at 5 degrees of hyperextension without involvement of the proximal interphalangeal joint. The patients admitted within 2 weeks of the trauma (28 patients, Group 1) and the patients that had a delayed treatment between weeks 2 and 4 (17 patients, Group 2) were observed and followed up by the same surgeon for 6 weeks, with a modified Stack splint that keeps the distal interphalangeal joint at 5 degrees of hyperextension without involvement of the proximal interphalangeal joint.

Results: The mean period of follow-up was 118.2 (89 - 180) months for all patients. The mean delay between initial injury and admission to our centre was 2.8 (range, 1 - 14) days in Group 1 and 19 days (range,
14 - 30) in Group 2. No significant differences occurred between groups, regarding age, initial extension lag and arc of flexion (p = 0.714). According to Crawford’s evaluation criteria, patients in the early treatment group (Group 1) had excellent results of 71.4%, while the delayed group presented 58.8% excellent results.

In the long term, there was no significant difference between groups (p = 0.517). We documented skin maceration and local inflammation in one patient, and identified a mild swan neck deformity in one Group 2 patient.

**Discussion:** There have been reports of different treatment results of patients with different presentation times, for heterogeneous groups of osseous or non-osseous mallet finger injuries. In our study, we excluded all types of bony injuries and composed a homogeneous group, which is rarely reported in the literature. Thus, a bone to bone healing model which is the most important variable influencing the results was excluded from our study. During this assessment, a single variable, which is the time of presentation, was considered and treatment results compared. The time to initiate the treatment is a very important factor affecting the outcomes of mallet finger and it is not clear when to treat the patients conservatively, regarding a safe period. Also, complication rates for surgical treatment were reported to be as high as 53%. Surgeons often preferred surgical treatment for neglected mallet injuries. In the long term, we obtained similarly good results for patients treated the same way, whom had been admitted within the first 2 weeks and at the 2 weeks to 1 month period, without seeing any significant difference. Interpretation of our results is important in terms of deciding the surgical treatment for neglected pure tendinous mallet injuries occurring up to 1 month before.

**Results:** A total of 126 patients (median age 45 years; 68 were female and 9 were immunosuppressed) with hand phlegmona were retrieved. All patients underwent surgical exploration and drainage for hand phlegmona; together with a median duration of postsurgical antibiotic therapy of 15 days (range, 7 - 82 d), of which a median of 3 days were intravenous therapy (range, 0 - 55 d). Twenty cases were due to animal bites, the majority were community-acquired trauma with a median delay between onset and first surgical exploration of 3 days. Only 8 patients were febrile, 10 revealed a proximal lymphangitis and 18 were under antibiotic treatment upon admission. There were only three clinical recurrences or new episodes (2%) after a median follow-up of 2 years; however, a total of 18 patients (14%) suffered from long-term sequelae such as stiffness, function laesa and pain. In an unmatched multivariable logistic regression analysis adjusting for case-mix, only the presence of a collection/abscess was significantly correlated with long-term sequelae (OR 4.6, CI 95% [1.5; 14.1]), whereas gender, age, immune suppression, serum C-reactive protein levels, the number of finger involved, or the number of surgical interventions were not. A prolongation of antibiotic treatment beyond 10 days was not formally protective from long-term sequelae or recurrence.

**Conclusion:** Provided that there is surgical drainage performed, concomitant oral antibiotic therapy for hand phlegmona could be reduced to a maximum of 10 days. The presence of phlegmona with abscesses harbors a worse functional outcome. Prospective randomized trials are needed to confirm this assumption.

**A-0127 Short duration of antibiotic administration concomitant to surgical drainage does not enhance recurrence risk of hand phlegmona**

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**Objective:** The ideal duration of prescription of antibiotic agents after surgical drainage for non-mycobacterial hand phlegmona is unknown.

**Methods:** Retrospective study at Geneva University Hospitals: only first episodes among adult patients were included, and we excluded atypical pathogens such as mycobacteria, fungi and nocardia.

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**A-0135 Posterior interosseous artery distal radius graft for ulnar non-union treatment**

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Ulnar non-union is a rare complication that is clinically disabling and may limit function of the wrist and elbow. Plates and nonvascularised bone graft are conventional surgical treatments, but it may take a long time for the bone union to occur. Vascularised bone grafting is indicated for segmental bone defects more than 6 cm, but it is also a promising solution for non-union with small bone defects in the presence of necrosis, inadequate vascularity of surrounding tissues, or failed prior graft. We describe a dorsal distal radius vascularized bone graft pedicled on the posterior interosseous artery (PIA), and its clinical application in three cases of ulnar nonunion. The fourth...
extensor compartment artery originates from the anastomotic arch between the posterior division of the anterior interosseous artery and the PIA, and provides periosteal branches to supply the dorsal distal radius metaphysis. A 2 cm vascularized bone graft can be harvested from the radius. Dissection of the PIA enables a long pedicle with a wide arc of rotation able to reach the ulnar diaphysis. The approach is limited to the forearm and distal radius and has minimal donor morbidity. This PIA-dorsal radius graft can be successfully used to manage selected cases of ulnar non-union with a small bone gap. This pedicled, vascularised bone graft is an attractive alternative to conventional nonvascularised and free vascularised bone grafting procedures.

A-0139 Comparison of functional results between techniques: Burton-Pellegrini and Uriburu as surgical treatments of trapezio-metacarpal osteoarthritis, Eaton Stages III and IV

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Introduction: The trapezio-metacarpal joint is the second site most frequently affected by osteoarthritis, after the distal interphalangeal joint. In spite of this, functional disability is much more significant, causing pain, and decreased strength in the pinch and making a fist. The aim of this research is to compare the functional results of two techniques for the surgical treatment of the trapezio-metacarpal osteoarthritis. One of them removes the trapezium, restores the anterior oblique ligament and interposes the tendon (Burton-Pellegrini), while the other technique (Uriburu) does not interpose the tendon.

Materials and methods: A randomized prospective study was carried out, comparing both techniques for the surgical solution of thumb base arthrosis, between 2007 and 2010. All the cases of trapezio-metacarpal idiopathic osteoarthritis level Eaton III and IV were included. Functional results were seen through the best Disabilities of the Arm, Shoulder and Hand (DASH) scores, and the Wilcoxon test was used as the statistical analytical method.

Results: We included 26 patients in this study, divided into two groups, treated with one technique or the other. The average age was 58.22 years in Group I and 60.03 years in Group II. The average follow-up time was 27.33 months for Group I and 26 months for Group II. The results of this research showed that the group with Uriburu technique had a medium DASH score of 36 points (level 17; ED: 5). Comparison of the functional results did not show statistically significant differences in the values of the DASH index (p = 0.86483).

Conclusions: Trapeziometacarpal osteoarthritis surgery is one of the most frequently used by the hand surgeon. Some of them consider the trapeziometacarpal arthrodesis to be the best option for the treatment of arthrosis of the thumb base, particularly in young workers. Nowadays, the simple removal of the trapezium can be made by arthroscopy, showing better short-term results. The aim of thumb function restoration is to provide stability without pain, movement with adequate firmness and appropriate balance of the metacarpal bone. The functional and subjective results were assessed by using the DASH scores. Analysis to determine whether there were significant differences between the results of each technique: the Wilcoxon test result was p = 0.8643, thus proving there are no differences. This research was prospective, giving greater value to the study. As a limitation, we found that the evidence is restricted and that the statistical analysis performed can be affected by it.
the modified Kleinert protocol and CAM. The analysis of TAM measurements under the rehabilitation protocols was conducted using t-tests and further linear modelling. As secondary endpoint we defined complication rates (adhesion, rupture and infection).

Results: Overall complication rates were 16.4% for adhesion, 7.4% for rupture and 0.4% for infection. For the comparison of rehabilitation protocols, we had 122 digits from 100 patients available for analysis after removing those with missing values. There was clear evidence that the CAM protocol increased a patient’s TAM earlier (at 4 weeks) in the rehabilitation process than the Kleinert protocol; however, at 12 weeks there was no significant difference between the two protocols. Older age and injuries with finger fractures are associated with lower TAM values.

Discussion: This study showed a favourable effect of the CAM protocol on early TAM recovery, without increasing the rupture rate. Further studies are required to confirm our results and to investigate whether faster recovery of TAM is associated with a shorter time out of work.

A-0143 Patterns of degenerative changes after scaphoid non-union: a 3-dimensional quantitative analysis

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Introduction: There has been little quantitative analysis of degenerative changes after scaphoid non-union. In this study, we performed a quantitative analysis of osteophyte formation after scaphoid non-union.

Materials and methods: From 2002 to 2012, 17 patients with unilateral scaphoid non-union underwent computed tomography (CT) of both wrists. There were 13 male and 4 female patients with an average age of 32.2 years (range, 15 - 75 y). Three-dimensional (3D) surface models of the affected scaphoid and the bilateral radius were constructed from these data. Non-unions were classified as follows: distal extra-articular fracture, where the fracture line was distal to the dorsal apex of the scaphoid ridge and the articular surface of the scaphoid to the radius was not involved; distal intra-articular fracture, where the fracture line was distal to the dorsal apex and the articular surface of the scaphoid to the radius was involved; proximal fracture, where the fracture line was proximal to the dorsal apex. Osteophyte volume of the radius and the incidence of dorsal intercalated segment instability (DISI) deformity were compared among the three types of non-unions. Osteophyte models of the radius were created by subtracting the mirror image of the contralateral radius model from the affected radius model, using Boolean Operation in Magics software (Materialise, Leuven, Belgium). The osteophyte models were divided into five areas: styloid process (SP), dorsal aspect of scaphoid fossa (DSF), volar aspect of scaphoid fossa (VSF), lunate fossa (LF) and sigmoid notch (SN). DISI deformity was defined as a radiolunate angle of more than 15° in a lateral radiograph of the wrist.

Results: There were no significant differences in age, sex or the interval between injury and examination among the three types: 5/6 (83%), 2/5 (40%) and none/6 (0%) had DISI deformity in distal extra-articular fractures, distal intra-articular fractures and proximal fractures, respectively. In SP, the average osteophyte volume of distal extra-articular fracture was the smallest among the three types (12.8 ± 11.0 mm³), distal extra-articular fracture; 81.1 ± 67.8 mm³, distal intra-articular fracture; and 48.9 ± 27.3 mm³, proximal fracture). There was a significant difference between distal extra-articular fracture and distal intra-articular fracture. In DSF, the average osteophyte volume of proximal fracture was the greatest among the three types (3.5 ± 2.6 mm³, distal extra-articular fracture; 10.1 ± 9.2 mm³, distal intra-articular fracture and 34.1 ± 25.5 mm³ for the proximal fracture). There was a significant difference between distal extra-articular fracture and proximal fracture. In LF, the average osteophyte volume of proximal fracture, though not significant, was the smallest among the three types (16.1 ± 23.3 mm³, distal extra-articular fracture; 15.7 ± 11.0 mm³, distal intra-articular fracture; and 5.8 ± 6.5 mm³, proximal fracture).

Discussion: Smaller osteophyte volume of distal extra-articular fractures in RS or in DSF can be attributed to an undamaged articular surface of the scaphoid to the radius. The lower incidence of DISI deformity in proximal fracture can be owing to the preserved connection between the lunate and the distal fragment of the scaphoid via the dorsal scapholunate interosseous ligament. Further investigation will be necessary to improve the knowledge of degenerative changes after scaphoid non-union.
A-0146 Treatment of chronic neuropathic pain: first clinical experience with peripheral nerve stimulation (PNS)

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Introduction: Central nerve stimulation (CNS) already has proved its efficacy for treatment of chronic severe pain. The aim of our clinical study was to prove the effectiveness of peripheral nerve stimulation (PNS) for treatment of chronic neuropathic pain syndrome of the extremities.

Materials and methods: In sum, we had 31 patients (19 female, 12 male) suffering from chronic neuropathic pain. Each patient had a minimum of two operations and every conservative treatment which was possible, but without any effect on the problem of neuropathic pain. None of the patients was able to use their extremity functionally. In all patients, the pain Numeric Rating Scale (NRS) was a mean of 9, even at rest, which required not only psychological treatment but somatic intervention. A stimulation lead was implanted into the peripheral nerves, fixed at the epineurium; and was, after a percutaneous testing phase, connected with a subcutaneously implanted stimulator.

Results: PNS was effective at reducing pain, from NRS mean 9 to NRS mean 3, and at regaining functional use of the extremity. Several technical complications, such as electrode dislocation and wire breakage, had to be noted. Relief from pain occurred immediately after onset of stimulation. The positive effect was directly correlated with PNS and stable over years.

Discussion: PNS reduced pain deriving from peripheral nerves reliably and effectively. Regarding our follow-up period of 2.5 years, PNS produced a stable, nearly pain-free interval in all patients. Positioning of the electrodes direct to the brachial plexus and close to the sciatic foramen allowed the movement of shoulder and hip to a nearly normal range of motion (ROM). PNS seems to represent an important technology for treatment of chronic neuropathic pain in selected cases.

A-0149 Management of post-traumatic stiff finger with the new method of tenolysis

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Introduction: This study aims to report our results in using the latest techniques in the treatment of stiff fingers, with special emphasis on the reanalysis of both flexor and extensor tendons, as well as other adjunct methods. We also wanted to review the effects of secondary injuries in the outcome of the stiff finger.

Methods: Type of study: Retrospective chart review. Evaluation parameters: Clinical examination of hand, DASH questionnaire, clinical evaluation of finger range of motion (ROM), extensor tendon deficit measurement, analysis of associated injuries, need for secondary treatments and/or procedures, and any other parameter that arose during the study. This involved performing both extensor and flexor tenolysis in the awake patient with wrist block, by approaching the proximal interphalangeal joint after releasing the A 1 pulley. Inclusion criteria: All patients who underwent treatment by the principal investigator for stiffness of the fingers: both closed and open injuries will be included. Patients were 18 years and older, having amputation or loss of part of the limb due to causes other than primary injury. Exclusion criteria: Patients with severe comorbid conditions, suffering from severe sympathetic dystrophy, or under the age of 18 years old.

Results: We studied 41 fingers belonging to 30 patients and evaluated results in terms of the ROM and extensor lag. Only 18/30 patients had good to excellent results, with only 2/30 showing poor results. A total of 15 cases had tendon damage and 22 cases needed open reduction and internal fixation, showing the severity of the injury and the increased possibility of stiffness. The improvement in mean ROM was more than 100%, while mean extensor deficit was reduced to 20° (from 90°).

Conclusions: The method of tenolysis involves active patient cooperation, as well as the surgeon identifying adhesions and releasing them. The finger and hand were evaluated in terms of the ROM and extensor deficit. The effect of the associated injuries were also proven to be great, bearing in mind the result of post tenolysis, the fingers of 5 patients needed secondary tenolysis. The author’s method was reliable and reproducible in the management of the stiff finger.

A-0154 Good clinical results after a few years, with an uncemented screw-fixed MoM wrist arthroplasty in 61 predominantly non-inflammatory patients

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Introduction: Historic wrist arthroplasties never demonstrated satisfactory long-term outcomes. We present the results of a new design of arthroplasty.
Methods: Since 2006, the Motec® arthroplasty was offered to all patients scheduled for wrist arthrodesis. The patients were included in a prospective follow-up study. The arthroplasty is modular, with a metal-on-metal ball and socket articulation and titanium-alloy screwshaped components for fixation in the distal radius and capitare/metacarpal. We included 61 patients (41 men, with 39 right hands and 39 dominant hands, of which 57 were non-inflammatory and 4 had inflammatory arthritis) in our prospective study and followed them up yearly. The mean age at surgery was 51 (18 - 76) years. Altogether, 52 previous wrist surgeries had been performed in 32 patients, in 16 of them, more than once. Fifteen patients had bilateral osteoarthritis, and 17 of the ipsilateral distal radioulnar joint (two previously underwent Darrach’s procedure). Preoperatively and at follow-up, the patients completed the DASH score, graded radial- and ulnarsided wrist pain (rest and activity, scale from 0 – 10). Active and passive range of motion (ROM) including flexion, extension, radial and ulnar deviation; forearm rotation; and grip strength were measured by independent hand therapists. The radiographs were evaluated for bone-implant contact, CMC3 arthrodesis and migration/loosening. The patients were followed up for a mean of 5.4 (range, 2.9 - 7.8) years.

Results: One patient declined follow-up after cast removal. Seven wrists were revised during the follow-up period, due to infection (two converted to arthrodesis), muscular imbalance (two arthrodesis) and loosening of the distal screw related to failed CMC3 arthrodesis (two revision arthroplasties and one arthrodesis). Two others demonstrated signs of distal loosening, not revised. The arthroplasty dislocated in one patient after 18 months, reduced closed, and was stable 2 years after. Additional surgery was performed in 12 other patients (De Quervain [1], bone resection due to impingement [7] and [tri-quetrum, scaphoid, radial styloid] and EPL rupture [11]). The clinical results were good. DASH was significantly reduced from 41 to 18, active ROM significantly increased from 98° to 123°, and pain significantly reduced at rest and activity, by a factor of 3.5. Grip strength significantly increased from 20 kgs to 26 kgs. Forearm rotation was unaffected by surgery. None of the patients uses analgesic for wrist problems, and 56/61 would have chosen arthroplasty over arthrodesis, knowing the outcome. Over one-half (36/61) of patients were working pre-operatively, 27/61 were working at follow-up, 9 are retired, and none are disabled due to wrist problems. All remaining implants demonstrate bone-implant contact, and no migration or loosening is observed. Of note, 6/7 revisions and 10/12 additional surgeries were performed on the first 30 patients.

Summary: We achieved promising pain relief and function in predominantly non-inflammatory high demand patients, without restrictions in use. We experienced a learning curve, now emphasising a more generous bone resection (proximal row carpectomy), a thorough CMC 3 arthrodesis and meticulous infection prophylaxis.

A-0158 Proximal-row carpectomy in manual workers: what can we expect? A single-center series of 17 patients with a 75-month average follow-up

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Introduction: Proximal row carpectomy (PRC) can be proposed to treat post-traumatic radio-carpal osteoarthritis; however, significant loss of grip strength is reported in the literature, after this procedure. Hypothesis: PRC can relieve pain and improve function in manual workers, in spite of loss of grip strength.

Materials and methods: We performed 23 PRCs between 1995 and 2009, on 21 manual workers (5 women and 16 men). Mean age was 53.7 years. Eight patients had suffered previous trauma. All were manual workers and 11 subjects were involved in hard manual labor. Eleven cases affected the dominant side and pain was their main complaint. Indications included a SLAC wrist in 14 cases (2 Stage-III, 11 Stage-II and 1 Stage-I), and a SNAC wrist was the indication in 9 (6 stage-IIIB and 3 stage-IIIB). All procedures were performed through a dorsal approach, under locoregional anesthesia. Average hospitalisation time was 3.7 days (range, 3 - 5 days). Postoperatively, in all cases a splint was prescribed for 1 month, to protect the wrist.

Results: At an average of 75.6 months’ follow-up [24 - 153], 3 patients had been lost to follow-up. A reflex sympathetic dystrophy syndrome was observed in 3 patients during the first year after the operation. At 10 years postoperatively, a wrist fusion was performed in one patient because of progression of osteoarthritis. For the 17 other patients, the mean QuickDASH score was 26/100. Mean VAS score was 2.2 and 5 patients suffered from residual pain. The range of motion (ROM) values were similar to preoperative values and represented 67.2% of the contralateral wrist. Grip strength was weaker by 34%, compared to preoperative values, and corresponded...
to 72.6% of the contralateral values. Sixteen patients were satisfied with their surgery. Four patients lost their initial employment because of loss of strength. Compared to the immediately postoperative X-rays, radiological assessment showed a capitate/radius impingement in three patients, with narrowing of the joint line. At follow-up, the capitate-radius distance decreased an average of 0.3 mm on both frontal and lateral radiographs. Similarly, carpal height decreased by 1.0 mm at follow-up, without any notable carpal translation.

**Discussion and conclusions:** PRC can be proposed to treat advanced SLAC and SNAC wrist, when the midcarpal joint is preserved. This procedure provides pain relief, while preserving preoperative wrist ROM; however, as reported in the literature, grip strength is often decreased, compromising return to work, especially for heavy workers. For patients with no midcarpal OA but with a demanding job, a therapeutic alternative like midcarpal fusion is preferable to PRC.

**A-0159 Denervation of the CMC joint of the thumb for primary arthritis: a prospective study on 30 thumbs**

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**Introduction:** Denervation of the CMC joint of the thumb is an attractive alternative for the treatment of carpo-metacarpal (CMC) arthritis. Unfortunately, in the literature only one series is found. We present the preliminary results at 1 year of a prospective study on 30 thumbs in 29 patients.

**Methods:** From August 2012 to February 2013, we saw 62 patients with clinical and radiological diagnosis of thumb CMC arthritis at our hospital. After presenting to the patients the different possibilities of treatment, 29 patients decided to undergo CMC denervation with the technique described by De Lorea. There were 21 women and 8 men, for a total of 30 hands: 19 patients were operated on the dominant hand, 1 patient on both hands. There was one other minor pathology to the same hand associated with CMC arthritis in 16 of the cases. All patients’ x-rays were staged for CMC arthritis before surgery. All the patients underwent a prospective assessment protocol before surgery; after 2, 6 and 12 weeks; and at 6 months. The assessment included the following: VAS for pain at rest, on light duties and on heavy duties, Kapandji score for thumb opposition, hand grip strength measurement with Jamar dynamometer (position 2) and K-pin strength with the K-pinch dynamometer.

**Results:** At 6 months, pain at rest and on light duties was resolved [VAS < 2] in 91.4% of the patients. In the rest of the patients, the pain improved by a mean of 2 points at rest and 3.3 points upon light duties, with the value never being > 4. Pain on heavy duties was resolved in 78% of the patients. In all patients but one with residual pain on heavy duties, the pain was in all cases but one in intermittent spikes. K-pin strength improved in all patients by a mean value of +82% (range, 9 - 250%). The hand grip strength did not significantly change in most of the patients (94%). Kapandji score for opposition never changed, in all but two cases. Most of the improvements were observed between post-operative weeks 2 and 6. None of the patients required further procedures. The quality of results did not seem to correlate with the radiological stage of arthritis.

**Discussion:** CMC joint denervation for CMC arthritis seems to represent a valid treatment option. It is a relatively simple operation that does not require postoperative immobilisation and specific hand therapy. Further investigation with a longer follow-up period is needed, in order to determine the lasting effects of this operation.

**A-0160 Rehabilitation of upper limb function in C5, C6, C7 brachial plexus palsies: a retrospective study on 45 cases**

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**Introduction:** In C5, C6 and C7 brachial plexus palsies (BPP), prognosis is dictated by the possibility of being able to use a partially functional hand again. Nerve surgery should be performed early and priority is given to the recovery of a functional shoulder and elbow. We present a series of 45 patients operated on between January 2002 and December 2012 for a C5, C6 and C7 BPP and propose a new therapeutic plan to rehabilitate their upper limb function.

**Patients and methods:** Firstly, our strategy was an early nerve surgery procedure for flexion and extension of the elbow and for shoulder function, based on root grafts where possible. The spinal accessory nerve was always preserved, to perform a shoulder arthrodesis, if necessary. Secondly, restorative surgery was performed for the extension of the wrist and fingers, based on triple tendon transfers. Thirdly, a shoulder arthrodesis was performed in the cases of nerve surgery failure, or if no root was available.
All patients were evaluated at a minimum of 2 years follow up.

**Results:** The average delay between trauma and surgery was 5.5 months. Out of 45 elbow flexion palsies, 38 nerve surgery procedures were performed; with 33 ulnar to biceps, median to brachial (UBMB); and 28 results above M4 (73.7%), 6 at M3 (15.7%) and 4 under M3 (10.5%). Out of 40 elbow extension palsies, 29 intercostal to triceps neurotisation (IKT) were performed with 14 results above M4 (48%), 11 at M3 (38%) and 4 under M3 (14%). Also, 14 cases (34%) of nerve surgery were performed to the shoulder, with 8 grafts from C5 to the suprascapular and axillary nerve and 1 graft from C7 to the axillary nerve. In six cases (43%), amplitudes in abduction and external rotation were above 60° and in five cases (36%) they were between 45 - 60°. There were two failures (5%). Out of 41 extension of the wrist and fingers paralysis, 4 recovered spontaneously and 37 had surgery, 18 of whom had a Flexor Carpi Ulnaris (FCU paralysis). A total of 19 got a triple transfer including the FCU, 7 had a triple transfer without the FCU and 11 had a wrist arthrodesis with other transfers. In 100% of the FCU transfer cases, full finger extension with a 20° wrist extension was obtained. In the other cases, 16 gained full extension of the fingers, but in two cases, the hand was not functional.

**Conclusion:** We propose a therapeutic model to restore shoulder function with a nerve surgery procedure preserving the integrity of the spinal accessory nerve. This enables us to perform a secondary shoulder arthrodesis. The elbow is systematically rehabililated by a UBMB double neurotisation and IKT neurotisation procedure, with 90% of results at M3 or above. For the dorsal forearm, the extension plan results are good in almost 100% of the cases, as long as FCU paralyses are excluded before transferring it and the volar forearm flexor plan is respected when weak.

**A-0162 The epidemiology of wrist and hand injury in Jerusalem**

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**Background:** Injuries to the hand are extremely common, pose a great functional and emotional burden to the patient and have considerable economic consequences. The aim of the study was to map out the differences in injury patterns in different populations in the Jerusalem area.

**Methods:** During a period of 3 months, we collected data regarding patients treated for hand injuries in the emergency departments of both Hadassah Medical Centers in Jerusalem. This was done during the patient’s visit to the hospital or later by phone interview, using a questionnaire designed to collect detailed information regarding mechanism and location of injury, demographic data and work-related risk factors. The data was analysed using the Fisher exact and Chi-squared tests and the interaction between different variables were examined using logistic regression models.

**Results:** During the study period, 808 patients completed the questionnaire, including: 75% males, 55% Jews and 43% Muslims. The average age was 27. They reported that 31% had their injury during work, school or army activities; 33% at home; and 36% during leisure time. We found significant differences between the mechanisms of injury, according to the area of residence (East vs. West Jerusalem), location of the accident and age. There was a significant correlation between religion and location of accident (p < 0.0001). In the Muslim population, there were more saw injuries and falling objects and in the Jewish population, more motor vehicle accidents, altercations and ball injuries. Women were found to be injured more often at home (48% vs. 27% for men; p < 0.0001) and at an older age (34 vs. 25 for men). Women were found to be injured more often during a fall, especially at an older age (p < 0.001). We found a significant correlation between religiosity and age of injury in the Jewish population (p < 0.001): 53% of the orthodox patients were under 10 years of age when injured, in comparison with 8% of the secular patients at this age; 8% of the orthodox patients were over the age of 40, in comparison with 26% of the secular patients. In work-related injuries, only 22% of the patients reported performing their work with faulty equipment, in a hurry or in a different manner than their routine.

**Discussion:** We found significant differences between the heterogeneous population of hand injured patients treated during the study period, regarding age, sex, location of injury and mechanism of injury. This may be a first step towards designing interventional programs to prevent injuries, addressing the high-risk activities of the different populations, as depicted in this study.

**A-0168 Pre-operative donor nerve electromyography as a predictor of nerve transfer outcomes**

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Introduction: Electromyography (EMG) is often used in the pre-operative assessment of brachial plexus injuries to estimate the degree of muscle denervation and motor unit preservation; however, the ability to predict post-operative motor outcome using pre-operative EMG has not been evaluated. We hypothesized that the health of the donor nerve and corresponding muscle, as assessed by EMG, could predict the outcome of nerve transfer surgery.

Materials and methods: A retrospective review was performed to investigate outcomes of nerve transfers for elbow flexion and shoulder abduction. Motor strength was graded pre-operatively and after a minimum 1-year follow-up, using the British Medical Research Council (MRC) Grading System. Pre-operative EMG results were classified as functionally normal or affected, based on motor unit recruitment pattern, and correlated with the follow-up motor strength and range of motion (ROM). All donor nerve distribution muscles were of normal strength on physical examination.

Results: We identified 40 nerve transfers: 27 were performed for elbow flexion and 13 for shoulder abduction. Overall, the 29 transfers in the ‘normal’ nerve cohort showed significantly greater post-operative improvement in motor strength (mean MRC increased from 0.2 to 4.1) than the 11 transfers in the ‘affected’ EMG cohort (MRC 0.0 to 3.0, p < 0.01). In the shoulder cohort, electrically normal donor nerves resulted in greater strength (MRC 4.0 vs. 2.4, p < 0.01) and active motion (83 vs. 25 degrees, p < 0.01), compared to affected donor nerves. In the elbow cohort, double fascicular transfers with two normal donor nerves demonstrated improved strength, compared to double nerve transfers where one donor nerve was affected (MRC 4.5 vs. 3.2, p < 0.01). The abnormal EMG cohort also displayed increased frequency of high-grade abnormal spontaneous activity, in the form of fibrillations and positive sharp waves.

Discussion: Our findings demonstrate that a simple EMG classification that describes the quality of donor nerves can predict outcomes, as measured by post-operative motor strength and ROM. Despite the small numbers studied, we observed significantly greater gains in motor strength and ROM in the normal donor nerve cohort, as compared to those less robust donor nerves. All muscles within our donor nerve territories were clinically strong, suggesting that preoperative clinical assessment of motor strength is inadequate to assess the utility of a potential donor nerve. Pre-operative EMG evaluation should be considered a valuable supplementary component of the donor nerve selection process, when planning brachial plexus reconstruction.

A-0170 Flexor tendon repair in Zone II, with 6-strand technique and early controlled active mobilisation

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Purpose: Several authors report that the rerupture rate was 4 - 43% of patients in immediate controlled mobilisation (passive flexion and active extension) after conventional 2-strand repair. Nevertheless, few reports have detailed the clinical outcomes of Zone II flexor tendon repair using the 6-strand suture technique and early controlled active mobilisation. The purpose of this study was to report the functional outcomes of the combination of 6-strand sutures and early active mobilization for Zone II flexor tendon injuries.

Methods: We studied 28 patients with Zone II flexor tendon injuries in 30 fingers, repaired using the 6-strands suture technique for early controlled active mobilisation. The patients consisted of 19 men and 9 women with an average age of 37.2 years (range, 18 - 76 y). Fingers were: index (10), middle (4), ring (6) and little (10). The evaluation of the clinical results was based on % Total Range of Active Motion (%TAM) and Strickland’s criteria. Surgical technique: The Yoshizu no. 1 (Y-1) technique combined the Tsuge suture with a 4-0 looped thread and the modified Kessler suture, using a double strand with 2 needles, which was a 4-0 newly-designed suture material. A simple running peripheral epitelen suture was added, with 6-0 monofilament nylon. A dorsal plaster splint was placed to hold the wrist in slight flexion, the MP joint in full extension. Mobilisation was begun on the first or second postoperative day, using rubber band traction. Patients conducted active extension, passive flexion and isometric exercise, the so-called place and hold exercise, under the supervision of the surgeon or therapist. An isometric exercise was added 1 week after surgery.

Results: The average %TAM was 90.4% (range, 81.0 - 100). According to Strickland’s criteria, we rated 18 fingers as excellent, 11 fingers as good and 1 finger as poor. The average score was 87.8 (range, 51.4 – 100). One of the repaired tendons ruptured.

Conclusions: We have had good clinical results with this small series of patients. The Y-1 technique, followed by controlled active mobilisation is safe,
produces no ruptures and achieves very good results in the Zone II flexor tendon.

A-0172 First rib anomaly in thoracic outlet syndrome for risk factor of subclavian artery aneurysm with literature review

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**Purpose:** Thoracic outlet syndrome (TOS) is caused by compressing neural and/or vascular structures among the scalene muscles, the clavicle and the first rib. The subclavian artery is rarely symptomatic in TOS; however, the space enclosed by the scalene muscles, the clavicle and the first rib is narrow, and structural anomaly may cause symptoms involving the subclavian artery. Emergent intervention is required when circulation of the subclavian artery is occluded. Herein, we describe cases requiring emergent interventions in TOS and review the literature.

**Methods:** We retrospectively reviewed nine surgically-treated cases with diagnosis of TOS (three were male and six were female). The average age at the time of surgery was 35 years (range, 17 - 45 y). Cases requiring emergent interventions for symptoms of the subclavian artery were investigated for physical symptoms, preoperative plain radiography or computed tomography (CT), and time interval between the onset of symptoms and emergent interventions. Also, we reviewed the available literature describing ischemic complication and bony malformation in TOS.

**Results:** Two of nine cases required emergent interventions. Both cases had progressively increasing severe pain; paler, pulseless and decreased temperature of the affected upper extremity; although in one case, neurological examinations were normal. Preoperative plain radiography or CT in the two cases showed an abnormal first rib, lacking the anterior one-half and assimilating with the second rib. The mean time interval between the onset of symptoms and emergent interventions was 4 months. Before resection of the abnormal first rib, both cases required anticoagulant therapy, and one of them needed endovascular therapy with embolectomy and stent insertion. Sporadic reports over several decades also have reported the incidence of vascular symptoms from compression of the subclavian artery, caused by an abnormal first rib, and the necessity of prompt treatment to avoid limb-threatening ischemic changes to the upper extremity.

**Conclusion:** First rib anomaly showing lack of the anterior one-half and assimilation with the second rib can cause emergent vascular events in TOS. Symptomatic TOS with such an anomaly requires intensive observation and prompt treatment.

A-0183 Rigid versus semi-rigid splinting following TMC arthroplasty: a randomized controlled trial

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**Introduction:** The trapezio-metacarpal (TMC) joint of the thumb is the second most common joint in the body affected by osteoarthritis. TMC arthroplasty is a common procedure used to alleviate symptoms. No randomized controlled trials are published on the efficacy of different post-operative splinting approaches.

**Method:** We allocated 56 participants who underwent TMC arthroplasty to two groups: either rigid splinting or semi-rigid splinting. Both groups started an identical exercise program at 2 weeks following surgery. Outcome measures were assessed by an assessor who was blinded to the group allocation. The primary outcome was the Patient Rated Wrist and Hand Evaluation (PRWHE) and secondary outcomes included the Michigan Hand Questionnaire (MHQ), palmar abduction, metacarpophalangeal extension and 3-point pinch grip. Measures were taken preoperatively and also post-operatively, at 6 weeks, and at 3 and 12 months. The difference between groups was analysed with linear regression.

**Results:** Both groups performed equally well. There was no significant between-group difference for the PRWHE scores (- 0.49, CI -13.5 to 12.5), including the subscales for pain and function, nor for any of the secondary outcomes at 3 months follow-up.

**Conclusion:** We found no difference in outcomes between using a rigid or semi-rigid orthosis after TMC arthroplasty. Factors such as patient comfort, cost and availability may determine the choice between orthoses in clinical practice.

A-0188 Reliability and construct validity of the 6-item CTS Symptoms Scale for outcomes assessment in carpal tunnel syndrome

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**Conclusion:** First rib anomaly showing lack of the anterior one-half and assimilation with the second rib can cause emergent vascular events in TOS. Symptomatic TOS with such an anomaly requires intensive observation and prompt treatment.
A-0191 Perilunate dislocation and fracture-dislocation of the wrist: retrospective evaluation of 65 cases

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and modification of the scapho-lunate angle (p = 0.029) were correlated with the occurrence of osteoarthritis.

**Discussion:** Perilunate injuries are severe wrist trauma with often numerous sequelae on follow-up: pain, stiffness, loss of strength, carpal instability and arthritis. Early diagnosis and anatomic reduction are prerequisite to a satisfactory functional result. Capsuloligamentous lesions must be repaired and fractures must be fixed, especially with open surgical technique. Postoperative therapy is also essential to a satisfactory result.

**Summary:** Perilunate injuries are severe wrist trauma with often numerous sequelae upon follow-up. Early diagnosis and anatomic reduction are prerequisites for a satisfactorily functional result.

**A-0193 The impact of psychological factors on pain persistence in hand surgery patients**

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**Background:** Chronic pain is known to be associated with psychological impairment. The aim of this prospective study was to examine whether and to what extent a psychological condition predicts pain persistence in hand surgery patients.

**Methods:** This prospective cohort study from May 2012 to February 2013 included 132 consecutive patients of a tertiary center for hand surgery. In addition to the initial surgical examination, we performed a psychometric assessment with the Hospital Anxiety and Depression Scale (HADS), as well as history taking concerning traumatic life events and a detailed pain interview. The 4-month follow-up session focused on pain persistence as measured by a visual analogue scale, ranging from 0 (no pain) to 10 (most pain imaginable). Chi square test, correlation and multiple regression analyses were used for data analyses. In the regression analysis, we controlled for age, gender and initial pain level.

**Results:** In patients who underwent surgery (n = 99), anxiety symptoms tended to be a significant predictor for an increased pain level at follow-up (B = .12, p = .09). In patients who did not undergo surgery (n = 33), depressive symptoms were found to be a significant predictor for an increased pain level at follow up (B = .38, p = .001). Evidence for post-traumatic stress disorder (PTSD) tended to be a significant factor for pain persistence in all patients (x2 = 3.60, p = .06).

**Conclusion:** Our findings provide some evidence for the notion that psychological factors, most particularly elevated symptoms of anxiety and depression, as well as PTSD, are predictive for a greater pain outcome in patients undergoing hand surgery treatment. Future studies should investigate whether contemporary treatment of anxiety, depression and PTSD would improve the outcome of pain levels at the 4-month follow up.

**A-0206 Computed tomography-based three-dimensional kinematic comparison of dart-throwing motion between wrists with malunited distal radius and contralateral normal wrists**

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The purpose of this study was to compare motion of the capitate, scaphoid, and lunate in wrists with a malunited distal radius and contralateral normal wrists, during dart-throwing motion (DTM), by three-dimensional (3D) kinematic studies using computed tomography (CT) images. CT was performed simultaneously on both wrists in six patients with a unilateral distal radius malunion at three stepwise positions simulating DTM. Using the volume registration technique, the kinematic variables of helical axis motion of the capitate, scaphoid and lunate were calculated and compared between both wrists. The helical motion of the capitate was also evaluated in a scaphoid- and lunate-based coordinate system. Among the average rotation, translation, and lengths of the moment arms of the scaphoid, lunate and capitates during the DTM, only the average rotation of the capitate was significantly different between the uninjured (88.9°) and the injured (70.0°) wrist (p = .0075). Rotation of the capitate relative to the scaphoid (26.3° vs. 37.8°, p = 0.029) or lunate (39.2° vs. 59.3°, p = 0.028) was smaller in the malunited wrist. The centers of helical axis motion of the three carpal bones were located more dorsally and radially in the injured wrist.

This 3D in vivo kinematic study of the capitate, scaphoid and lunate in wrists with distal radius malunion might be the first to present a 3D kinematic analysis...
of the effect of distal radius malunion on the carpal bones. This study showed that decreased DTM in wrists with a distal radius malunion resulted from decreased midcarpal motion. DTM is a crucial motion of the wrist joint in activities of daily living and occupational tasks, and the present result indicates that anatomical reduction of distal radius fractures should be performed, in order to maintain the function of the wrist. DTM and capitate motion should be parameters to evaluate the function of a wrist with a distal radius fracture or malunion.

A-0209 Second-look arthroscopy of openly repaired triangular fibrocartilage complex (TFCC)

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Introduction: Since 2002, we have indicated the open transosseous repair technique for subacute to chronic avulsion of the triangular fibrocartilage complex (TFCC) at the fovea of the ulna. In the present study, we evaluated second look arthroscopic findings and clinical outcome of open repair of the TFCC in our series.

Patients and methods: Since 2002, we had 139 wrists of 136 patients that underwent open transosseous pull-out repair of the TFCC for subacute to chronic, complete or partial avulsion of the radioulnar ligament (RUL) at the fovea. Among them, 27 wrists of 27 patients underwent second look arthroscopy. There were 23 male and 4 female patients, with an average age of 30.8 (range, 16 - 49) at the time of second look arthroscopy. The period between the initial open repair and second look arthroscopy was an average of 16.9 months (range, 7 - 30). We found that 20 wrists indicated complete avulsion of the RUL and 7 indicated avulsion of the dorsal portion of the RUL. Additional tears with TFCC foveal avulsion were fracture/non-union of the ulnar styloid in 13 wrists; and scaphoid fracture, Galeazzi fracture-dislocation and distal radius fracture in one wrist each. Ulnar variance at the initial surgery indicated +3 mm in 5, +2 mm in 7 and neutral variance in 15 of them. Fixation of the ulnar styloid fracture/non-union in 13 wrists with tension band wiring and 12 patients with positive ulnar variance underwent ulnar shortening simultaneously, with open repair of the TFCC. Second look arthroscopy was performed at the time of hardware removal in 25 wrists, and two patients proposed second look arthroscopy for recovery to their original sports activity. We evaluated the Hook Test via radiocarpal arthroscopy in all wrists or conditions of repaired RUL, via DRUJ arthroscopy in late 20 wrists. Clinical outcome of final follow up was also evaluated with our DRUJ evaluation system.

Results: Hook Test was negative in 25 and positive in two wrists. Early seven wrists without DRUJ arthroscopy indicated negative hook test in six and positive in one wrist. DRUJ arthroscopy was performed in late 20 wrists: excellent repair of the RUL was recognized in 19 (95%) wrists, while one wrist indicated loss of tension of the RUL through DRUJ arthroscopy. There was no re-repture of the RUL in the 20 wrists that underwent DRUJ arthroscopy. Ulnar styloid fracture was healed in 10 wrists; and the fragment of the ulnar styloid was removed and remnant tissue was re-attached to the base of the ulnar styloid in three wrists. All 12 wrists in which there was ulnar shortening performed obtained union of the ulna. Clinical results obtained: 25 excellent, 1 good and 1 fair.

Conclusion: In the present study, direct visualisation of the repaired RUL via DRUJ arthroscopy indicated 95% excellent repair of the RUL, when the TFCC was repaired by open transosseous technique to the ulnar fovea. Open transosseous repair obtained excellent and good clinical results in 96% of the patients.

A-0210 Radiographic and arthroscopic assessment of DRUJ instability due to foveal avulsion of the radioulnar ligament in distal radius fractures

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Background: As the triangular fibrocartilage complex (TFCC) anchors the distal radius to the ulna via the radioulunar ligament (RUL), severely displaced distal fragment of the radius may be associated with a foveal avulsion of the TFCC. The purpose of this retrospective study was to radiographically and arthroscopically assess the relationship between the displacement of the radius, ulnar styloid and avulsion of the RUL, resulting in distal radioulnar joint (DRUJ) instability.

Materials and methods: We radiographically and arthroscopically assessed 29 wrists of 29 patients of intra- and extra-articular distal radius fractures/malunion whom underwent reduction or a corrective osteotomy of the displaced/malunited fracture, and/ or wrist arthroscopy. Radial translation, radial inclination, radial shortening, volar or dorsal tilt and the presence of an ulnar styloid fracture with more than 4 mm of displacement were measured from the initial
fibrocartilage complex

A-0211 Distribution of sensory nerve endings in the human triangular fibrocartilage complex

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Background: The aim of this study was to analyse the pattern and types of sensory nerve endings in the triangular fibrocartilage complex (TFCC) using immunohistochemical techniques, in order to gain more insight into the proprioceptive function of the distal radioulnar joint (DRUJ).

Methods: TFCC of 11 human cadaver wrists were included: we investigated the subsheath (SS) of the extensor carpi ulnaris (ECU) tendon, the meniscoid, the triangular disc, the dorsal and volar radioulnar ligaments (DRUL/VRUL), as well as the ulnolunate (UL) and ulnotriquetral (UTq) ligaments. We classified sensory nerve endings according to Freeman and Wyke, after staining with hematoxylin-eosin (H&E), low-affinity neurotrophin receptor p75, protein gene product 9.5 and S-100 protein. We counted Ruffini, Pacini, Golgi-like, and free nerve endings, as well as unclassifiable corpuscles, in five levels per specimen with respect to the total cell count per section; and thereafter adjusted them as a number per cm².

Results: Free nerve endings were the predominant mechanoreceptor and significantly more frequent than all other types of sensory nerve endings (p < 0.0001, respectively); these were followed by unclassifiable corpuscles, Ruffini endings, Pacini corpuscles and Golgi-like endings. The triangular disc contained significantly fewer free nerve endings (p ≤ 0.001, respectively) and blood vessels (p ≤ 0.001, respectively) than the SS, the meniscoid, the UTq and the DRUL/VRUL. Furthermore, the triangular disc had significantly fewer unclassifiable corpuscles than the SS and the meniscoid (p = 0.0022, respectively). Intrastructural analysis revealed no significant differences in mechanoreceptor distribution in all investigated specimens.

Conclusions: Increased radial translation and radial shortening, decreased radial inclination of the distal fragment can be associated with a foveal avulsion of the RUL. Radial translation can be an independent risk factor of foveal avulsion of the RUL.

A-0214 The open release of stiff wrist: long-term follow-up

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The activities of daily living are performed through 35° of active range of motion (AROM). Stiffness of the wrist interferes with function. Stiffness might affect the joint (intrinsic), the surrounding tissues (extrinsic), or both. At the plateau of the rehabilitation program, surgery is required. Release is usually performed arthroscopically, but scanty information is available on the open approach. The purpose of this paper is to investigate the long-term follow-up of the open release, to define the most appropriate technique when dealing with a stiff wrist. Sixteen patients underwent an open release for stiffness of the wrist: 13 men and 3 women; mean age 44.43; 13 with intrinsic and extrinsic stiffness. The surgical steps required release of fascia and tenotomy (extrinsic), or both. At the plateau of the rehabilitation program, surgery is required. Release is usually performed arthroscopically, but scanty information is available on the open approach. The purpose of this paper is to investigate the long-term follow-up of the open release, to define the most appropriate technique when dealing with a stiff wrist. Sixteen patients underwent an open release for stiffness of the wrist: 13 men and 3 women; mean age 44.43; 13 with intrinsic and extrinsic stiffness. The surgical steps required release of fascia and tenotomy (extrinsic stiffness), followed by capsulotomy, release of sinchias by a blunt dissection with a curved rougine (intrinsic stiffness). Passive range of motion (PROM) and AROM were recorded. The OAS and PRWHE were administered to measure the subjective outcomes. The mean increase of AROM of 46.5° was statistically significant, according to Wilcoxon’s test, and the p value was < 0.05. In every case, stiffness was associated with a prevailing fracture of the distal radius. Open release of the post-traumatic stiff wrist appears to be almost...
mandatory in the extrinsic type of the contracture. When intrinsic and extrinsic types of contracture coexist, meticulous release of all tissues surrounding the wrist must be carried out. Intrinsic stiffness should be tackled by exploiting all the surgical tips assembled both in the open and arthroscopic surgical domain.

A-0215 Acceptable parameters for alignment of distal radius fracture with conservative treatment in elderly patients

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Background: Treatment of distal radius fractures in elderly patients is conflicting, because fracture reduction does not appear to be as strongly associated with functional outcomes as in younger patients. The purpose of this study was to evaluate radiographic findings of acceptable reduction, without leading to wrist dysfunction and poor outcomes.

Methods: This study included 52 active and healthy elderly patients with conservatively-managed distal radius fractures. They were 7 men and 45 women, older than 60 years. Radiographic assessment included volar tilt, radial inclination (RI) and ulnar variance; and outcome was evaluated including the Mayo wrist score and the DASH score. As a control group, we examined their preoperative radiographic and clinical outcomes, as well as for 19 patients older than 60 with a malunion, for whom corrective osteotomy was performed because of the wrist dysfunction. The radiographic parameters and clinical outcomes were compared between the two groups in a statistical manner; and the correlation coefficients of the radiographic parameters with Mayo wrist score and DASH score were analysed by multiple regression.

Results: Volar tilt (mean, -1.2°) and ulnar variance (mean, 2.5 mm), as well as the Mayo wrist score (mean, 80.0 points) and DASH score (mean, 8.6 points) in the objective group were significantly superior to those in the control group, with comparison of radiographic parameters and clinical outcomes. There was no significant difference between the two groups in regard to RI (mean, 14.9°). Multiple regression analysis revealed that volar tilt and ulnar variance were significantly correlated with the clinical outcomes in the objective.

Conclusions: The parameters of volar tilt and ulnar variance had a significant correlation with clinical outcomes. Clinical outcomes significantly worsened when those parameters exceeded a tolerable range. In elderly patients, it is important to determine an appropriate therapeutic modality for a distal radius fracture, considering the acceptable parameters for alignment.

A-0222 Percutaneous treatment of scaphoid fractures: comparative evaluation of radiographic parameters and functional outcomes between the operated and the healthy hand. A prospective study

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Introduction: Treatment of acute scaphoid fractures is controversial. Although surgical and conservative treatment achieve high rates of consolidation, the first one allows early wrist mobilisation and return to normal life in a working population, so that we want to support surgery in young patients with these fractures, but we are concerned about the possible changes caused by surgery on carpal anatomy.

Objective: With this study, we want to make a comparative evaluation of radiographic parameters and functional outcomes between the operated (before and after surgery) and the healthy hand, to analyse if percutaneous treatment could change scapholunate, radiolunate or scaphoid length; and if all these parameters may influence functional outcomes, in terms of articular balance and grip strength.

Methods: A prospective chart review (2009 - 2013) was performed for 30 working-aged (average, 33 years old) patients with a scaphoid fracture, whom had percutaneous fixation (Acutrak ® mini: 25 with the volar technique, 4 with the dorsal one). We classified fractures according to the Herbert classification. We evaluated return to work and scaphoid time of consolidation, and measured scapholunate, radiolunate and scaphoid length both preoperatively and 12 months postoperatively in the injured hand, and we also measured them in the healthy one. We evaluated wrist flexion, extension, ulnar and radial deviation, and grip strength in both hands. A comparative evaluation was performed of all measurements, in the case of radiographic parameters between pre- and post-surgery in the injured hand, and between the healthy and operated scaphoid; and in the case of functional outcomes between the injured and non-injured hand.
Results: According to the Herbert classification, we had 81.48% Type B2, 11.11% Type B1 and 7.5% Type B3 fractures. One case of no consolidation was a Herbert B2 fracture treated immediately after trauma. Patients returned to work at an average of 2.5 months. No statistical differences were found in the radiographic parameters nor in functional outcomes.

Conclusion: No statistical differences were found in the angles nor in the articular balance, plus patients’ return to work was at an average of 2.5 months after surgery, so we strongly believe that percutaneous surgery is a reliable procedure in young, active patients with a scaphoid fracture.

A-0223 Scaphoid non-union with carpal instability: radiological and arthroscopical assessment, and clinical results

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The purpose of this study was to determine the incidence of carpal instability with scaphoid non-union, as well as to review the clinical results. We hypothesised that carpal instability with scaphoid non-union is not uncommon and that carpal instability is associated with observable radiological factors. We retrospectively reviewed 62 cases of Herbert screw fixation with bone graft for scaphoid non-unions. The mean time of delay from injury to surgery was 30 months. We confirmed scapholunate (SL) and lunotriquetral (LT) instability (Geissler grade III or IV) and lunate morphology by arthroscopy. We analysed the fracture pattern and fragment displacement with computed tomography (CT). Carpal alignment (radiolunate, radioscaphoid and scapholunate angle) was analysed with a plain radiograph. Approximately one-half of the non-union scaphoid cases had carpal instabilities. All LT instabilities were Geissler Grade III, and four cases of SL instability were Grade IV (three of these four also had LT instability). Two of these cases were treated with temporary scapholunate fixation. At the final follow-up evaluation, wrist function as evaluated by the Mayo wrist score was excellent in 35 patients, good in 17 patients, fair in 8 patients and poor in 2 patients. Cases with both SL/LT instabilities tended to have decreased wrist flexion-extension range of motion. Type 1 lunate and displaced non-union fractures were associated with a dorsal intercalated segment instability (DISI) pattern; however, fracture pattern and SL/LT instability had no correlation with radiologic carpal alignment. Preoperative radiographic analysis cannot detect the presence of SL/LT instability with scaphoid nonunion, a not uncommon combination, but arthroscopy can detect SL/LT lesions. We found that 50% of scaphoid nonunion cases had SL and/or LT instability, and that both SL and LT had to be present for decreased wrist flexion-extension range of motion. Our results suggested that there is an indication for arthroscopy in scaphoid non-union, if surgical fixation is offered, to avoid the detrimental effects of an undiagnosed ligament tear.

A-0230 Use of action camera in hand surgery, a new useful tool

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Scope of impact: The use of action cameras for recreational activities is becoming popular in the last years. We present a new way to use this technology in hand surgery, either for teaching purposes, self-learning or just to show the technique to future patients.

Material and methods: We used a Gopro Hero3 Black Ed as an action camera, using a head strap on the main surgeon. Our editing resource was the Adobe Premiere Pro Cs6 software, and we worked on a MacBook Air to create the videos. Tips and tricks: After one year of use, we show the most common errors and how you can correct them without an advanced understanding in video editing. Wrist arthroscopy, dorsal carpal exposures and nerve decompression are some of the cases where we have used this tool.

Conclusions: This is a different point of view in our profession, to show and share our work with other professionals and patients. Even if you have an audio-visual and communication department at your hospital, we expect to help all hand surgeons whom would like to try this new tool and give them an easier start at obtaining what they expect.

Disclaimer: None of the authors have received or will receive grants or economic compensation from the trademarks previously referenced above.

A-0233 CapFlex-PIP©: a new modular surface-gliding arthroplasty. Results of a prospective pilot study

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**Introduction:** Osteoarthritis in the proximal interphalangeal joint (PIP) frequently occurs in people over the age of 60 and leads to pain, loss of function and restrictions in daily activities. Various implants of different materials are used for PIP joint replacement, each with some disadvantage like instability, large bone resection, missing osteointegration, etc. The CapFlex-PIP© is a new, modular, surface-gliding implant which should prevent those problems. The purpose of our pilot study was to investigate the clinical, subjective and radiographic outcomes in the 1-year period after surgery.

**Methods:** Patients with primary osteoarthritis of the PIP joint were enrolled into this pilot study. The surgery was performed by two surgeons, both using the dorsal approach described by Chamay. They were assessed preoperatively; after 6 weeks; and 3, 6 and 12 months for range of motion (ROM) of the PIP joint and grip strength. Patients rated their pain on a numeric rating scale (NRS) and filled out the quick Disabilities of the Arm, Shoulder and Hand Outcome Questionnaire (quickDASH) and the Patient Evaluation Measure (PEM), part 2. Standard radiographs were taken.

**Results:** We included 10 patients (3 female and 7 male patients) with a mean age of 67.5 ± 7.1 years. The active ROM of affected PIP joint increased slightly from 41.5° ± 16.3° preoperatively, to 51.1° ± 28.4° after 1 year (p = 0.312). Patients reported significant pain relief from the preoperative to the 12-month follow-up period [7.9 ± 0.4 to 1.1 ± 1.5; p = 0.018]. Compared to the preoperative period, there was also a significant improvement in the quickDASH, from 43.2 ± 12.2 points preoperatively to 14.8 ± 17.0 points after 1 year (p = 0.007). Similar results were found for the PEM (p = 0.038). All implants remained intact over the postoperative time and no migration, osteolysis, nor implant fractures occurred.

**Conclusion:** One year after the first 10 surgeries using the CapFlex PIP implant, we yielded promising results. All implants showed complete osteointegration and no evidence of radiological migration. The positive subjective and clinical outcomes confirm the radiological results. In the future, mid- and long-term results will be the subject of further research.

**A-0239 Radiographic predictor of DRUJ instability in distal radius fractures**

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**Introduction:** This study analysed predictors of distal radioulnar joint (DRUJ) instability in distal radius fractures and focused on radial translation (DRUJ gap) as a predictor, based on our clinical and biomechanical analysis.

**Materials and methods:**

1. Clinical Study: Since 2004 to 2012, we conducted a prospective study for evaluating DRUJ instability associated with unstable distal radius fractures. Open reduction and internal fixation using volar locking plates and screws was done for 346 patients with unstable fractures. Following fracture fixation, the surgeon manually examined the DRUJ ballottement test. When we found DRUJ instability in the injured wrist, the wrists were explored by arthroscopy, followed by open surgery. Potential radiographic predictors of DRUJ instability included three fracture characteristics: severity of fracture pattern, ulnar styloid fracture and magnitude of fracture displacement. We used five radiographic parameters to assess the magnitude of fracture displacement: ulnar variance, radial inclination, radial translation (DRUJ gap) in a posteroanterior radiograph; and volar tilt and sagittal translation in a lateral radiograph. We tested the univariate associations between the outcome variable and the potential predictor. The outcome variable was the presence or absence of DRUJ instability, due to complete radioulnar ligament tears.

2. Biomechanical study: We used three fresh upper extremity cadaveric specimens. The humerus and ulna were fixed to the testing apparatus with the elbow at 90° flexion, and the radiocarpal unit was allowed to rotate freely around the ulna. In both the intact and triangular fibrocartilage complex (TFCC) sectioned wrists, the DRUJ gap distances were measured using a three-dimensional (3D) space electromagnetic tracking device during the passive mobility testing, which translated the radius with a load of 2 kgf in radial direction. Simulated radioulnar dissociation instability was a divergence between the radius and ulna during the testing, which was designated as the DRUJ gap distance.

**Results:**

1. Clinical study: In the current prospective cohort of 346 patients, 22 patients had gross DRUJ instability with complete radioulnar ligament tears. In univariate analyses, only the radial and sagittal translations were significant predictors of DRUJ instability. The radial translation (DRUJ gap distance) of the 22 patients with complete tears averaged 5.0 mm (range, 0 - 12), whereas those of the 324 patients without tears averaged 1.6 mm (range, 0 - 6.4).
2. Biomechanical study: In the TFCC intact wrists, changes in the DRUJ gap distances during the passive mobility testing averaged 1.9 ± 1.3 mm in neutral forearm rotation. In the TFCC sectioned wrists, average change in the DRUJ gap distance increased to 4.6 ± 1.4 mm.

Discussion: In the current analysis, a radiographic finding of widening of the DRUJ gap distance on posteroanterior views was an important predictor to identify DRUJ instability accompanying unstable distal radius fractures. It was intriguing that our clinical data are similar to preliminary biomechanical data. DRUJ widening in the fractured wrists was observed in patients with complete radioulnar ligament tears, even if no external force was applied. This widening may be explained by internal force, such as increased pressure of the DRUJ due to intra-articular hematoma, anything to intervene, or maintenance of radial displacement of distal fragment by brachioradialis muscles.

A-0240 Anterograde pedicle advancement flap in finger-tip injury

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Hypothesis: Soft tissue reconstruction is needed to maintain the maximum length of the fingers in cases of: the occurrence of necrosis following a crushed finger-tip injury, failed replantation, or amputation without stump. The purpose of this paper is to provide information about the indication and treatment of problems resulting from anterograde pedicle advancement flap in finger-tip injury, among the various ways of soft tissue reconstruction.

Methods: This study analysed 12 cases involving soft tissue reconstruction with anterograde pedicle advancement flap, in finger-tip injuries from January 2012 to October 2012. Five cases involved post-amputation treatment; seven cases involved injuries caused by crushing. Concerning the procedure of the surgery: first, the surgeon decided the necessary size of the flap and the length of advancement; the surgeon then dissected a pedicle involving the finger-tip nerve and finger-tip artery, within the range of the proximal interphalangeal joint; last, the pedicle was dissected, concentrating on providing a rather bigger digital nerve than digital artery and keeping the width of the pedicle 3 - 4 mm. At the same time, the dissection was achieved up to the proximal interphalangeal joint and a flap was lifted. After advancement, blood circulation was identified and connected to the area of the injury site.

Results: The length of the flap advancement was on average 8.9 mm [range, 7 – 11 mm]. Ten cases were successful and the patients had no subsequent problems. Venous congestion occurred in two cases of crushing injury and venous draining was implemented for 2 - 3 days. It is thought that this venous congestion is related to the damage mechanism. The proper size of the pedicle should be more than 4 mm in the cases of a crushing injury. Oblique amputation type of the finger-tip in the cases of the amputation of the finger-tip provides an easy method of handling the flap. Thus, it was a very advantageous method for covering damaged soft tissue. In all 12 cases, normal sensory and interphalangeal joint function followed surgery.

Summary: This method is easier than that involving V-Y advancement flap in flap handling. It results in less scarring than the reverse pedicle flap treatment and obviates proximal interphalangeal joint stiffness. In cases requiring 10 mm of flap advancement from the finger-tip injury and oblique amputation type, it can bring about much better results.

A-0241 Medium-term results of unlinked elbow arthroplasty for stiff elbows with rheumatoid arthritis

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Introduction: Total elbow arthroplasty is an option for the treatment of severe elbow stiffness in rheumatoid arthritis (RA) patients, but there have only been a few reports about this procedure for stiff or ankylosed elbows. Linked implants are generally used for these patients and there is little information with respect to unlinked arthroplasty. Accordingly, the present study was performed to evaluate the medium-term outcome when unlinked total elbow arthroplasty was used to treat RA patients whom had elbow stiffness.

Patients and methods: We reviewed 10 RA patients [11 elbows] with a mean age of 53 years [range, 46 - 59 years] and a pre-operative range of elbow motion ≤ 30°, whom underwent total elbow arthroplasty using unlinked components with cementless fixation. An unlinked total elbow prosthesis, the Osaka University Model Elbow System (MMT Co. Ltd., Japan), was used in all of the elbows. The preoperative duration of stiffness ranged from 9 - 24 years. Subjective and objective data were collected for calculation of the Mayo elbow performance score. A handheld goniometer was used to measure the arc of flexion. We obtained
antero-posterior and lateral radiographs at the time of latest follow-up, for all 11 elbows.

**Results:** All patients were followed for a minimum of 5 years (mean, 8 years; maximum, 10 years). The outcome was rated as excellent for one elbow, good for eight elbows, and fair for two elbows. The mean pre-operative Mayo elbow score was 41 points (range, 15 - 65 points), while the mean postoperative score was 80 points (range, 60 - 95 points); and the elbow score improved significantly after surgery ($p < 0.001$). The mean preoperative arc of flexion was 25° (range, 10 - 30°), and it was located from 61 - 86° (range: 0 to 80° and range: 30 to 110°, respectively) in the normal flexion arc. Postoperatively, the mean arc of flexion was 75° (range, 30 - 100°), and it was between 51° (range, 35 - 75°) and 127° (range, 105 - 140°) in the normal flexion arc. The mean increase in the arc of flexion was 50° (range, 0 - 85°), with a mean increase of 46° for flexion and 10° for extension. There was no progressive radiolucency around either the humeral nor ulnar component, in any of the elbows. Valgus deformity was seen in two elbows and one elbow showed valgus subluxation. In the elbows with valgus deformity, this was recognised at 6 months and 8 months after surgery, respectively, while valgus subluxation occurred at 9 months postoperatively; however, all three elbows showed no progression of the valgus deformity/subluxation on radiographs obtained at the final follow-up.

**Discussion/conclusion:** The results of this study indicate that unlinked total elbow arthroplasty is a valuable option for the treatment of stiff elbow in patients with RA.

**A-0245 Possibility of neurotization of the avulsed brachial plexus, by means of nerve grafts from the cortico-spinal tract (experimental research)**

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By means of long-lasting research on spinal cord lesions, repair and regeneration, the possibility of reinnervation of muscles by means of putting grafts from the corticospinal tract (CST) of the cord to peripheral nerves has been demonstrated. The fibres of the corticospinal tract of the cord, after connection with any peripheral nerves, are able to give to the newly-connected muscles their proper function, independently from the previous functionality of the cortical neurons. In accordance with this research, an experimental connection of the cortico-spinal tract of the cord (distal to the origin of the brachial plexus) with nerves of the brachial plexus at the armpit was done, with functional recovery of the paralyzed muscles. These results, besides confirming that the CST is able to reinnervate the muscles via the upper motor-neurons and glutamate stimulation, instead of their normal cholinergic excitation, also demonstrates that even upper axons destined to muscles of the lower limbs are able to give functional, selective commands to muscles of the upper limbs, due to the brain plasticity of multiple single neurons scattered all over the brain cortex.

**A-0247 Treatment of ulnar lay carpometacarpal periartricular fracture dislocation with a temporary plate fixation bridging over the carpometacarpal joint**

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For comminuted ulnar lay carpometacarpal periartricular fracture dislocation, a displacement which causes the pain or limited range of movement (ROM) of the carpometacarpal joint is reported as a major complication, after pinning or fixation by screw. To avoid it, we have performed an open reduction and pinning with temporary plate fixation bridging over the carpometacarpal joint for the selected four cases. We report here the surgical results of this treatment on four patients selected between May 2011 and October 2013. Three patients sustained 5th carpometacarpal intra-articular fracture dislocations and one patient sustained a 4th metacarpal diaphyseal bone re-fracture after a pinning fixation. We evaluated these patients (three men and one woman; average age 41 years [range, 14 - 81 y]. The average follow-up period was 160 days [range, 119 - 185 d]. The surgical method is the following: after reduction and fixation of the fracture site, particularly in the articular surface, by Kirschner wire; a straight small reconstruction plate (Profyle Combo, Stryker, Japan) was bridged over the carpometacarpal joint for the purpose of off-loading through the axial and rotational direction. Kirschner wire was embedded under the skin. The night splint immobilised the wrist postoperatively for 2 weeks. All carpometacarpal joint bridging plates were removed postoperatively, at an average of 98 days. We evaluated Roentgen findings. The functional analysis included ROM, Patient Rated Wrist Evaluation (PRWE) and Disability of the Arm, Shoulder, and Hand (DASH) scores; grip power; and any detectable surgical complications. All fractures...
were united. Flexion of metacarpal joint was 83.3 (range, 70 - 90) and grip power was 27 kg at the last follow-up. PRWE score was 12.7 (range, 0 - 38); DASH score was 4.4 (range, 0.8 - 10.8). One patient sustained a contracture of the 5th metacarpal joint, for which she underwent surgical mobilization of 5th metacarpal joint postoperatively, at 120 days. The aim of the present method is to prevent the displacement of the comminuted fragment. Consequently, no cases sustained the displacement of the fragment after final follow up. The merit of this method is that patients are allowed to do light work immediately after the first surgery, because of a solid fixation of the carpometacarpal joint. The demerit was that it needed removal of the plate after the fracture was healed, although after removal of the plate, the recovery of ROM of the carpometacarpal joint become quick. Limitations were that this is a small report in four patients and that the plate does not have a locking structure. We consider a locking plate bridging over the carpometacarpal joint as more theoretical than a conventional plate, to realise the internal off-loading effect. We treated four ulnar lay carpometacarpal peri-articular fracture dislocations with temporary plate fixation bridging over the carpometacarpal joint. This method allowed for a patient to return back to previous work, immediately after the first surgery. The results are good and there was no case with displacement of the fragment. We consider this method may be useful for treating the comminuted carpometacarpal fracture dislocation.

Methods: Climbers aged ≥ 18 years were recruited by opportunity sampling from outdoor climbing crags (n = 22) and indoor boulders (n = 13) in Catalonia, Spain, and invited to complete a 5-part self-assessed questionnaire:

1. Explanation of the disease with pictures;
2. General data: name, sex, age, weight, height, occupation and handedness;
3. Risk factors, including: alcohol intake, smoking, diabetes, liver disease, other diseases and upper limb injuries;
4. Climbing history (maximum climbing grade, classified into four levels [I to IV, from lower to higher]; and total climbing days, expressed as climbing years [total days/365.2]); and
5. DD data, including disease severity in each hand, age at onset and family history. Frequencies and percentages, and median and interquartile ranges (IQR: P25 - P75) were used to describe categorical and continuous variables, respectively. We used univariate and multivariate logistic regression models to estimate predictive factors for DD.

Results: A total of 396 climbers completed the questionnaire and were included in the analysis: 72.5% were men, with a median (IQR) age of 32 years (27 - 37), median body mass index (BMI) of 21.8 (range, 20.4 - 23.2) and a median total climbing years of 2.19 (range, 0.82 - 4.93). The CI 95% prevalence of DD was 5.3% (range, 3.5% - 8.0%) and of the 21 cases, 17 were male, with median age at disease onset of 31 years (range, 28 - 34). Univariate logistic regression analysis identified the following predictive factors for DD: other fibromatoses OR 18.9; CI95% [1.14 - 313.32], with a maximum climbing grade (reference level I) of II 3.27 [0.38 - 28.46], III 8.57 [1.1 - 66.66], IV 6.44 [0.56 - 73.83]; a family history of 29.49 [6.11 - 142.3]; and cumulative climbing years of 1.17 [1.07 - 1.28] (trend test p < 0.001). Multivariate analysis of the same variables [except maximum grade, due to collinearity with the cumulative climbing years] identified family history 40.2 [7.91 - 204.38], other fibromatoses 31.36 [1.72 - 517.74] and cumulative climbing years 1.20 [1.09 - 1.32] as independent predictive factors for DD.

Conclusions: In this study, disease onset occurred at an early age in both male and female rock climbers. In addition to known risk factors, such as a family history of DD and other fibromatoses, we found a clinically-relevant, statistically-significant 20% increase in the adjusted risk of DD per cumulative climbing year.
A-0252 Physiotherapy under hypnosis: a solution for acute algodystrophy syndromes

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Introduction: For many years, the pathophysiology of acute algodystrophy syndromes has remained obscure. Now called Type-1 or Type-2 Complex Regional Pain Syndrome (CRPS), it involves a combination of excessive excitability of the sympathetic system, with body-image disorders combined with the intervention of psychological factors. To date, few treatments using psychological mediation have been assessed. In 2009, our preliminary study of 15 patients treated by a combination of hypnosis, physiotherapy ± administration of a 50:50 nitrous-oxide:oxygen mixture [H/P/M], showed the advantages of this method. We report a larger series of 69 patients in whom the same protocol was used, to evaluate the efficiency of this treatment for hand or wrist algodystrophy.

Materials and methods: Between 2006 and 2013, H/P/M was used in the pain-control unit of the Toulouse-University Hospital to treat 69 patients (38 women and 31 men) with a Type-1 hand- or wrist-CRPS. Their average age was 47 years (range, 25 – 68 y). H/P/M sessions were managed jointly by a hypnotherapist and a physiotherapist. The initial consultation was focused on demystifying hypnosis, explaining practicalities and collecting the relevant clinical data. The same operator performed all hypnosis sessions. The nitrous-oxide:oxygen mixture was administered in 57 cases. After an initial induction phase, hypnotherapy was focused on the dissociation and protection from pain. This was followed by metaphorical work with suggestions, in order to improve the body-image disorders as well as the underlying emotions. It was during this stage that the physiotherapist performed passive mobilisation and massage to the affected limb.

Results: The preliminary interview revealed a previous trauma history [fracture or surgery] in 63.7% of cases and significant affective episodes in 70%. At the beginning of their treatment, 80% of patients were taking painkillers. The mean number of sessions was 4 [range, 1 - 7] and each lasted ± 1 hour, distributed as follows: 10 min for the patient to express his/her feelings since the last session, 40 min of H/P/M and 10 min for debriefing. At the end of the study, only 20% of patients were still taking painkillers and the sessions were deemed ‘beneficial’ by 80%. In 87% of patients, pain and sympathetic symptoms had decreased while the range of movement [ROM] increased.

Discussion and conclusions: Hypnotic suggestion reduces the activity of certain areas of the brain that are normally stimulated when pain-inducing care is administered. It acts on the emotional and affective components of pain, reducing its unpleasantness and lowering the perception of its intensity. Hypnosis enables the virtual activation of the affected limb by stimulating the same cerebral areas as true mobilisation would, i.e. the frontal-lobe premotor cortex, the supplementary motor area [SMA] and the motor cortex. It also enables emotional release, frequently observed during these sessions. The varied facets of hypnosis explain the advantage of using this regimen when caring for CRPS patients, as much to facilitate potentially painful physiotherapy as to get rid of pain and autonomic-dysfunction symptoms.

A-0255 Union of scaphoid waist fractures assessed by CT scan at 6 weeks

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Purpose: Comparative studies on the union of scaphoid waist fractures are mainly based on radiographs and not on computed tomography (CT) scans. Today, CT scans have proven more accurate in the assessment of scaphoid fracture characteristics and union. The aim of this study was to evaluate the time to union of scaphoid waist fractures, based on CT scan at 6 weeks. Furthermore, we aimed to compare the time to union between conservative treatment in a cast and internal screw fixation, in a randomized subgroup having a non-displaced scaphoid waist fracture.

Methods: We included 65 consecutive scaphoid waist fractures in this study. A prospective subgroup from this cohort, with a non-displaced fracture (< 1 mm dislocation and/or < 15º volar angulation) was randomized to conservative treatment [n = 23] or arthroscopically assisted internal fixation [n = 15] in the proximal to distal direction. We obtained CT scan slices with axial sections 0.6 mm thick in the longitudinal axis of the scaphoid, to provide fracture characteristics and to assess bone union.

Results: Overall, at 6 weeks, we found a 90% union rate for the non- or minimally-displaced fracture treated conservatively and a union rate of 82% for those whom had internal fixation. There was a trend towards prolonged time to union and a risk for non-union among the displaced (> 1.5mm) scaphoid fractures. In the randomized subgroup of non-displaced
fractures, no difference in time to union was demonstrated between those who were treated conservatively and those who underwent surgery. The conservatively-treated fractures from this subgroup with prolonged time to union (10 to 14 weeks) were comminuted, demonstrating a separate cortico or cortico-spongyous fragment on the radial side of the scaphoid.

Conclusions: The vast majority of non- or minimally-displaced scaphoid waist fractures are sufficiently treated with 6 weeks of immobilization in a cast. Those with a comminuted radial fragment may require a longer immobilisation period, despite otherwise being radiographically non- or minimally-displaced. Internal screw fixation did reduce the time to union for non-displaced scaphoid waist fractures.

A-0257 Does distal scaphoid resection in radioscapholunate arthrodesis increase range of motion at long-term follow-up?

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Introduction: Intra-articular distal radius fractures sometimes lead to degenerative lesions due to necrosis of cartilage fragments. Radiocarpal arthrosis causes stiffness and wrist pain. The radioscapholunate arthrodesis (RSL) has very specific indications, as far as the midcarpal joint is intact. In the literature, the scaphoid excision increases wrist motion in flexion and radial deviation compared to RSL without scaphoidectomy. The aim of our study was to compare the intraoperative range of motion (ROM) with and without scaphoidectomy, and at long-term follow-up.

Material and methods: Nine patients with RSL arthrodesis and scaphoid excision were evaluated. There were eight cases of symptomatic post-traumatic arthrosis and one case of septic osteoarthritis. All patients had a distal scaphoidectomy by palmar approach. The mean follow-up was at 2.8 years.

Results: After the scaphoid resection, ROM was 44° for flexion, 41° for extension, 17°/23° for radial and ulnar deviations. At the latest follow-up, ROM was 18° for flexion, 30° for extension, 10°/18° for radial and ulnar deviation and 70°/70° for pronosupination. We observed a decrease in ROM between the pre- and post-operative status, consisting in loss of 40% for flexion and radial deviation and loss of 20% for extension and ulnar deviation. Postoperative mean force was 58% of the contralateral side. Complications such as midcarpal arthrosis occurred in three cases: two pancarpal arthrodoses and one arthroplasty. We had no pseudarthrosis to report.

Conclusion: Radioscapholunate arthrodesis is a surgical option to consider when radiocarpal arthrosis occurs with a preserved midcarpal joint. Resection of the distal scaphoid increases intraoperative ROM. This gain is not conserved at long-term follow-up. Motions are similar to RSL without scaphoidectomy, if we compare to the Nagy and Büchler report (1997). Radial deviation is the only motion that remains substantially increased: 3° without scaphoidectomy and 10° with scaphoid excision. This resection is nevertheless essential to reduce the non-union rate and scaphotrapeziotrapezoidal arthrosis.

A-0258 Unstable metacarpal fractures treated with intramedullary nail fixation

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Introduction: Fractures of the metacarpals account for nearly 36% of all hand fractures. While many metacarpal fractures can be treated through nonsurgical means, unstable metacarpal fractures which are subject to malrotation, displacement, foreshortening and angulation require reduction and stable fixation. Flexible intramedullary nail (IMN) fixation of fractures has become the cornerstone of treatment of long bone fractures with the medullary cavity. It provides distinct advantages over other methods, because it is minimally invasive with minimal soft tissue dissection, stability of fixation, and enhances bone healing by preventing distraction of the fracture site. This is a particularly great option for patients presenting multiple metacarpal fractures. Our study evaluated outcomes in a case series of unstable metacarpal fractures treated with flexible IMN fixation.

Materials and methods: This study includes 55 cases of fractures that healed, by clinical and radiographic assessment, at an average of 12.7 weeks. The outcomes were assessed via a radiological study of longitudinal and angular collapse, and final functional outcome as measured by the Disabilities of the Arm, Shoulder and Hand (DASH), active wrist range of motion (AROM), and the Grip and Pinch Strength tests.

Results: Pins were removed in all cases at an average of 13.9 weeks. Patients regained full finger ROM at
final follow-up and were capable of 72.4% of motion post operatively, after 2 weeks. The mean DASH score at final follow-up was 6.5. Complications included: three cases of extensor tendon irritation that resolved without functional impairment and two cases of ‘backing out’ that required reoperation to replace the pin. In one case, a bony exostosis formed on the affected metacarpal that led to tendon irritation and required operative excision.

**Conclusions:** We found that this technique allowed for the stabilization of fractures, an early ROM with early resumption of usual activities, reduced immobilisation and minimal complications. A removable orthosis, instead of a cast, allowed for mobilization of the proximal interphalangeal (PIP) joint.

**Summary statement:** The use of a multiplanar fixation system for complex intra-articular distal radius fractures allows for stabilisation of the larger and smaller fragments, whilst providing outcomes similar to other associated techniques.

**Introduction:** This study aims to assess the outcomes of complex, intra-articular distal radius fractures (AO Type C) treated with closed reduction, cross-pin multiplanar fixation, and a non-spanning external fixator. The use of this device was hypothesized to maintain anatomic reduction and allow for range of motion (ROM) in AO Type C distal radius fractures, as assessed via radiographic variables, functional outcomes and the Disabilities of the Arm, Shoulder and Hand (DASH) score.

**Materials and methods:** We included 23 patients with complex, intra-articular (AO Type C) distal radius fractures (DRFs) in this study. All patients were treated with closed reduction and percutaneous fixation, using K-wires attached to a non-spanning external fixator. Postoperatively, a removable orthosis was applied, at a mean of 6 days (range, 2 - 10) and formal wrist rehabilitation began, at a mean of 8 days (range, 2 - 16). Standard radiographs were obtained pre-op, post-op, at 8 - 12 weeks and at 10 - 14 months. Radiographic variables were measured at each time point from digitized radiographs, using Digimizer software. Patients were also evaluated for grip strength, pinch strength and active wrist ROM. The Patient-Rated Wrist Hand Evaluation (PRWHE) and the DASH were used to determine subjective outcomes. Differences between numerical pre- and post-operative variables were analysed using Student’s t-test. All t-tests were paired, 2-tailed tests and statistical significance was set at P < 0.05.

**Results:** At an average follow-up of 17 months (range, 12 - 36), the grip and lateral pinch strength recovered 82.2% and 95.1% respectively, and mean active wrist ROM increased to a minimum of 82% of the non-injured side. The mean DASH and PRWHE scores at the last follow-up period were 10.8 and 9.1, respectively. There was no loss of reduction and no significant change in radiographic parameters following reduction (P > 0.33), although the parameters were slightly outside of accepted ranges in three patients. There were no pin track infections, non-unions, tendon injuries nor angular collapses. Two patients had an increase in ulnar variance; one patient developed complex regional pain syndrome that resolved; and one patient had mild transient superficial radial nerve sensitivity without functional compromise. All patients returned to their prior employment and/or activities.

**Discussion/Conclusion:** We treated 23 patients with complex intra-articular DRFs with closed reduction, cross-pin fixation and a non-spanning external fixator. Subsequently, patients demonstrated excellent radiographic, functional and subjective outcomes (Final DASH of 10.8). Two patients experienced complications that resolved without functional compromise. This preliminary study suggested that the use of non-spanning external fixator may be indicated for complex intra-articular DRFs, if closed reduction is possible.

**A-0263 Soft tissue reconstruction of the hand with a heterodigital artery flap**

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**Background:** Reconstruction with flap tissue is required in injuries where tendons, bones, joints and neurovascular structures are exposed. Pedicled
A-0264 An anatomical study as a basis for endoscopic cubital tunnel release and the associated clinical outcomes

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Purpose: This is an anatomical study in fresh-frozen cadavers of the ulnar nerve, as related to endoscopic release of the cubital tunnel. We also present a retrospective review of patients treated with decompression via endoscopic visualization.

Methods: To further our understanding of relevant anatomy, we dissected 26 cadaver arms. We paid special attention to fascial membranes as potential sites of constriction, as well as the position of nerves, vessels and aberrant anatomy of interest. These findings facilitated our understanding of the extent of release in 81 patients (93 cases) with cubital tunnel syndrome, utilising endoscopic simple decompression. Outcome measures included (a) DASH score; (b) Gabel and Amadio score; and (c) Grip and pinch strength.

Results: We noted a fascial band proximal to the medial epicondyle in 12/26 cadaver specimens. We observed a high degree of variability in the anatomy of the flexor pronator aponeurosis distal to the medial epicondyle. Where present (n = 10), medial antebrachial cutaneous nerve branches crossed the ulnar nerve at an average distance of 2.9 cm, (range, 1.0 - 4.5). Aberrant structures were noted in 8/26 specimens, including the anconeus epitrochlearis muscle in two specimens, the basilic vein crossing the ulnar nerve in four specimens and the epimysium of triceps in two specimens. The average preoperative DASH score was 48.7 (n = 34) and postoperatively, was 24.6 (n = 56). The Gabel and Amadio outcome scores were: 24 excellent, 40 good, 25 fair and 4 poor (n = 93). Average follow-up was 8.2 months (range, 0.13 - 34.8 mo).

Conclusions: Cadaveric dissections shed light on vulnerable anatomy during release, including branches of the MACN, UN, brachial artery, facial bands and the basilic vein. The high degree of anatomical variability in this study highlighted the advantage of endoscopic visualisation in allowing surgeons to minimize operative trauma. This technique is simple and minimally invasive.

A-0265 Anatomical study of the motor branches to the flexor-pronator muscles of the upper limb and guidelines to hyperselective neurotomy

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Purpose: Hyperselective neurotomy of the nerves of the upper limb showed promising results to relieve spasticity in the long term, but lacked a consensual surgical strategy. The aim of the study was to describe the branching pattern of the motor branches dedicated to the elbow, wrist and fingers flexor and pronator muscles, in an attempt to develop technical guidelines for surgery.

Methods: We dissected 56 upper limbs of fresh cadaver specimen (16, 20 and 20 limbs for the musculocutaneous, median and ulnar nerves, respectively), in order to record the number of muscular branches and the distance between their origin and entry points into the muscles.
A-0267 Isolated lunotriquetral ligament tears treated with ulnar shortening osteotomy

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arthrodesis, there are two options, total prosthesis of the wrist or panarthrodesis. Both solutions have limitations. The aim of our study was to evaluate an alternative therapy: interposition arthroplasty with pyrocarbon implant at a follow up of a minimum of 6 months.

**Methods:** This is a retrospective monocentric study with clinical and radiological evaluation. This study includes 11 patients with a mean age of 55.2 years. There were four failures of first row carpectomy, a failure of partial arthrodesis, a case of post-infection osteoarthritis, four cases of Stage IV SNAC wrists and one siliconitis after a scaphoid implant.

**Results:** At the average follow-up of 11 months, pain was improved in nine cases. The average flexion was 36.5° and average extension, 35°. The average strength was 8.3 kg. Two implant dislocations occurred, only one required a second look surgery for implant replacement; however, in this patient, the pain remained severe and required panarthrodesis. In a third patient, a second panarthrodesis was performed for resistant pain.

**Conclusions:** The interposition arthroplasty with pyrocarbon seems to give encouraging results as an alternative therapy. It gives satisfactory mobility and pain relief, but moderate strength. It has the advantages of being a simple technique and it does not preclude manual activities. A long-term validation is, of course, necessary.

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**A-0273 Reconstruction of glabrous skin defects in the hand: experience and advantages of the thenar base donor site**

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Defects of the glabrous skin surfaces of the palm and fingers result from numerous causes, including larger fingertip injuries and unhealed burns, and following of surgery for diverse pathologies. The qualities of glabrous skin in the hands and feet are specifically tailored to the functional requirements of high shear strength and robustness, and the bulk of the epidermal layers unique stratum lucidum reflects this. Despite these unique properties, graft reconstruction of such defects is frequently achieved with skin harvested from non-glabrous donor site regions, such as the medial forearm. Non-glabrous donor skin has a poor colour and texture match for such applications, and is frequently associated with unsightly donor site scars. Other options include split thickness grafts of glabrous skin from the hypothenar or foot instep regions; however, whilst glabrous split skin grafts offer the ability to cover larger areas of skin loss, they carry their own morbidity in terms of slow, painful donor site healing. We describe our experiences harvesting full thickness grafts from the glabrous skin centred over the proximal flexion crease of the thumb. We have utilised this site to harvest skin grafts of up to 2 x 3 cm for the resurfacing of small-to-medium sized defects on the palmar surfaces of the hands and fingers in 28 patients, under both traumatic and planned circumstances. The skin has an excellent type-match to the defect and demonstrates very little shrinkage, once matured. Harvest of skin from this region is quick and easy to perform, due to its adjacent location to the defect, whilst the quantity of available skin is easily assessed by marking the skin fold apices that form over the flexion crease as they are pinched together with the thumb in mild opposition. The distance separating these points when the thumb is extended then forms the widest point of the planned skin graft ellipse, which is designed to lie in-line with the proximal flexion crease. This process ensures that the donor site can always be closed without tension and we have had no experiences of difficulty regaining full thumb extension, once the donor site has had chance to heal. In addition, the scar matures with the typical speed and quality of glabrous skin, and as it lies along the thumb base crease, it becomes all but invisible once matured. Furthermore, the donor site is one of the least used contact surfaces within the hand; and therefore, it avoids the potential discomfort associated with FTSG harvest sites described for the hypothenar region or the medial aspect of the great toe. Patient satisfaction with the procedure has been high and it represents a useful alternative to traditional non-glabrous skin graft donor sites for small-to-medium sized defects.

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**A-0274 Morphologic change of median nerve correlates with symptom relief after mini-incision and endoscopic carpal tunnel release: a randomized trial**


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The symptoms in carpal tunnel syndrome (CTS) can be ameliorated by open or endoscopic release of the transverse carpal ligament. It is unknown whether a mini-incision or endoscopic carpal tunnel release more effectively reverses the pathological changes that are observed in the median nerve in patients with CTS. We therefore compared subjective outcomes and the ultrasonographic (US) morphology of the median nerve in patients treated with either mini-incision or
endoscopic release. Between November 2011 and January 2013, we randomized 67 patients with CTS in their dominant wrist to either mini-incision \( (n = 32) \) or endoscopic \( (n = 35) \) release. Each patient was assessed by both the Boston Carpal Tunnel Questionnaire (BCTQ) and the Disabilities of the Arm, Shoulder and Hand (DASH) pre-operatively, and 24 weeks post-operation. An US examination was conducted at both time points, to measure the cross-sectional area (CSA) at the inlet and the flattening ratio (FR) at the middle and outlet of the median nerve. The post-operative mean BCTQ and DASH scores improved significantly from the pre-operative scores in both groups \( (p < 0.001) \). The mean CSA at the inlet decreased similarly in the mini-incision and endoscopic groups \( (3.3 \text{ and } 2.9 \text{ mm}^2 \text{, respectively}) \). The mean FR at the middle/outlet decreased from 3.6/4.2 to 3.2/3.0, and 3.8/4.3 to 3.2/2.9, in the mini-incision and endoscopic groups, respectively. There were no significant differences in the subjective outcome scores nor median nerve measures between the two groups. Improvement in the BCTQ-S only was significantly correlated with changes in the CSA at the inlet and the middle. In conclusion, mini-incision and endoscopic release both similarly relieved subjective symptoms and functions, along with the pathological changes, in the median nerve morphology along the carpal tunnel in patients with idiopathic CTS. This study suggested that similar subjective outcomes following mini-incision and endoscopic release can result from similar morphologic changes in the median nerve, following surgical decompression.

A-0276 Malunited distal radius fracture: long-term results of extraarticular corrective osteotomies

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**Background:** Numerous reports on short- and midterm results demonstrate the value of corrective osteotomies of the distal radius for malunited fractures. First at all, however, long-term results show whether a procedure has stood the test of time. The present publication wants to close some gaps in the knowledge of long-term courses after these corrective procedures. Main topics were:

(a) Are clinical and radiological improvements, recorded at short- and mid-term follow up, lasting?  
(b) Are consecutive procedures required, especially salvage procedures?

(a) What about the development of post-traumatic osteoarthritis?

**Patients and methods:** This study was based on the prospective data of 17 patients who underwent an extra-articular corrective osteotomy of the distal radius for symptomatic malunion \( (13 \text{ extension and } 4 \text{ flexion malunions}) \) between August 1992 and August 2003. Corrective osteotomy was performed via an opening wedge osteotomy, with transplantation of an iliac crest bone graft and stabilisation by a palmar plate in 16 patients, and a dorsal approach in 1 patient.

**Results:** All osteotomies showed bony union. One patient had to be excluded from the long-term evaluation for wrist fusion and ulnar head hemiresection, after 15 years. In the other patients, long-term results showed a lasting improvement for all parameters. A comparison of short-term and long-term results revealed no deterioration of the results, but further improvement in grip strength. In the group with extension malunion, seven patients showed no osteoarthritis, three showed primary osteoarthritis \( (1^o) \), one showed secondary osteoarthritis \( (2^o) \) and one, tertiary osteoarthritis \( (3^o) \). In the group with flexion malunion, no osteoarthritis was present.

**Conclusions:** The postoperative improvements after extraarticular corrective osteotomies last for more than 10 years. Only one subsequent procedure as a salvage procedure was required. Moderate and severe post-traumatic osteoarthritis appeared only in one patient each. Corrective osteotomy of the distal radius has therefore stood the test of time, even in the long-term course, and is thus recommended for malunited fractures.

A-0278 Isolated paralysis of the serratus anterior muscle: results of 52 consecutive cases of surgical release of the distal portion of the long thoracic nerve

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**Introduction:** Isolated paralysis of the serratus anterior (SA) is a rare condition that usually occurs in a mechanical context, after a single trauma or iterative strains. Pain is usually present with a neuropathic component and/or pain secondary to overuse of the other scapular muscles. Unlike Parsonage Turner syndrome, in which SA paralysis is not isolated,
spontaneous recovery is frequently partial or absent. The long thoracic nerve (LTN) may be compressed along the thoracic wall by vascular branches and/or fascial fibrosis. The present study reports the results of release of the distal portion of the LTN in isolated SA paralysis.

**Patients and methods:** A retrospective study included 52 consecutive non-iatrogenic cases operated on between 1997 and 2012. Mean age at diagnosis was 32 years (range, 13 - 70). Winging of the scapula was present for a mean duration of 24 months (range, 4 - 259) and SA palsy was complete in 52% of cases. A pre-operative electromyographic study was always performed, demonstrating persistent SA denervation without abnormalities in the other shoulder girdle muscles.

**Results:** A vascular or a muscular abnormality, and/or fascial fibrosis was found in every case. There were no complications related to surgery. A functional benefit, at least partial, was observed in all cases. Gain was excellent or good in 45 cases (86.7%), fair in 4 cases (7.7%) including 3 cases with scapulothoracic dyskinesia despite complete SA recovery, and poor in 3 cases (5.6%). Scapular winging resolved completely in 32 cases (61.5%), was improved in 19 cases (36.5%) and was unchanged in 1 case. Patients with a pre-operative neuropathic pain had a shorter pain history, compared to those suffering from muscle compensation pain (p = 0.06) and had an earlier beginning of post-operative pain relief [p = 0.05]. There were more excellent or good results in the cases with pre-operative neuropathic pain, compared to those with muscle compensation pain (p = 0.006).

**Discussion:** Isolated SA paralysis secondary to mechanical causes resembles entrapment syndrome, with compression or fixity of the LTN found on surgery. Release of the distal portion of the LTN is effective, in terms of function and pain, especially neuropathic; and usually allows a useful muscular recovery. It is a simple and safe procedure which is efficient when performed during the first year after the onset of palsy. Results are less predictable when muscular pain has set in, or in cases of persistent scapulothoracic dyskinesia. This technique can give a useful functional result, even after a long-lasting palsy, and must be considered before palliative surgery.

**A-0279 Simultaneous arthroscopic repair of deep and superficial TFCC portion for ulnar-side tear with DRUJ instability**

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**Purpose:** Because the deep portion of the triangular fibrocartilage complex (TFCC) is one of the primary stabilizers of the distal radioulnar joint (DRUJ), detachment of this portion from the ulnar fovea induces marked DRUJ instability. According to current biomechanical studies, the superficial portion of the TFCC, rather than the deeper portion, which is attached to the ulnar styloid, largely contributes toward stabilisation of the DRUJ in the pronated position; therefore, it would be reasonable to repair not only the deep, but also the superficial TFCC portions. We hypothesized that simultaneous arthroscopic repair of both TFCC portions would be effective for treatment of the ulnar-side TFCC tear with DRUJ instability. This study examined the post-operative outcomes in patients who underwent the procedure.

**Methods:** From 2011 to 2013, we conducted a retrospective study that included 10 patients (3 female subjects and 7 male subjects; mean age, 33 years (range, 14 - 59 y); all patients were diagnosed with ulnar peripheral TFCC tears with DRUJ instability by magnetic resonance imaging (MRI) and DRUJ arthroscopy. The fovea sign and DRUJ ballottement tests were positive in all patients. The mean ulnar variance value was +0.7 mm (range, 0 - 3 mm) on radiographs. Arthroscopic TFCC repair was performed using meniscus mender instruments; using a 2-0 Fiberwire® suture, the deep portion was repaired in an ulnar trans-osseous fashion into the fovea through two radiocarpal and two dorsal DRUJ portals. Simultaneously, the superficial portion was repaired by an outside-in technique to the capsule, using 3-0 PDS® sutures. All patients were categorized as Class 2, according to the Atzei classification. The post-operative immobilisation period lasted 4 weeks. Subjective data were collected by the Quick Disabilities of the Arm, Shoulder, and Hand questionnaire (Quick DASH), the Mayo wrist score and grip strength.

**Results:** The average follow-up period was 21 months (range, 12 - 26). After the procedure, none of the patients exhibited the fovea sign and DRUJ ballottement test positivity. There were no complications (such as tendon rupture or nerve injury). For the Mayo wrist score, the preoperative average of 68 points (range, 50 - 85) significantly improved, to a post-operative average of 94 points (range, 90 - 100). For the Quick DASH score, the preoperative average of 25.7 points (range, 5 - 57) significantly improved to a post-operative average of 2.7 points (range, 0 - 9). For the percentage of grip strength of the contralateral side, the preoperative average of 80% (range, 48 - 96%) significantly improved to a post-operative average of 100% (range, 78 - 132%).

**Conclusions:** Our observations revealed that patients with ulnar peripheral TFCC tears with DRUJ instability...
who underwent arthroscopic TFCC repair for both the deep and superficial portions simultaneously, experienced significant improvement in subjective and objective outcomes. Considering that the outcomes were excellent, this anatomical reconstructive procedure is recommended for the patients with TFCC tears associated with DRUJ instability.

A-0282 Medium to long-term surgical outcomes for chronic radial head dislocation in children

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Purpose: The treatment of chronic radial head dislocation remains controversial. This study reports the surgical results of open reduction with ulnar osteotomy for chronic radial head dislocation, after > 2 years’ follow-up.

Patients and methods: The study group consisted of 12 patients (6 boys and 6 girls) whom had been treated surgically for chronic radial head dislocation. All patients had had anterior dislocation. The mean age at the time of surgery was 9.3 years (range, 2.6 – 13). The mean follow-up was 7.1 years (range, 2.8 – 15.1). There were eight patients with a confirmable history of injury (Group A). The mean interval between the injury and operation was 9 months (range, 2 – 26). In contrast, four patients had no history of injury (Group B). In Group A, seven patients underwent open reduction and ulnar osteotomy and one patient underwent open reduction. In Group B, all four patients underwent open reduction and ulnar osteotomy, with reconstruction of the annular ligament. At follow-up, all patients were directly evaluated physically and radiologically, and then assessed according to the Mayo elbow performance score.

Results: There were no serious surgical complications. On X-ray, 11 patients had a good reduction and 1 patient (Group B) showed anterior subluxation of the radial head. Flexion extension arc was full in all patients. Forearm rotation was slightly restricted in nine patients, with an average loss of 19° of pronation and 3° of supination. Two patients who had been followed more than 10 years after surgery complained of slight pain after strenuous activities. Three patients showed mild osteoarthritis upon X-ray. Ten patients resulted in excellent, and two in good scores (average, 97.5 points).

Discussion and conclusion: Our surgical procedure provided excellent or good functional results without serious complications. Good functionality did not deteriorate at an average of 7.1 years follow-up.

A-0283 Management of distal phalangeal fractures: a 7-year review

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Introduction: Distal phalangeal fractures are commonly encountered fractures of the hand. Treatment options vary from conservative to surgical, depending on fracture and injury configurations. This is a review of distal phalangeal fractures comparing the outcomes between different treatment modalities.

Materials and methods: We studied the records and radiographs of all patients with distal phalangeal fractures treated between 2007 and 2013. Information was collected for patient demographics, injury characteristics, management details and recovery. Radiographs were studied pre-operatively, immediately post-operatively and at final follow-up. CI 95% and the z-test were used for statistical analysis.

Results: We reviewed a total of 175 patients with 179 distal phalangeal fractures. The commonest mechanism of injury was due to a heavy object falling on the hand (57%). A total of 78% were workplace-related injuries, where the majority injured were skilled workers (41%), followed by manual workers (38%). While 54% of the fractures were closed, 45% were open. The most common location was the tuft (70%), followed by the neck (11%), base (10%) and shaft (9%). The most common configurations are transverse and comminuted (both 47%), followed by oblique (5%). We found that 80% of fractures were managed conservatively, while 20% of fractures had K-wire and/or screw fixation. The average follow-up time for the three treatments was 2.8 months (range, 1 week – 23.4 months), 6.4 months (range, 3.7 – 9.3 months) and 7.7 months (range 2.6 – 14.9 months), for the conservative, K-wire and screw fixation procedures, respectively. For the conservative group, the X-ray union rate was noted to be 56%, while the mean time to X-ray union was 1.8 months (CI 95%, 1.3 – 2.3 months). The mean range of motion (ROM) of the distal interphalangeal joint at final follow-up was 54.2° (CI 95%, 50.4° - 58.0°). For the K-wire group, the union rate was 91%, with a mean time to X-ray union of 3.4 months (CI 95%, 1.8 – 5.0 months). The mean ROM of the distal interphalangeal joint at final follow-up was 48.9° (CI 95%, 37.4° - 60.4°). All the patients required a second procedure for removal of the K-wire. For the screw fixation group, the union rate was 100%, with a mean time to X-ray...
union of 2.9 months (CI 95%, 0.8 - 5.0 months). The mean ROM of the distal interphalangeal joint at final follow-up was 55.5° (CI 95%, 47.1° - 63.9°) and 35% of patients underwent surgery for removal of the screw. The difference in union rate between conservative versus screw or K-wire was statistically significant (z-test), but not for screw versus K-wire. No complications were encountered in this study.

Conclusion: Screw fixation and K-wire had a significantly better union rate, compared to conservative treatment. Although time to union was longer for screw fixation and K-wire compared to conservative, these results were statistically not significant. The functional outcome after screw fixation was best, followed by conservative and lastly, K-wire; however, the difference was not significant. In conclusion, screw fixation is a viable option for management of distal phalangeal fractures.

A-0285 Triangular fibrocartilage complex dorsal tear
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Purpose: We have noted various kinds of triangular fibrocartilage complex (TFCC) injury patterns according to the development of wrist arthroscopy. The dorsal tear of TFCC was first reported by Estrella et al. (2007); however, clinical appearance is still obscure. We report the clinical feature of TFCC dorsal tear.

Methods: We studied 13 wrists (4.9%) of dorsal tear in 268 traumatic TFCC tears. The patient age ranged between 15 - 44 years (average, 29 y), there were 9 male and 4 female patients, and 11 right wrists and 2 left wrists were involved. The associated injuries were subluxation of DRUJ, Galeazzi fracture-dislocation and distal radius fracture.

Results: Clinical symptoms were variable: tenderness at the ulnar-dorsal side, pain and locking while rotating the forearm, and ulnar head instability to the dorsal side. Axial view of magnetic resonance imaging (MRI) was effective for pointing out the dorsal tear; supinated dislocation of the ulnar head was often recognised. Other types of TFCC injury were often associated: there were three foveal tears, two ulnar styloid tears and two disc tears. Variable treatment was performed: eight arthroscopic repairs; two direct repairs; one each of ulnar shortening, debridement and cast immobilisation.

Conclusions: Palmer’s classification has been used for TFCC injury; however, as we noticed various kinds of TFCC injury, it is necessary to establish a new concept of TFCC injury patterns. A dorsal tear of TFCC, a new concept of injury, may be misdiagnosed if the surgeon does not keep this injury in mind. It is mandatory that the point of tenderness, MRI findings, suspicion of this injury and cautious arthroscopic procedure are used to make a diagnosis of TFCC dorsal tear and treatment.

A-0286 Reconstruction of hand and upper extremity using anterolateral thigh perforator flap
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The flap for reconstruction of the hand and upper extremity should have the following features: thin and pliable tissue for molding the contour, provide a gliding surface for tendon movement, and also have adaptability to the variable types of injuries. Recently, several flaps that are based on cutaneous perforators are commonly used. Among them, the anterolateral thigh (ALT) flap is the easiest and has the least associated morbidity. This study investigated the versatility of ALT perforator flap in reconstruction of soft tissue defects of the upper extremity and hand. There were 81 patients who had soft tissue reconstruction with the ALT perforator flap: there were 64 male and 25 female subjects aged 7 - 67 years (mean, 40 y). Types of flap used were as follows: cutaneous flap (79 cases), fasciocutaneous flap (5 cases) and musculocutaneous flap (5 cases). Flap size averaged 160 cm² (range, 24 - 459 cm²). There were 76 cases with musculocutaneous perforator and 13 cases with septocutaneous perforator. We used T-shaped pedicles to reconstruct and to preserve the major artery of the upper extremity, in 10 cases. The overall flap success rate was 97.5%. There were some complications related to flaps: seven cases of venous congestion required decompression of the pedicle and reanastomosis after exploration, two cases had total necroses, four cases had marginal necrosis of the flap that were treated by debridement and skin closure. Although three cases had donor site breakdown, it healed by secondary intention. The ALT flap is a versatile and useful flap for a variety of upper extremity soft tissue reconstruction.

A-0287 Prevention of nerve adhesions by alginate gel using a new experimental model of median nerve adhesion in the carpal tunnel
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**Introduction:** One of the major problems that occurs after peripheral nerve surgery is adhesion of the nerve, which is especially problematic following operations for recurrent carpal tunnel syndrome, because neurolysis is extremely difficult. The purpose of this study was to establish an experimental rabbit model of median nerve adhesion in the carpal tunnel, and to evaluate the ability of alginate gel to prevent nerve adhesions using this model.

**Materials and methods:**

**Study 1:** Establishment of a rabbit model of median nerve adhesion in the carpal tunnel. In the Adhesion Group, the median nerve of Japanese female white rabbits was exposed and elevated. Next, the surface of the neural bed was excised. The transverse carpal ligament was then replaced and sutured with 6-0 nylon sutures. Three weeks after surgery, electrophysiological function was evaluated at the compound muscle action potential of the thenar muscle, and histological examination of the carpal tunnel site was evaluated with hematoxylin and eosin (H&E) staining. Results were compared with those from the unoperated Control Group.

**Study 2:** Examination of the ability of alginate gel to prevent nerve adhesions. In addition to the same surgical steps mentioned above, conduct the bilateral, alginate gel was injected into the right carpal tunnel (Gel Group) and saline was injected into left carpal tunnel (Saline Group). At 1 week and 2 weeks after surgery, we evaluated microscopic and histological findings. Microscopically, adhesion was evaluated by the type of dissection required to achieve a complete neurolysis.

**Results:**

**Study 1:** Electrophysiological function in the Adhesion Group was significantly worse than that of the Control Group. The distal latency was 1.81 ± 0.2 ms in the control group and 2.20 ± 0.3 ms in the adhesion group. The amplitude was 7.77 ± 3.1 mV in the control group and 2.49 ± 1.5 mV in the adhesion group. Histological findings showed the disappearance of perineural adipose tissue and formation of intraneural and extraneural scar tissue in the Adhesion Group.

**Study 2:** Microscopically, dissection tended to be more difficult in the Saline Group than in the Gel Group. Complete neurolysis was achieved in all Gel Group rabbits; neurolysis was not possible with sharp instruments in some Saline Group rabbits. Histologically, there was a greater degree of perineural fibrosis and adhesion in the Saline Group rabbits at 1 and 2 weeks after surgery.

**Discussion:** We considered that our experimental model of median nerve adhesion was valid, because of the advanced adhesion, and the intraneural and extraneural tissue changes that we observed in Study 1. This model was considered to have greater similarity to clinical cases than past models using sciatic nerves, in which adhesion occurred between the nerve and surrounding muscles. Alginate gel seems to be effective in preventing nerve adhesions, as found in Study 2. Various materials to prevent the nerve adhesion were examined and we considered that alginate gel was ideal, because it is bioabsorbable and acts as a physical barrier. Our study will continue until the clinical application of alginate gel.

**A-0288 Biomechanical analyses of the Human Flexor Tendon Adhesion Model in the Hand: a cadaveric study**

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Trigger finger is one of the most common hand disorders, characterised by catching, snapping or locking of the involved flexor tendon, associated with dysfunction and pain. Patients with longstanding trigger finger may develop flexion contracture at the proximal interphalangeal (PIP) joint that persists, even after division of the A1 pulley. The purpose of this study is to verify the hypothesis that the flexion deformity of the PIP joint in advanced trigger finger results from severe adhesion between the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) tendons. The index, long and ring fingers of 10 fresh-frozen cadaveric hands were used for the experiments. After exploration and preparation of the extrinsic flexor, extrinsic extensor and intrinsic muscle tendons, the cadaveric hands were fixed on the custom-made frame. After we applied weights on the flexor tendons, we increased the tensions applied to the extrinsic extensor tendons using weights, and then measured the metacarpophalangeal (MCP) joint flexion angle in each condition. When the MCP joint was fully extended, then we started to increase the tension applied to intrinsic muscle tendons, using weights, and measured the PIP joint flexion angle under each condition. To make a flexor tendon adhesion model, we sutured the FDS and FDP tendons to each other around the A1 pulley and repeated this experiment. The initial flexion angles of the MCP and PIP joints in our adhesion model were greater than those of the adhesion-free state. The average tensions applied to the extrinsic extensor and intrinsic muscle tendons required for full extension of the MCP and PIP joints were greater in the adhesion models than in the...
adhesion-free state. When the same tensions were applied to the FDS and FDP tendons, the MCP and PIP joints were more flexed in the flexor tendon adhesion model. As a result, more tension was required on the extrinsic extensor and intrinsic muscle tendons for full extension of the MCP and PIP joints. These findings suggested that tenosynovectomy to release the adhered FDS and FDP tendons may be necessary, as well as A1 pulley release, for the surgical treatment of longstanding trigger finger with a fixed flexion deformity at the PIP joint.

A-0290 Nerve transfers in upper limb arthrogryposis

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Introduction: Nerve transfers are an important, selective neurotisation tool in severe proximal nerve injuries like brachial plexus palsy. They might be applied to other conditions. We present a potential indication in severe upper limb arthrogryposis, when shoulder muscles and elbow flexors are affected and joints not restricted.

Materials and methods: We considered four children with proven arthrogryposis and severe upper limb palsy for reconstructive surgery, including nerve transfers. On exploration of the anterior arm, only two of the children showed remnant biceps muscle mass, so a typical nerve transfer according to Oberlin could be performed.

Results: We show clinical results through range of motion (ROM) measurements and videos. Our preliminary results support the hypothesis that these techniques could be used in indications different from the classic brachial plexus or peripheral nerve lesions, and will change the paradigm in arthrogryposis treatment. In precise indications, early nerve and/or muscle transfers are helpful.

A-0292 Movement analysis of the upper limb

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Introduction: Objective motion and strength assessment is an important outcome measurement tool in upper limb and hand surgery. Our collaboration for over 15 years with biomedical engineers participated in the development of measurement tools for range of motion (ROM), painless EMG and muscle strength and related forces and torques on joints.

Materials and methods: The technology was applied to healthy volunteers and children affected by a severe upper limb nerve injury (obstetric brachial plexus palsy), both operated and non-operated.

Results: We showed that typical motion patterns in standardized movement sequences, patterns of muscular co-activation (co-contractions) and alterations in joint position modifying net forces and torques explained clinically well-known joint deformities.

Discussion: Motion analysis is much more than a video-assisted recording system, but a multifactorial analytic tool applicable in the planning and follow-up of complex reconstructive surgery procedures of the upper limb.

A-0293 Prospective multicenter trial of modified retrograde percutaneous intramedullary K-wire fixation for displaced metacarpal neck and shaft fractures

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Purpose: Few studies have investigated the effectiveness of retrograde intramedullary percutaneous wire fixation in treating unstable displaced metacarpal fractures. The authors devised a new technique, consisting of retrograde percutaneous insertion of intramedullary Kirschner wires at the metacarpal head, extraction of the end of wires proximally, and bending it dorsally. The purpose of this prospective multicenter study is to assess the clinical and radiographical outcomes of the newly-devised technique of retrograde intramedullary fixation with multiple K-wires in metacarpal neck and shaft fractures.

Methods: This prospective study involved 109 consecutive patients with 125 metacarpal fractures, which were treated operatively with the same procedure by three surgeons in three different centers. Under fluoroscopic guidance, the authors reduced the fracture using the Jahss maneuver. Once the fracture was reduced, a Kirschner wire was inserted through the metacarpal head, extraction of the end of wires proximally, and bending it dorsally. The purpose of this prospective multicenter study is to assess the clinical and radiographical outcomes of the newly-devised technique of retrograde intramedullary fixation with multiple K-wires in metacarpal neck and shaft fractures.

Discussion: Motion analysis is much more than a video-assisted recording system, but a multifactorial analytic tool applicable in the planning and follow-up of complex reconstructive surgery procedures of the upper limb.
proximal fragment. After insertion of the first Kirschner wire, one or two more Kirschner wires were inserted in the same manner, depending on the width of the intramedullary space or rotational stability. Next, with the wrist flexed maximally, the wires were advanced further through the dorsal subchondral bone of the metacarpal base, soft tissue overlying carpal bone, and dorsal skin, sequentially. Once the proximal end of wire penetrated and protruded from the dorsal skin, it was held by vice grip plier, which was then hammered during the distal end of the wire was located at the subchondral bone of the metacarpal head. After the rest of the wires were inserted in the same manner, the wrist was fully extended forcefully, with the proximally-protruded wires, in order to maintain the wrist in a more functional position. The average follow-up period was 10 months. The surgical outcome was assessed by clinical data consisting of range of motion (ROM); presence of rotational deformity; Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire; and by radiographic data consisting of dorsal apex angulation, shortening and the time to union.

Results: The average ROM in the metacarpophalangeal joint of the injured side was not significantly different from that of the uninjured side. There was no case of residual rotational deformity postoperatively, and the average DASH questionnaire score was 8.5 (range, 0 - 41). Average dorsal apex angulation and average shortening were reduced significantly, from 39.0° and 3.1 mm, to 9.7° and 0.0 mm, respectively, in neck fractures; and from 29.5° and 3.0 mm, to 7.0° and −0.1 mm in shaft fractures, respectively. Average time to union was 5.6 weeks. There were no cases of non-union.

Conclusions: Modified retrograde intramedullary fixation with multiple Kirschner wires is a straightforward and reliable technique that was successful in attaining good functional and cosmetic results, in addition to excellent bone healing.

A-0298 Reconstructive surgery of complicated consequences of elbow fractures

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An analysis of surgical treatment of 57 patients with consequences of intra-articular fractures of the distal meta-epiphysis of the humerus and proximal ulnar and radial epiphyses was made. The average age of patients was 39 years, and there were 25 men and 32 women. The term of admission to the hospital after injury was 5.7 months. Patients were divided into two groups: the first group consisted of 21 patients who had consolidation of the bones forming the elbow joint in the correct or riding position, but with contractures of varying degrees; in the second group, there were 36 patients with non-union or incorrect consolidation of the elbow joint bones. In all patients of this group, deformation of the elbow and significant limitation of motion were observed. In nine patients, we observed significant mobility at the level of non-union, which imitated movements of the elbow joint. Practically 40 - 45% of patients in the second group had indications for total elbow arthroplasty. In patients of the first group, we performed elbow arthrolysis. If necessary, we accomplished the operation with release and transposition of the ulnar nerve. In the second group, in case of consolidation in the wrong position, we performed corrective osteotomy, often with bone plasty, and stable osteosynthesis. If non-union occurred, bone autoplasty of the bone defect and osteosynthesis using the LCP system was performed. For revision and osteosynthesis of the radius head, we used lateral exposure. For osteosynthesis of the ulna, standard posterior exposure. Anterior exposure is rarely used, but it is necessary for osteosynthesis of coronoides, in the case of consequences of multi-fragmental fractures of the proximal ulna metaepiphysis. At the final stage of treatment of second group patients, after bone consolidation and restructuring, we made an elbow joint arthrolysis while removing plates, which allowed for significantly increasing of the range of motion (ROM) in the elbow. In all cases, after osteosynthesis or mobilisation, the upper extremity was fixed in the position of maximum extension. It is important that the patient should be under general anesthesia during the application of immobilization. In all patients, from the first days after the surgery, we used an active-dynamic rehabilitation program that included three periods of increasing movements in the elbow joint. In patients of the first group, satisfactory functional results were achieved: ROM in the elbow joint was 100 - 135°. In the second group of patients, the results were not so good, and the ROM in the elbow joint made up 75 - 110°. Deterioration of treatment results in the second group were due to the more severe initial state. In 41% of patients in both groups, we achieved almost full ROM of the elbow. Limitations in achieving full ROMs in the rest of the patients were associated with the impairment of the articular surface shape and the cartilage defects caused by inappropriate treatment in the previous stages.
A-0299 Latissimus dorsi transplantation to patients with Volkman’s ischemic contracture of the hand

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On the base of the Upper Limb Microsurgery and Reconstructive Surgery Department with the Institute of Health Improvement Technologies (IHIT) under the Academy of Medical Sciences (AMS) of Ukraine, 25 patients with severe ischemic contractures (IC) in the residual period received surgery within 1999 - 2012. A rapid development of microsurgery has led to changes in the treatment tactics for such patients as those having severe IC. Depending on the muscle grafting performed, the post-operative patients were divided into two clinical groups: the first group included 17 (68%) patients who had received a constrained muscle grafting on the ischemic limb and the second group included 8 (32%) patients with free muscle grafting. Out of the 17 first group patients, for recovery of the elbow joint and fingers flexion in 4 (26.7%) cases, the latissimus dorsi were used. To recover the elbow joint and finger flexion and to repair skin defects, a free grafting of the musculocutaneous flap of latissimus dorsi was used in the second group of patients. A transitory thermal ischemia lasted 2 hours and 10 minutes, on average. The treatment history was evaluated 2 years later in 14 (82.3%) patients with constrained muscle grafting and in 6 (75.4%) patients after free grafting. The long-term final results of the operative treatments were assessed over > 2 years in 22 patients of all clinical groups (88%). We used the AAOS (1994) score for functional assessment of our patients. The total gain in the ischemic upper limb function exceeded 42%, this being quite enough for the medico-social adaptation of this patient category.

A-0302 Radial forearm flap: possibilities in hand trauma sequences (anatomical search)

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Introduction: The main goal of the research is to evaluate if it is possible to use radial forearm flap on the distal vascular pedicle in palmar arch damage as hand trauma sequelae.

Materials and methods: Data of topographic anatomical research: 46 body, forearm and hand measures, 46 arteries of interest measures, 22 cases of precise preparation, 39 X-ray pictures of forearm and hand. In 16 cases of experimental radial forearm flap forming on the distal vascular pedicle, we performed X-rays of those flaps and photographed 49 cases.

Discussion: It was proved that in spite of two palmar arches, the radial artery forms three more groups of anastomoses with other forearm arteries and their branches. They are located in the lower front third of a forearm (Group 1), in the rear of radiocarpal joint (Group 2) and on the palm proximate to the profound palmar arch (Group 3). Group 1 includes arteries connecting radial artery to ulnar or anterior interosseous artery. They are located in the distal part of the front forearm, between two parallel lines, one of them connects the heads of styloid processes of the ulna and radius, and the other lies 5 cm proximal to it. Group 2 of radial distal anastomoses is located at the rear of the radiocarpal joint and includes the wrist dorsal arterial network formed with dorsal carpal branches of radial and ulnar arteries and terminal branches of the front and back interosseous arteries. Group 3 of radial distal anastomoses is localised on the front of the radiocarpal joint and proximal portions of palmar hand parts, proximal to the deep palmar arterial arch. It includes anastomoses of palmar arterial carpal arch (formed from one or two branches of the radial and ulnar arteries) and, in some cases, anastomotic branches from the front interosseous artery and from the deep palmar arterial arch. Herein, three groups of arterial anastomoses provided the blood supply in the radial forearm flap on the distal vascular peduncle, forming alongside with superficial and deep arterial arches. The additional blood supply could rise in cases of the palmar arterial arch’s damage or ligation, due to compensatory hypertrophy of intact distal radial artery anastomoses. When one or both palmar arches are damaged, there are two ways to mobilise the distal vascular peduncle of the radial forearm flap: the broadened variant, up to styloid processus of the radius; and the limited one, to the level of 5 cm proximal to this point. In the former variant, only the 2nd and 3rd groups of anastomoses were preserved; in the 2nd one, all three groups of distal vascular connections remain intact.

A-0303 Predictors of digital replantation outcomes

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Introduction: Traumatic finger loss can cause significant functional and aesthetic impairment. The impact on patients’ lives cannot be underestimated. This study evaluates the demographics, operative findings, outcomes and predictive factors for successful replantations in our unit.

Methods: Retrospective review of Saint Andrew’s trauma database identified all digital replantations between January 2006 and December 2010. Patient demographics, mechanism of injury, operative and outcome details extracted from medical records and hand therapy notes were recorded on a proforma and analysed using Pearson’s Chi squared test with a significance level set at 0.05.

Results: We identified 75 digital replantations in 53 patients with a mean age of 40.6 years. The circular saw was the main mechanism of injury (56%). The most frequently involved digit was the ring finger (45%); 50% of replanted digits were in Tamai zone 4. Survival rate was 70% (47/68). Return to theatre rate was 20.40%. We saved 7 digits out of 20. Venous congestion was the leading cause of replant failure, followed by acute ischemia. Mean sensory recovery was 7.9 mm (range, 3 - 15 mm), TAM 112°, and the DASH score 27.49 at an average of 36 months follow-up.

Conclusions: In a univariate analysis smoking history, score 27.49 at an average of 36 months follow-up.

Objective: To evaluate patients’ long-term satisfaction after supraclavicular first rib resection for thoracic outlet syndrome (TOS).

Methods: A previous retrospective review of data on 145 patients whom had undergone supraclavicular first rib resection for thoracic outlet syndrome by our same surgeon revealed 82% good overall post-operative results. To evaluate the patients’ long-term satisfaction, all available addresses were checked. A standardised and a Quick-DASH questionnaire were sent by post to 100 patients whose addresses were presumed to be still correct.

Results: By now, 58 patients have returned these questionnaires (58%). The mean patient age at operation was 43 years (range, 13 - 64 y), and 70% of them were female. A total of 10 patients had bilateral operations (17%), with a total of 68 first rib resections performed at an average of 10 years ago (range, 0.5 – 22 y). Currently, 50 had correctly completed the Quick-DASH questionnaires and were available for evaluation: the mean score was 21. We found that patients are very satisfied (57%) or satisfied (30%), whereas seven patients were not satisfied with the operative result. A total of 87% of the operated sites were considered symptom-free (37%) by the patients, or significantly improved (50%). In six operated sites, symptoms were reported to be unchanged after the operation, and three times a patient had complained of being worse off than before. A total of 51/58 patients would undergo the operation again (88%). The 12% who considered the operation a failure showed a mean Quick-DASH score of 63, whereas the satisfied patients willing to undergo the operation again had a mean Quick-DASH score of 13. The data of the patients not satisfied with the operation will be analysed in detail, in order to detect pre-operative predictive factors for a poor outcome.

Conclusion: Supraclavicular first rib resection for thoracic outlet syndrome offers consistently good long-term results with high patient satisfaction.

A-0319 Mid-term results of STTI pyrocarbon implant in management of isolated STT arthritis

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Introduction: Isolated scaphotrapeziotrapezoidal (STT) osteoarthritis is rare. Its prevalence is estimated between 2 - 16% and it often remains asymptomatic. Physiology, anatomy and biomechanics of the STT joint remain partially understood, especially when arthritic changes occur; however, several authors agree that STT arthritis leads to carpal deformation with dorsal translation of the lunate. Most of the time, medical treatment is efficient and surgery is only indicated when conservative treatment fails to release the pain. STT arthrosis was the first described procedure; but latter excisional arthroplasty with or without interposition was preferred, because it was less technically demanding, gave less stiffness and had fewer complications. The major drawback of this arthroplasty remains the post-operative carpal deformation that can occur. The pyrocarbon interposition implant STPI (Tornier, Bioprofile©) was designed with the aim to prevent this instability. There are only a few series focusing on
this implant and no comparative study exists between excisional arthroplasty and STPI. The purpose of this study was to evaluate the results of patients with STPI interposition and compare their results to the literature.

**Patients and methods**: We conducted a retrospective multicentric study on patients who underwent an interposition arthroplasty with STPI in two academic centers, between 2006 and 2012. We evaluated pain, grip and pinch strength, mobility, Quick Dash questionnaire and postoperative satisfaction. X-rays with the wrist in a neutral position were also performed for post-operative DISI measurement. Statistical analysis was performed using the Wilcoxon and Mann-Whitney non-parametric test.

**Results**: We included 21 wrists on 17 patients in the present study, with a median follow-up period of 42 months (range, 25.5 - 48). Both the pain and the Quick Dash score were significantly improved. Seven implant’s luxations were observed, leading to a reoperation for implant removal. Concerning the radiological assessment, the implant didn’t seem to prevent the midcarpal instability.

**Discussion**: When compared to the literature, our clinical outcomes seem to be equivalent to others STPI interposition series, though we had more luxation cases and a higher rate of postoperative midcarpal deformity. Compared to the excisional arthroplasty, clinical outcomes seem comparable, except in terms of mobility: that seems in favor of excisional arthroplasty. The removal of the implant, however, might lead to a more important midcarpal deformity than when excisional arthroplasty was performed in first intention. The small sample of this study associated to its retrospective nature remains a limit to the data analyses.

**Conclusion**: This study doesn’t allow the authors to conclude the benefit of the implant, compared to excisional arthroplasty. Even if the clinical outcomes seem similar, the post-operative midcarpal deformity doesn’t seem improved by the implant and mobility appears lower. It could be interesting to investigate a prospective study, in order to compare these two surgical techniques and to assess if there is an advantage of using the STPI implant to prevent the post-operative midcarpal deformity.

**A-0321 Sonography before and after carpal tunnel release**

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**Hypothesis**: This prospective study is to compare the measurements of the median nerve and the carpal tunnel (CT) in patients before and after surgical release in carpal tunnel syndrome (CTS).

**Methods**: One unblinded examiner saw 48 patients scheduled for surgical release for CTS (28 female subjects, mean age 56.3, range 25 - 86) for sonography of 26 right wrists’ CT. Patients were seen before, 2 weeks and 1 month after surgery. We used a 5 - 16 MHZ probe from Sonosite. Transverse sonograms were made at 3 levels: radiocarpal, lunocapitate and carpometacarpal joint. The longitudinal image of the CT was captured when the nerve was seen through the tunnel. The images were analysed by three technicians, who measured the following, using direct tracing: Cross sectional area of the nerve (CSA) at the entry, the nerve angle inside the CT, the height and width of the nerve from which the Flattening Ratio (FR) was calculated and the thickness of the TCL at its thickest portion. Data were transmitted for statistical analysis with Pearson’s X-test and ratio calculations. We consider differences as significant in dimension and ratio when p < 0.05.

**Results**: Mean CSA preoperatively was 11.03 mm² and got slightly better [10.7]. Flattening ratio was better, from 3.25 to 3.05, but only 60% of the cases got better. Nerve angle improved dramatically, from a mean of 9.8° to 2.1°: this is the only criteria that allows to follow carpal tunnel after surgical release. All patients had less that 4° kinking after release; this measure is specific and sensitive.

**Summary points**: Thickening of the distal part of the transverse carpal ligament is the cause of CTS and its transection corrects the nerve angle. It is generally admitted that compression is the cause of CTS and in this study we demonstrated that kinking of the median nerve is the main problem and that its correction treats CTS. This needs reflection, and can lead us to think about new treatment options that can correct the nerve angle or TCL thickening.

**References**

A-0322 Sonographic-aided surgery in the hand

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Hypothesis: Ultrasound is widely used for diagnosis purposes in hand problems. With high frequency probes, ultrasound imaging is used in first line, in most common pathologies. Three-dimensional (3D) reconstruction of soft tissue can easily be done pre- and perioperatively. Surgery, especially releases, can be done guided with sonography. The advantages are that the tissue to be transected is seen in 3D and the surgery is minimally invasive; however, reliable detection of the instrument is a prerequisite for safe and efficient ultrasound-guided surgery. This study presents the research work that led to the development of echogenic instruments and their use in the operating room.

Method: The instrument: the intensity of the reflected ultrasound depends on the surface of the instrument, so different coatings and grooves have been tested in laboratory. The brightest part of the instrument, which look like a tuning fork, was placed at the bottom part. The fork can be introduced on the tissue to be cut. The blade is then introduced between the two parts of the fork. The imaging: we used a free hand 2D probe, 5 - 16 MHZ. The probe is placed transversally at different levels, then longitudinally. We therefore have a proper preoperative view of the operative field. During the procedure, we again use the 2D probe in the two planes. The procedures: our practice has used different operations since 6 months ago and we report here: 25 trigger finger releases, 5 Degervain, 20 aponeurotomy, 10 carpal tunnel release and 5 PIP arthrolysis.

Results: Time of surgery: mean time in the operating room (OR) did not change (mean time of traditional or endoscopic surgery is 30 minutes in the OR). Post-op care: due to minimal incision, post-op care was reduced to 3 days. Return to activities of daily living: this was reduced from 10 to 5 days. Cost of surgery: the cost of the procedure was reduced by 30%.

Summary points: Image-guided surgery is becoming more frequent with high-frequency ultrasound. Preoperative imaging in the OR is common and the use of a specific instrument will allow us to perform most of the soft tissue releases sooner.

A-0324 Minimally-invasive stabilization of upper limb pathological fractures with an intramedullary polymer

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Introduction: Pathological fractures of the upper limb seriously affect quality of life and nursing care. The therapeutical aim is to achieve pain relief, allowing mobilization preferably without extensive surgical procedures.

Materials and methods: Through a small incision using the Seldinger-technique, a Dacron balloon catheter is inserted into the medullary canal after reaming with a flexible cannulated drill. The balloon is filled with a liquid non-toxic plastic monomer. After confirmation of the correct positioning of the intramedullary device, with image intensification curing of the monomer using a visible blue light (wavelength 436 nm) through a fiber optic cable, we achieved within 400 - 600 seconds the creation of a customized intramedullary rod, comparable in strength to steel or titanium. The Dacron balloon contains the entire monomer during the hardening process. The balloon adapts to the often irregular shape of the medullary cavity. After the curing process and polymer formation, a locking screw may be inserted through the implant and bone, to increase rotational stability.

Results: We treated 12 long bone pathological fractures of the upper limb in 10 patients (humerus 8x, radius 2x and ulna 2x). There were 8 female and 2 male patients, with an average age of 73.3 years. In all cases, the pathological fracture occurred in a compromised bone segment with a minimum length of 3 cm. Primary pathologies consisted of: breast cancer, prostate cancer, plasmocytoma and lung cancer. The average operating time was 53 minutes, and all implants were inserted through incisions of 15 mm or less. Stabilisation allowed immediate post-operative physiotherapy and use of the upper limb, in all patients. No revision had to be carried out during the survival period of the patient, which was influenced by the primary pathology.

Conclusion: Minimally invasive treatment of pathological fractures using an intramedullary polymer implant is suitable to manage pathological fractures affecting one or more sections of long bones in the upper limb. The radiolucent polymer allows radiological visualisation of the entire bone and facilitates radiation therapy in select cases. Stability may be increased with transverse locking screws placed at any position of the implant, as determined by anatomical safe zones.

A-0326 Reconstruction of extensive arm defects with free flaps

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Extensive arm defects due to burn, trauma, infection and tumor ablation are challenging problems for the reconstructive surgeon when dominant hands are involved, because it cannot be replaced by a prosthesis, as in the lower extremities. Flap reconstruction is inevitable in this situation; however, a large dimension of flap is difficult and can cause various complications. Therefore, the sharing of experiences on this topic is helpful for managing extensive arm defects. Eight patients with extensive arm defects underwent reconstruction between January 2008 and March 2012. Inclusion criteria were: circumferential defects which size over 200 cm² from upper arm to forearm. Cases of hand defects and small defects were excluded. Patient’s data regarding defect size, flap character, flap size, complications, combined procedures and follow ups were retrospectively reviewed. A total of 10 flaps were performed on eight arms. Six latissimus dorsi perforator or chimeric flaps, three anterolateral thigh flaps and one deep inferior epigastric artery perforator flap, and achieved aesthetic and functional results. Extensive defects in the extremities result in complex defects that are characterized by bony fracture, muscle destruction, skin and soft tissue defects, and compromised vascularity. Choosing an appropriate flap is essential for skin and soft tissue defects, and compromised vascularity. Extensive defects in the extremities result in complex defects that are characterized by bony fracture, muscle destruction, skin and soft tissue defects, and compromised vascularity. Choosing an appropriate flap is essential for functional and aesthetic reconstruction. Furthermore, it is difficult to make a 3-dimensional reconstruction when circumferential defects were found. We performed total arm resurfacing using a latissimus dorsi flap in a chimeric pattern, or combined with anterolateral thigh flap or deep inferior epigastric artery perforator flap, and achieved aesthetic and functional reconstruction.

A-0327 Length of medial collateral ligament in elbow osteoarthritis
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Purpose: Range of motion (ROM) in elbow osteoarthritis is restricted by bone and soft tissue problems. Imaging tools can estimate the bone factor, but not soft tissue; thus, the extent of soft tissue factor effect on the motion range limitation is obscure. We simulated the length of a medial collateral ligament, which may be a cause of the ROM limitation.

Materials and methods: We enrolled 8 patients, 8 elbows of osteoarthritis, with computed tomography (CT) taken in the fashion described below, in this study. Their mean age was 43 years (range, 32 – 63 y), and all were men. According to Rettig’s classification, one was Class I, four were Class II, and three were Class III. CT was taken in three positions: maximum extension, flexion of 90° and maximum flexion; and these data were reconstructed into 3-dimensional (3D) surface images of the humerus and the ulna. Screw axes of flexion and extension ranges were calculated, and two images, the extension 0° and flexion 140°, were simulated by rotating the ulna around the axes. Four parts of medial collateral ligament, the anterior edge (AOLa) and the posterior edge (AOLp) of anterior oblique ligament and the distal edge (POLd) and the proximal edge (POLp) of the posterior oblique ligament were investigated, and their insertions were pointed on the humerus and the ulna. The length of these ligaments was calculated in five positions: extension of 0°, maximum extension, flexion of 90°, maximum flexion and flexion of 140°. The length of ligaments was calculated as the shortest distance between the two insertions, circumventing the osseous protrusion.

Results: AOLa was almost isometric, with the exception of one patient of Rettig Class III, whose ligament elongated along with flexion. Axis displacement influenced this elongation. AOLp, POLd and POLp elongated along with flexion, and this was notable in POLp. In maximum flexion to flexion of 140°, the length of POLp tended to elongate more in patients of more severe Rettig’s classification, due to axis displacement and osteophyte protrusion.

Discussion: In more severe Rettig’s classification, the posterior oblique ligament becomes taut in flexion, and the isometry collapses by the axis displacement; thus, these factors may restrict the range of motion in elbow osteoarthritis.

A-0329 Result of capito-hamate lengthening osteotomy fixed with Herbert screw to compensate for decreased carpal height in advanced Kienbock’s disease
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Introduction: In Kienbock’s disease, Stage IIIB, collapse of the lunate results in decreased carpal height as the capitate moves proximally, with subsequent decrease of the space between the radius and the trapezium that is linked to the capitate. As the latter space is occupied by the normally volarly inclined scaphoid, this space reduction results in increased scaphoid flexion with subsequent arthritis at the radio-scaphoid joint. Traditionally, treatment aims at...
correcting scaphoid malrotation and keeping it in position by scapho-trapezio-trapezoid (STT) fusion. Our hypothesis was that it is more logical to correct the primary decreased carpal height, rather than the secondary scaphoid malrotation. This was accomplished through capitate and hamate (as the capitolhamate joint is immobile) lengthening osteotomy, to increase the space between the trapezium and the radius back to normal, with better accommodation of the scaphoid and decreasing its palmar flexion. The osteotomy was lengthened by impacting a tricortical iliac crest bone graft through the osteotomy, and its fixation with a Herbert screw, thus allowing early wrist movement.

Patients and methods: Between August 2005 and February 2010, we treated 19 patients with Kienbock’s disease Stage IIIB. They were 14 male and 5 female subjects with an average age of 25.6 ± 2 years (range, 20 - 34 y). Average total wrist movement arc was 58.2º ± 3º (range, 45º - 65º), with average dorsi-flexion of 37.6º ± 3º (range, 25º - 45º) and average palmar flexion of 19.3º ± 2º (range, 15º - 25º). Hand grip strength had a mean of 47% of the contralateral side (range, 35% - 55%). Plain X-ray films showed decreased carpal height and increased radioscapoid angle (average 73º ± 3º; range, 65º - 80º). Through a transverse dorsal approach of the wrist, a transverse osteotomy was made at the capitate waist and hamate. Tricortical iliac crest bone graft was inserted in the osteotomy gap (made by traction on thumb and index), to lengthen the capitate to the extent that the radioscapoid angle was corrected under the image intensifier. Herbert screw was inserted in antegrade fashion, i.e. from a proximal toward distal direction, through the capitate, across the graft. Movement was begun 10 days post-operatively.

Results: The average follow-up period was 38 ± 2 months (range, 30 - 45). No pain was reported by 16 patients and a mild ache in three. Average postoperative total wrist movement arc was 79.5º ± 2º (range, 60º - 90º) [P = 0.03, compared with pre-operative], with average dorsi-flexion 44.6º ± 2º (range, 35º - 55º) and average palmar flexion 38.3º ± 1º (range, 25º - 45º). Grip strength had a mean of 77% of that of the contralateral side (range, 55% - 85%) [P = 0.09, compared with pre-operative]. The average radio-scaphoid angle was 48.8º ± 3º (range, 40º - 55º) [P = 0.05]. Radiological healing of the osteotomy was confirmed in 17 patients, with no significant symptoms in the others. The Mayo modified wrist score improved from a mean of 58 ± 2 (range, 50 - 65) preoperatively, to 83 ± 2 (range, 70 - 90), postoperatively [P = 0.04].

Conclusions: In advanced Kienbock’s disease, capitolhamate lengthening osteotomy restores carpal height, thus correcting scaphoid overflexion. Fixation with a Herbert screw permits early postoperative motion, to avoid stiffness and ensure healing of the osteotomy through compression.

A-0331 Tension band wiring for medial and lateral columns in open reduction and internal fixation of supra-condylar distal humeral fractures in adults

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Introduction: In adults, supracondylar distal humeral fractures are not as common as in the pediatric population. Adult elbows do not tolerate immobilisation as well as pediatric elbows do, because the former are more liable to experience stiffness. So these fractures require rigid internal fixation, to allow early post-operative elbow movement. Internal fixation using plates and screws is not stable, as the distal fragment is cancellous, with weak screw-holding grip and also, it is small in size, with most of its surface covered with articular cartilage, so that only a few screws, sometimes a single one, can be inserted through it. Smooth Kirschner wires are not rigid enough and require prolonged postoperative immobilisation, with subsequent stiffness. Tension band wiring (TBW) using two stiff kirschner wires with a figure of eight stainless steel malleable wires applied to medial and lateral columns of the distal humerus are ideal, especially when applied to the tension dorsal surface of the distal humerus, as the latter is normally bent anteriorly, creating volar compression and dorsal tension surfaces. This technique permitted early postoperative elbow movements, especially flexion, to exert compression across the fracture site through the dorsally-placed tension device. Restoring flexion is more important than extension, as the latter can be compensated for by shoulder and torso movements, while the former can be compensated for only through excessive wrist and neck flexion, which is not tolerated in the long term.

Patients and methods: We treated 16 patients, 12 male and 4 female, with an average age of 28.5 years old (range, 17 - 49 y) having unstable supracondylar humeral fracture, were treated through open reduction and internal fixation using bilateral TBW. Two of these patients had associated olecranon fractures of the same elbow. All injured elbows were totally healthy prior to the trauma. Through a posterior approach of the elbow, the fracture was exposed using triceps reflecting approach, except when associated with olecranon fracture, where the humeral
fracture was reached through the fractured olecranon. A drill hole was made in each column proximal to the fracture site, and a stainless steel malleable wire was passed through each hole. The fracture was reduced with each column fixed in retrograde fashion, i.e. from a distal-ward to proximal-ward direction, with two stiff Kirschner wires around which the stainless steel wire was tensioned as a figure-of-eight band. The ulnar nerve was transposed to the anterior of the elbow, to avoid its possible irritation by the hardware. Elbow movements were encouraged as few days postoperatively as tolerated by the patients.

**Results:** Average follow-up period was 22 months. Fractures healed within an average of 12.5 weeks (range, 10 - 15). Average elbow flexion/extension arc was 108º (range, 100 - 120º). Average hand power grip was 82% of the other side (range, 68 - 93%). The Mayo elbow performance score had an average of 86.8 points.

**Conclusions:** In a supracondylar humeral fracture in adults, dual tension band wiring for both columns, applied to the posterior aspect of the distal humerus, seems to offer a simple yet rigid fixation technique that allows early postoperative elbow movement.

**A-0336 Ultrasound-guided closed reduction of distal radius fractures**

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**Purpose:** To assess the accuracy and ability of ultrasound-guided closed reduction for distal radius fractures.

**Methods:** We enrolled consecutive patients undergoing ultrasound-guided closed reduction of an acute displaced distal radius fracture at our department. The control group was extracted from patients who underwent a closed reduction for a similar fracture, under the fluoroscopy. To confirm the accuracy of the ultrasonography measurements, displacement distance values were compared with those on the radiographic imaging, before and after reduction. X-ray parameters for pre- and post-reduction, and the clinical outcomes, were compared between the ultrasound-guided and control groups.

**Results:** The ultrasound-guided group consisted of 38 patients (mean, 68 years old) and the control group consisted of 31 patients (mean, 72 years old). The displacement distances of the distal radius fractures were measured, with no significant differences between radiographic and ultrasound measurements. In the X-ray parameters for pre- and post-reduction and in the clinical outcomes, there were no significant differences between the two groups.

**Conclusions:** Ultrasound examination had the ability of successful reduction for distal radius fractures, as well as the fluoroscopy. Ultrasonography is a useful device for easy guidance of the closed reduction, instead of using fluoroscopy.

**A-0347 The functional outcome of a distraction plate for comminuted intra-articular distal radial fracture**

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**Introduction:** The use of a distraction plate, combined with bone-grafting when needed, was due to the extensive metaphyseal and diaphyseal comminution or failure to achieve stabilisation with conventional surgical methods.

**Methods:** Eighteen patients who had extensively comminuted distal radius fractures were treated with an extra-articular dorsal distraction plate from the radius to the third metacarpal. Cases of complication, such as extensor tendon rupture, were recorded. The functional outcome was measured by using the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire score, overall patient satisfaction, grip strength and the range of motion (ROM). Results were correlated with the length of time that the distraction plate was in situ.

**Results:** All fractures united at the end of follow-ups. An average DASH score was 35 at the 1-year point (range, 11 – 56). Plates were removed post-operatively, at 4 - 6 months. The duration of immobilisation did not correlate with the ROM nor DASH score at 1 year. There were two cases of EPL rupture reported, before the distraction plate was removed.

**Conclusions:** The use of a distraction plate can be an effective technique to treat fractures of the distal radius with extensive comminution, or failed conventional surgical treatment. Despite a prolonged period of immobilisation, a functional ROM can be achieved.

**A-0349 Shaft fractures to both forearm bones: the outcomes of surgical treatment with the platings and a combination of plating and intramedullary nailing**

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**Introduction:** There is a difficulty in the management of fractures involving both the radius and ulna, which cannot be managed with a single plate. The aim was to evaluate the outcomes of surgical treatment of both radius and ulna fractures with plating and combination of plating and intramedullary nailing.

**Methods:** A retrospective review of 61 consecutive patients who had a fracture involving both radius and ulna, which were treated with the platings and a combination of plating and intramedullary nailing was conducted. The functional outcomes and complications were assessed.

**Results:** The mean follow-up period was 24 months. The mean time to union was 12 weeks. The mean DASH score at 1 year was 30. There were no complications related to the implants.

**Conclusions:** The use of surgery with plating and combination of plating and intramedullary nailing is a viable option for the management of both radius and ulna fractures.
Purpose: Plating is the most commonly used technique for the treatment of shaft fractures of both forearm bones (SFBFBs). However, all fractures are impossible to be treated with the platings, because of soft tissue injuries, the fractures’ pattern or the patients’ condition. The purpose of this study is to compare the functional results between both platings and combining a plating and intramedullary (IM) nailing in SFBFBs.

Materials and methods: We retrospectively reviewed 56 cases that were surgically treated for SFBFBs from June 2007 to July 2012. In this study, we included 47 cases that were followed up after 12 months. All SFBFBs were divided into two groups, by their methods for internal fixation: both platings (Group A) and a combined plating and IM nailing (Group B). The method for internal fixation was intraoperatively selected. The plating was considered as the first option in all fractures, but the combined plating and IM nailing was applied as the second option, if both platings were impossible. Group A had 31 cases and Group B had 16 cases. The functional results were evaluated with the Grace and Eversmann rating system, and the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire.

Results: In Group A and B, a radiologic union was achieved in 30/31 and 14/16 cases, and the average union time was 11.1 and 17.8 weeks, respectively. According to the Grace and Evermann rating system, Group A had excellent results in 15 cases, good in 14, acceptable in 1 and unacceptable in 1. Group B had excellent results in 3 cases, good in 9, acceptable in 2 and unacceptable in 2. The average DASH score was 7.1 (range, 0 - 19.2) points in Group A and 15.1 (range, 0 - 29.6) points in Group B. Three unacceptable cases with non-union achieved a bony union by additional procedures, and the functional results of those were improved, as good or excellent.

Conclusion: The functional results and the average time to fracture union were more superior in Group A than Group B; however, we think that the combined plating and IM nailing is a useful method for SFBFBs that could not be fixed with both platings, because the difference between the two groups is not big.

A-0350 Surgical treatment of finger proximal interphalangeal joint fracture-dislocation with dynamic external fixation

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Purpose: Fracture-dislocation of the proximal interphalangeal (PIP) joint is a serious injury that can result in poor outcome if underestimated and inadequately treated. It can be treated with extension-block splinting, dynamic traction or open reduction and internal fixation; however, good results cannot always be expected. We present the outcome of dynamic external fixation (DDA2 External Fixator, Medical Engineering System, Tokyo, Japan) treatment for such injury.

Methods: Between July 2011 and August 2013, 16 consecutive patients with a mean age of 37.5 years (range: 15 - 80 y) were treated with dynamic external fixation for the PIP joint fracture-dislocation. The average time from injury to surgery was 5.0 days (range, 2 - 9 d). For the depressed fragments of the base of the middle phalanx, percutaneous transmedullary reduction (Hintringer procedure) was performed adjunctively.

Results: The mean range of motion (ROM) of the PIP joint was 92°. The average score of quick-DASH was 8. Grip strength was 94% of that of the unaffected hand. The average score on the visual analog pain scale was 0.4.

Discussion: Dynamic external fixation can maintain both a concentrically reduced joint and a reduced position of bone fragments by distraction, while allowing for early motion. For the depressed fragments of the base of the middle phalanx, percutaneous transmedullary reduction was effective in advance of external fixation. External fixation is a simple and effective modality for PIP fracture-dislocation. In combination with percutaneous transmedullary reduction, it can be applied for most cases of PIP fracture/dislocation.

A-0351 The Effect of rhBMP-2 and VEGF in a Vascularized Bone Allotransplant Experimental Model based on surgical neoangiogenesis

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We have demonstrated survival of living allogeneic bone without long-term immunosuppression, using short-term immunosuppression and simultaneous creation of an autogenous neoangiogenic circulation. In this study, bone morphogenic protein-2 (rhBMP-2), and/or vascular endothelial growth factor (VEGF), were used to augment this process. Femoral diaphyseal
bone was transplanted heterotopically from 46 Dark Agouti to 46 Lewis rats. Microvascular repair of the allotransplant nutrient pedicle was combined with intra-medullary implantation of an autogenous saphe nous arteriovenous [AV] bundle and biodegradable microspheres containing buffer [control], rhBMP-2 or rhBMP-2 + VEGF. We gave FK-506 daily for 14 days and maintained the nutrient pedicle flow during angiogenesis. After an 18-week survival period, we measured angiogenesis [capillary density] from the AV bundle, cortical bone blood flow [hydrogen washout], bone formation [histomorphometry] and the osteoblast count [histology]. Angiogenesis and cortical blood flow measures were greater in the combined [rhBMP-2 + VEGF] group than in the rhBMP-2 and control groups \( p < 0.05 \). Osteoblast counts were also higher in the rhBMP-2 + VEGF group \( p < 0.05 \). A trend towards greater bone formation [histomorphometry] was seen in both rhBMP2 + VGF and rhBMP2 groups, as compared to the controls \( p = 0.059 \). Local administration of VEGF and rhBMP-2 augments angiogenesis, osteo blastic activity and bone blood flow from the implanted blood vessels of recipient origin in vascularized bone allografts.

A-0354 Economic analysis of surgical and conservative treatment for trapeziometacarpal osteoarthritis: a prospective cohort study investigating health care costs and loss of productivity

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Objective: To analyze the economic aspects of conservative and surgical treatment of patients with trapeziometacarpal osteoarthritis [TMC OA], with regard to costs associated with health care and with loss of productivity.

Methods: In this prospective observational study, patients diagnosed with TMC OA who received either conservative [corticoid injection] or surgical treatment [trapeziectomy with ligament reconstruction, and tendon interposition or arthrodesis] were included. At baseline and 3, 6 and 12 months after the intervention, patients filled out the Work Productivity and Activity Impairment Questionnaire [WPAI], to assess absenteeism, presenteeism and overall costs due to loss of productivity for 1 week. Health care costs were measured using the earnings of our clinic in Swiss Francs (CHF). As of 29 November 2013, the conversion rate from CHF to Euro is 0.81, to USD is 1.10, and to UK Pound is 0.68.

Results: We included 161 patients, of whom 103 received surgery. Health care costs for the surgically-treated patients were a mean 10,303 CHF (± 3730), compared to 622 CHF (± 337) for the conservative treatment. Costs for weekly overall loss of productivity significantly decreased in the surgical group, from mean 1776 CHF [± 1033] at baseline, to 907 CHF [± 806] at 1 year \( p \leq 0.001 \). Related costs for the conservative group were 1829 CHF [± 861] at baseline, and 1621 CHF [± 831] at 1 year \( p = 0.415 \). Between both groups, no differences regarding absenteeism, presenteeism nor overall costs due to productivity loss were found at baseline and 6 months [for all: \( p > 0.05 \)]. At 3 months, the patients who underwent surgery had an overall loss of productivity of 64%, while conservatively-treated patients had 38% \( p = 0.022 \). In contrast, at 1 year, the patients treated conservatively reported a 48% loss of productivity, which is significantly more than in the surgical group, who reported only a 25% loss \( p = 0.012 \).

Conclusions: Surgery is expensive, regarding health care costs and short-term absenteeism due to sick leave; however, the costs for loss of productivity 1 year after surgery are significantly lower, compared to baseline, and compared to patients treated conservatively. Although differences in health care costs and loss of productivity were found between both groups, no treatment recommendation can be made, because the indications for injection and surgery are different. Further studies, at best with a randomized design, should focus on a cost-utility analysis of different surgical options.

A-0355 Ulnar collateral ligament injury in the thumb: MRI classification and treatment prognosis

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Damage to the ulnar collateral ligament [UCL] of the thumb is a common injury that requires thorough assessment to identify the presence of joint instability that could herald the presence of a Stener lesion. Accurate diagnosis under these circumstances is important, as the Stener lesion cannot heal by splintage alone and mandates operative repair. Clinical examination and plain/stress radiographs are useful tools in the initial assessment of these injuries, but their prognostic value lies mainly in the identification of stable joints that can be treated conservatively. Neither can one identify the presence or absence of a Stener lesion, nor predict
the outcome of splintage, when the joint is found to be unstable. This frequently leads to operative exploration of the unstable joints on a presumptive basis, for fear of missing an injury that has no prospect of healing by conservative measures. More definitive information on the nature of the ligament injury has come from the use of adjunctive scanning, using ultrasound and magnetic resonance imaging (MRI). In this context, MRI delivers clear images of the UCL and newer extremity-specific coils can now resolve ligament tears down to the millimetre. Work in the literature using MRI in thumb UCL injury suggests several discreet sub-types of injury, ranging from partial tears through degrees of complete tear displacement, and ending with the Stener lesion. This present study sought to reconcile the initial MRI findings in 42 cases of UCL injury, with the clinical course of each patient from presentation to successful resolution, via either operative or conservative routes. Initial treatment was conservative in all cases except where MRI demonstrated a Stener lesion, which was repaired surgically at presentation. We found that patients with undisplaced and displaced UCL tears of less than 3 mm typically healed by splintage, whilst conservative management in cases of >3 mm displacement was nearly always unsuccessful. These patients subsequently required secondary operative repair, in the same manner as the cases initially identified with a Stener lesion, and all subsequently healed uneventfully.

From these data, we helped define the degree of UCL displacement that can be expected to heal without operative intervention; and by association, to better identify those patients whom actually need surgery and those whom can be confidently splinted. To aid the practical application of this work, we have proposed a treatment-oriented, 4-stage MRI classification of thumb UCL injury, which is both reproducible and easy to use. The spectrum of unlar collateral ligament injuries as viewed on MRI of the metacarpo-phalangeal joint of the thumb.

A-0356 Mal-rotation after upper limb long bone fracture and its treatment

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Introduction: Mal-rotation after a long bone fracture is not corrected spontaneously. Patients sometimes complain of limitation of ADL or cosmetic troubles and visit orthopaedic surgeons to seek treatment option.

Purpose: We summarize our experiences of treatment for mal-rotation of upper limb long bone fracture to clarify clinical prognosis and surgical results of those patients.

Materials and methods: Since 2007, we have been visited by 12 patients seeking a treatment option or second opinion for their rotational deformity, after upper limb long bone fracture, excluding internal rotation deformity with cubitus varus after supracondylar fracture of the humerus. The original fracture site was the forearm in six cases and hand in six cases. Correction osteotomy was performed in nine cases (four in the radius, one in the ulna, three in the metacarpus and one in basal phalanx) and three cases were treated conservatively (one child forearm, one basal phalanx and one mid-phalanx).

Results: One child rotation-angulation deformity after both forearms’ bone fracture was remedied in 6 months. She obtained full rotational arc of motion in her forearm, without any cosmetic problem. Two patients with mild rotation of the phalanx (10° in basal phalanx and 15° mid-phalanx) did not want further surgical correction, because of endurable functional or cosmetic problems. We performed correction osteotomy in another nine cases. In four cases of hand fracture, simple vertical osteotomy and rotational correction around the MP joint, with crisscross pinning augmented by circular wiring, was performed. Results were acceptable without any complication (full grip and full extension of the involved finger, without overlapping with the adjacent one). In the forearm deformity, precise correction was not always easy. Residual mal-rotation or poor adaptation of the distal radio-ulnar joint was observed in two cases, resulting in limitation of forearm function (30° and 70° loss of supination). After that, we introduced preoperative simulation of three-dimensional (3D) corrective osteotomy, assisted by personal computer (1). Three patients’ forearm deformity (one ulna and two radius) were corrected with use of this system, and the functional results were quite favorable (no limitation of forearm, wrist and elbow motion).

Conclusion: In finger mal-rotation cases such as overlapping of the fingers after metacarpus fracture, simple peri-articular osteotomy is an easy way to obtain good function. On the other hand, forearm deformity is variable. In some cases, self-remodeling and adaptation of an adjacent joint solve the problem. In some cases, a multifactorial deformity makes the problem complicated. Preoperative PC-assisted corrective osteotomy simulation was useful in those cases.

Reference
A-0358 Total wrist fusion using a volar locking plate

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Introduction: Total wrist arthrodesis is indicated in advanced symptomatic arthritis, secondary to degenerative, inflammatory, post-traumatic or post-infective conditions. The goal is to provide the patient with a stable wrist for power grip, whilst sacrificing wrist motion, to allow for pain relief and satisfactory function. A variety of techniques and fixation devices have been described, in order to produce a successful fusion. These include: intramedullary rod, Steinmann pin, or dorsal plate and screw fixation, often in conjunction with synthetic or autogenous cancellous bone graft from the iliac crest or distal radius. There have been a number of complications associated with the traditional methods of fusion, including: painful hardware, scaphotrapeziotrapezoid arthritis, metacarpophalangeal joint stiffness and DRUJ arthritis or ulnar impaction. Additionally, there is controversy as to the ideal position of the hand when placed in fusion; most commonly, the wrist is placed in slight extension and ulnar deviation, to optimize power grip. We present the clinical outcomes of eight patients who underwent a novel method of total wrist arthrodesis, using the DVR Anatomic (Biomet, Inc) locking plate, which was primarily designed to address displaced distal radial fractures. It is a pre-contoured volar locking plate, allowing an optimum position of the fused hand in slight extension.

Methods: Nine wrists were treated with the DVR Anatomic locking plate device and were followed up for a minimum of 40 weeks. Patients were assessed preoperatively and at follow-up for pain, range of motion (ROM), grip strength and radiological outcome. Functionality was measured using the DASH score.

Results: There were 2 male and 6 female subjects, with an average age of 44 (range, 25 - 64) years. Indications for fusion were painful arthritis due to rheumatoid arthritis (n = 3), post-traumatic arthritis (n = 3) and osteoarthritis secondary to chronic mid-carpal instability (n = 3). A fusion rate of 100% was achieved in all. All patients experienced significant pain relief; their grip strengths improved; and both pronation and supination remained the same preoperatively and post-operatively, and was similar to the contralateral side. The resting angle was neutral, varying between 0 - 10°. One patient required removal of the plate, due to extensor tendon irritation. Mean DASH score was 47.3 (range, 38.6 - 54.5).

Conclusions: Despite the loss of wrist motion following wrist fusion, most patients report satisfactory functional outcomes and are able to accomplish most activities of daily living with some adaptation. In our experience, the DVR-A plate delivers stable fixation and confers a myriad of advantages to its use. It is pre-contoured to the optimal angle for fusion. In comparison to other traditional plate designs, is a locking plate with a very low profile. In addition to ease of application, its use involves less surgical dissection and its placement in the wrist does not involve the carpometacarpal joints, sparing this level of articulation and maintaining anatomical integrity. The DVR-A plate is a safe and effective treatment for wrist arthrodesis.

A-0366 Tendinitis of the flexor carpi radialis tendon after trapezectomy with tendon interposition-arthroplasty: an unattended problem?

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Since 2000, we use a modified version of the trapezectomy, with flexor carpi radialis (FCR) interposition-arthroplasty (IA), introduced by Weilby in 1988, in patients with symptomatic Eaton-Littler Stage II - IV carpometacarpal thumb osteoarthritis. In 4/50 operated patients in a period of 13 months, we saw pronounced FCR-tendinitis, which on average persisted for 11 ¼ months and finally needed surgical revision. We analysed the current studies about trapezectomy with ligament-reconstruction-tendon-interposition (LRTI), in order to find possible reasons for this complication. In the literature, this problem is mostly summarised under tendon rupture and adhesion. Accordingly, predominantly listed are not tendinitises, but rather adhesions of the palmar scar and pulling discomfort in the area of the FCR or the palmaris longus tendon. Rarely a tendinitis is mentioned as one of many reasons for a failure of the treatment. In none of the studies did we find a surgical revision because of a tendinitis in the area of the donor tendon mentioned. The accumulation of this complication at our clinic is in strong contrast to current studies about trapezectomy with LRTI. We control and correct possible reasons, for example insufficient opening of the osteofibrous canal, or too much tension on the tendon, intraoperatively. Another cause for the accumulation of the
FCR-tendinitis could also be a pre-operative, already existent irritation of the tendon, caused by a scaphotrapezio-trapezoidal-arthritis (STT arthritis), which gets activated by the operation. In all four patients, STT arthritis could be confirmed radiographically or intraoperatively. Both in the literature about FCR-tendinitis and STT-arthritis, as well as in our patients, a small number of cases is concerned. Therefore, and because of inadequate imaging-diagnostics to detect pre-existing FCR pathology, it is not possible to prove the connection between STT arthritis and post-operative FCR-tendinitis. In spite of the insufficient data, we think that tendinitises in trapezectomy with LRTI or IA are more common than the current studies let us assume, and that they should be kept in mind as a possible reason for therapy-resistant discomfort.

A-0371 The vascularised bone flaps in complex acute hand trauma: the Birmingham Hand Centre experience

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Introduction: In military conflicts, 80% of all wounds are limb wounds. As more limb injuries are surviving, composite loss of soft tissue and bone requires reconstruction. This complex defect requires a staged approach. Serial debridements and topical negative pressure is initially utilized, followed by flap cover.

Patients and methods: We performed a retrospective case note review of all complex bone reconstructions in Birmingham hand centre between 2010 - 2013. We identified 11 cases, of which three were free fibula flaps, three medial femoral condyle flap and one each of posterior interosseous flap with ulna or IA are more common than the current studies let us assume, and that they should be kept in mind as a possible reason for therapy-resistant discomfort.

Conclusion: Vascularised bones can be used during initial reconstruction. It can be harvested from multiple sites and can be used as either isolated or composite flaps. It is a reliable and safe technique to reduce the number of surgical procedures for these complex reconstructions.

A-0372 Nerve transfers in the upper limb: the Birmingham Hand Center experience

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Introduction: A nerve transfer converts a high proximal nerve injury to a more distal nerve injury, which may accelerate muscle reinnervation. The concept and procedures have gained greater acceptance. Standard nerve transfers are used more frequently, and innovative nerve transfers have been developed to treat a variety of deficits. We present our series and discuss the indications and modifications used.

Patients and methods: A retrospective case note review was performed from June 2010 to June 2013. Over a 3-year period, 42 nerve transfers in 28 patients were identified. This series includes Somsak, modified Somsak, Oberlin, nerve transfers for high ulnar nerve and radial nerve injuries; and nerve transfers in brachial plexus injuries, including intercostal and contralateral C7, with or without a functional muscle transfer.

Results: The timing of nerve transfers was the main factor in the outcome of this surgery. The patients who had Oberlin and Somsak transfer, and its modification, reliably achieved MRC Grade 4 muscle power. Tendon transfers are as reliable in high radial nerve injuries and FDP tenodesis, combined with AIN to motor branch of Ulnar nerve for high ulnar nerve injury, and provides a more reliable result. We did not have problems with neuropathic pain in our sensory nerve transfers. We present our sequential algorithm for the management of these cases.

Conclusions: Nerve transfer is a useful option in the hand surgeon’s armamentarium. Nerve transfers can be combined with tendon transfer for specific indications. When chosen for the appropriate situation, the nerve transfer is a time-tested procedure.

A-0373 Characteristic features and natural evolution of Kienböck’s disease: 5-year results of a prospective case series and retrospective case series of 94 patients

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Objectives: Scientific databases index numerous references related to the treatment of Kienböck’s disease,
yet little is known about the nature of the disease and its pathognomonic features. This study provides a cross-sectional analysis of the pattern and extent of osteonecrosis in a large cohort and a longitudinal analysis to determine the rate of spontaneous disease progression in single patients.

**Methods:** In a prospective case series, the pattern and extent of osteonecrosis was correlated with the duration of symptoms in all patients with Kienböck's disease, confirmed using high-resolution 3-tesla magnetic resonance imaging (MRI) and ultra-thin section computed tomography (CT) scan, since 2009. Furthermore, a retrospective consecutive case-series study was conducted to determine the rate of spontaneous evolution in all consecutive patients treated conservatively in our university hospital since 1990.

**Results:** Among the 35 consecutive patients with Kienböck's disease diagnosed in high-resolution 3-tesla MRI and ultra-thin section CT, 46% (16/35) presented degeneration of lunate cartilage on CT scan in the first 12 months following the onset of symptoms. Median wrist pain duration of patients presenting a fracture of the lunate was 14 months. 31% (11/35) of the patients had arthritis of the lunate, yet no fractures, at the time of examination. Of 94 consecutive patients with Kienböck's disease and complete records, three cases were identified with well-documented spontaneous courses, from apparent intact lunate shapes until fragmentation within 6 months.

**Conclusions:** Kienböck's disease progresses significantly faster than previously described, and contrary to current classifications, the articular cartilage of the lunate degenerates in the early stages.

**A-0374 Outcome after hypothenar pad flap surgery for terminal and recurrent carpal tunnel syndrome**

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**Introduction:** The use of the hypothenar pad flap (HPF) is a reliable procedure for the coverage of the median nerve, mostly used in cases of recurrent carpal tunnel syndrome. We investigated the effects of the HPF on patients with recurrent carpal tunnel syndrome (RCTS) and terminal carpal tunnel syndrome (TCTS). We define TCTS as the end stage of CTS, as there was no neurophysiologic continuity found for the fibers of the median nerve beyond the carpal tunnel.

**Materials and methods:** We studied 16 patients, operated by the same surgeon whom were splinted for 1 week, receiving the same hand therapy regimen, whom were divided in two groups: eight patients with TCTS (mean age, 71 years) and eight patients (mean age, 45 years) with RCTS. Tests were performed preoperatively and after 3, 6 and 12 months postoperatively. Sensibility, strength and the assessment of symptoms and functional status were tested. For the sensibility, we used the Semmes Weinstein Monofilaments Test (SWMT) on the top of the pollex, index and medius; with static 2-point discrimination (2P) and Shapes - Textures Identification (STI) on the index. Strength was examined for grip force and key -, tripod- and tip pinch. We asked the patients if they felt pain during testing. The pain was scored with the Visual Analogue Scale (VAS). The assessment of symptoms and functional status was researched with Levine’s questionnaire, which has two items: symptoms (LevA) and functional status (LevB).

**Results:** We used a paired, single tailed Wilcoxon test. For the TCTS group: after 3 months, significant results were found for: SWMT pollex, SWMT index, 2P discrimination, STI, and LevA and B. After 6 months, significant results were found for: maximum and average tip pinch, SWMT pollex, SWMT index, SWMT medius, 2P discrimination, STI, and LevA and B. One year after surgery, there was significant improvement for the maximum and average tip pinch, SWMT pollex, SWMT index, SWMT medius, STI, and LevA and B. For the RCTS group: after 3 months, significant results were found for: maximum Jamar; maximum and average tip pinch, tripod- and tip pinch; STI index; LevA and B; and for the VAS. After 6 months, significant results were found for maximum and average Jamar; maximum key pinch, tripod and tip pinch; STI; LevA and B; and VAS.

**Conclusion:** The outcome was very good, according to Levine’s questionnaire. Moreover, all patients had improvement on sensibility and strength. Although both presented symptoms of carpal tunnel, the two groups were clearly different. The patients with RCTS returned quickly to the clinic, because they recognised the symptoms of CTS. The patients with TCTS waited too long, until they were disabled due to loss of sensation, but had no pain. For patients with TCTS, sensibility was surprisingly restored for functional use. We concluded that the HPF is a good procedure for RCTS and TCTS.

**A-0377 The medial femur condyle flap for treatment of scaphoid non-union with avascular proximal pole**

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Introduction: Scaphoid non-unions associated with osteonecrosis of the proximal pole have proven difficult to treat, given the need to restore both vascular supply, as well as scaphoid length. Therefore, vascularised pedicled or free bone grafts have been established as the first choice of treatment. Of these, the microvascular bone flap from the medial femoral condyle is a promising option. We present our initial experience with this flap in a series of 21 patients.

Patients and methods: Between August 2008 and December 2013, we performed 21 free vascularised medial femoral condyle periosteal bone flaps for scaphoid non-unions with an avascular proximal pole. All patients were male subjects and their age ranged between 17 - 41 years. The operative technique for flap harvesting will be explained by an operative video.

Results: We had 12 patients whom had been treated conservatively, whereas 5 patients were treated with a Herbert Screw without success, before the microvascular bone flap operation. The remaining patients presented the non-union at first appearance. Pre-operatively, we performed plain x-rays, as well as a magnetic resonance imaging (MRI) investigation. Post-operatively, the patient was kept in an immobilising splint including the elbow joint, for 6 weeks. In all patients, the flap would be transferred successfully. All patients reported massive pain relief and gain of motion. In two cases, we found a hypertrophic callus that caused limitation of motion.

Conclusion: In our hands, the vascularised medial femoral condyle periosteal bone flap is now the first choice for the treatment of all scaphoid non-unions that show an avascular proximal pole or have been unsuccessfully operated on. Advantages include: short immobilisation time, constant flap anatomy and relatively short operative time in a team approach.

A-0379 The use of SPECT/CT to differentiate between carpometacarpal-1 and scaphotrapezio-trapezoid osteoarthritis

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Background: The specific affected site in osteoarthritic (OA) wrist pain is difficult to determine. Radiographs and planar bone scintigraphy can be useful tools, but they are often inconclusive, due to the complex anatomy of the wrist. Yet the differentiation between carpometacarpal (CMC)-1 and scaphotrapezio-trapezoid (STT) OA is vital for further treatment. SPECT/CT combines the strength of revealing metabolic disorders and showing clear three-dimensional (3D) images, and should therefore be able to discriminate between CMC-1 and STT OA.

Methods: Eight patients with wrist pain and suspected CMC-1 or STT OA were included in this study. All patients received x-rays and planar early-phase/late-phase SPECT/CT imaging. SPECT/CT images were compared to the x-rays and planar bone scintigraphy. Also, the therapeutic influence was evaluated.

Results: In seven patients (87.5%), SPECT/CT could discriminate between STT and CMC-1 OA. In one case, SPECT/CT showed both CMC-1 and STT OA. In 5/8 patients (62.5%), the results had therapeutic influence. Three patients were treated with STT arthrodesis. Two of out the three performed well after the surgery, with a PRWHE score of 49 and 40, respectively. One patient remained with postoperative wrist pain. The CT-scan after 1 year showed no fusion between the three carpal bones. Two patients underwent trapeziectomy. One performed very well and reported no complaints after surgery, with a PRWHE score of 0. The other patient scored a PRWHE of 57 at 5 months post-operatively. The remaining three patients were treated with a splint.

Conclusions: SPECT/CT proved to be an excellent tool in differentiation between CMC-1 and STT OA. Patient management was significantly influenced. SPECT/CT should therefore be integrated in a standard diagnostic algorithm, when conventional imaging is inconclusive.

A-0380 Evaluation of gracilis free functioning muscle transfer to elbow flexion, with neurotisation to the ulnar nerve, in patients with upper brachial plexus injury

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Introduction: Brachial plexus injuries are generally quite severe lesions and are associated with a high degree of persistent functional deficit of the upper limb. In a brachial plexus injury with involvement of higher roots, elbow flexion deficit is a common finding. The purpose of this study is to present our experience with free functioning transfer of the gracilis muscle with neurotisation to the ulnar nerve, in order
to gain elbow flexion in patients with high brachial plexus injury.

**Methods:** The evaluation method for elbow flexion strength was the British Medical Research Council (BMRC) scale and articular range of motion (ROM). Eight patients with involvement of C5 and C6 nerve roots (associated or not with C7 injury) and elbow flexion deficit characterized by BMRC muscular strength of M1 or less (M0 in 7 patients; M1 in 1 patient) were treated with free-functioning gracilis muscle transfer for elbow flexion. Muscle strength for wrist flexion were M4 in 1 patient and M5 in 7 patients. The interval between surgery and the initial plexus injury was of at least 13 months, up to 60 months, and the follow-up period ranged from 25 - 55 months (mean, 33 mo). The gracilis muscle was transferred to the arm, sutured to the clavicle, and the thoracoacromial trunk was chosen as the recipient vessel. The motor branch of the gracilis was sutured to fascicles of the ulnar nerve and then final tensioning of the gracilis muscle was obtained.

**Results:** Patients’ age ranged from 6 - 44 years. Postoperative results for muscle strength were as follows: M5 in 1 case, M4 in 5 cases, M3 in 2 cases. The elbow ROM after the gracilis muscle transfer ranged from 80 - 130°, with an average of 104°. The first signs of re-innervation of the gracilis occurred between 4 - 8 months, postoperatively (average, 6 mo), and the maximum strength was achieved at 18 months.

**Conclusion:** Free-functioning transfer of the gracilis muscle for elbow flexion with neurotisation to the ulnar nerve, in patients with high brachial plexus injury, is a reliable procedure: it consistently improved the flexion strength and ROM, with low donor site morbidity.

**A-0382 Percutaneous, transtrapezial fixation without bone graft leads to consolidation in selected cases of delayed union of the scaphoid waist**

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**Introduction:** Scaphoid fractures are the most common carpal fractures and carry a higher risk of delayed healing and pseudarthrosis, when left untreated. Delayed union of the scaphoid is often considered to be a contraindication for percutaneous fixation. Untreated non-unions will lead to Scaphoid Non-union Advanced Collapse (SNAC). Surgical options vary, from percutaneous fixation with or without bone grafting, to open reduction and internal fixation. Open reduction and internal fixation of the scaphoid has a high complication rate, including scar problems, infection, nerve injury and aldystrophy. Percutaneous fixation is a safe and minimally-invasive technique; however, only limited data is available for its use in delayed union of the scaphoid.

The purpose of this study is to evaluate the use of percutaneous fixation with a headless bone screw in a selected group of patients with delayed union.

**Methods:** A retrospective study was performed, to analyse the outcome of the percutaneous fixation technique for delayed union of the scaphoid waist. We included 18 patients with non-displaced, delayed union of the scaphoid in this study: 17 male and 1 female patient, with an average age of 28 years (range, 17 - 61y). Percutaneous fixation of the scaphoid pseudarthrosis was performed between 2006 - 2011. Delayed union was defined as failure of signs of union, 2 months or longer after the index fracture. Patients were excluded from this study if the use of bone graft was deemed necessary, if sclerotic bone formation was present at the fracture site, or if correction of a deformity was indicated. A percutaneous, transtrapezial approach was used in all cases, to obtain central placement of the screw. Postoperatively, all patients were treated with a splint, and were reviewed every 4 weeks until we observed clinical and radiographic union. At the final follow-up, we performed a clinical and radiographic examination; and obtained both Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire and Patient-Rated Wrist/Hand Evaluation (PRWHE) outcome scores.

**Results:** We treated 18 patients with scaphoid pseudarthroses with percutaneous screw fixation, without the addition of a bone graft. Radiographic consolidation of the fracture occurred in all but one patient: he developed a scaphoid non-union after percutaneous fixation. He was scheduled for revision surgery and excluded from further results. In retrospect, there were signs of sclerosis at the fracture site at the time of index surgery. Average follow-up time was 35 months (range, 3 - 98) and we encountered no complications from the percutaneous technique. The average postoperative DASH score was 5 (range, 0 - 18). The average postoperative PRWHE score was 8 (range, 0 - 35). There was no significant difference between the range of motion and grip strength between the operated side and the contralateral side.

**Discussion and conclusions:** Percutaneous screw fixation of the scaphoid is successful in carefully selected cases of scaphoid pseudarthrosis. Cyst formation is not a contraindication, as long as there are no signs of fracture displacement. We do not recommend using this fixation technique if there are signs of sclerosis at the fracture site.
A-0384 Prevention of perineural fibrosis after neurolysis and carboxymethyl cellulose/poliethilene oxide barrier agent for the treatment of recalcitrant postsurgical neuropathic pain: experimental study on mice and preliminary clinical results

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Introduction: The surgical treatment of recalcitrant pain, due to scar formation around a nerve, is represented by the neurolysis of the nerve and the covering with a gliding and/or well vascularised tissue (e.g. adipofascial flap or synovial flap), a vein wrapping or a barrier agent to prevent the scar formation. We show the results of an experimental and a clinical study on the use of a barrier agent. The aim of this experimental study was to assess the efficacy in reducing the adherences in a mouse model, by means of an antiadherential gel composed of carboxymethyl cellulose (CMC) and poliethilene oxide (PO) (Dynavisc® Gel), after induction of a perineural lesion (the experimental model of epineural fibrosis was used). This barrier agent has been widely employed in spinal surgery, but never tested in peripheral nerve surgery. In the meantime, we assess the outcome of eight patients whom were operated with a neurolysis and the application of CMC and PO, for recalcitrant neurological pain.

Materials and methods: We used 25 adult mice in this experimental study. The animals were divided into two groups: in both the bed muscle around the sciatic nerve was burned by diathermo coagulator [model to create a scar around the nerve]; in one group we applied the antiadherential gel. After 3 weeks, the perineural fibrosis was assessed by means of a biomechanical test (measurement of the maximum force required to detach the nerve from the muscle) and by histological evaluation (amount of fibrous tissue/collagen around the nerve). In the clinical study, we assessed eight patients operated on for recalcitrant pain, after previous surgical procedures on nerves (seven female and one male patient, average age 47.5 years, pre-operative visual analogue scale (VAS), 6 - 8). In all eight patients, a neurolysis and combined application of CMC and PO gel was performed. The painful component of the syndrome was assessed by means of the VAS scale, pre-operatively and post-operatively, at 1 day, 1 month and 6 months.

Results: Experimental: According to the results obtained by means of histological and biomechanical analysis, the CMC and PO gel is able to reduce perineural scarring. The group with burned muscle beds showed an adhesion force of 68 g, the CMC and PO group 48 g, and the control group 38 g. There was a statistically significant difference between the control group and the one with the CMC and PO gel. Qualitative histological analysis showed reduction of the scar tissue after the gel application. Clinical: In all cases analysed we did not observe adverse effects due to surgery after the application of CMC and PO. In 7/8 cases, we obtained satisfactory results with a reduction [difference ≥ 4 VAS] of pain in both the short and long term. In 6/8 cases, the pain regressed to a level compatible with the performance of a regular daily routine (VAS ≤ 2).

Conclusion: This experimental study showed that CMC and PO gel can reduce perineural scar formation in the mice model. In the clinical setting, no adverse effects were noted and treatment seemed to give satisfactory results after a neurolysis, reducing pain, probably from the reduction of fibrogenesis around the nerve.

A-0386 Improvement in self-rated activities in tetraplegic patients after grip reconstruction

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Objective: To assess the functional results in self-rated activities of tetraplegic patients undergoing surgical grip reconstruction.

Materials and methods: We present a prospective cohort study. After a multidisciplinary team evaluation in which the subject chooses his personal goals, 11 patients underwent surgery between December 2010 and June 2012: 10 men and 1 woman, with a mean age of 23.3 years old [range, 18 - 26 y]. They underwent surgery 4.9 years after their accident [range, 1.4 - 7.7]. The best-functioning hand was chosen: 3 right hands and 8 left hands. The patients, according to ICSTH, were in Group 1: 1 patient; Group 2: 4 patients and Group 4: 6 patients. They underwent presurgery evaluation guidelines with COPM, Wee-Fim and Baseline Pinch Measurement [pinch strength] tests. The
A-0395 Range of motion of thumb metacarpophalangeal joint: is it within the normal limits?

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Purpose: The range of motion (ROM) of the thumb metacarpophalangeal (MCP) joint varies widely among individuals. Because of this variability, the normal angles of flexion and extension of the MCP joint are difficult to determine. If the ROM of the thumb MCP joint is sufficiently similar between the right and left sides, the contralateral normal side can be used for outcome assessment in hand surgery. The purpose of this study was to define the difference between right and left ROM of the thumb MP joint in the normal population, and to assess the utility of the normal side’s value as a normal indicator.

Methods: We included 300 hands of 150 subjects (75 men and 75 women; average age, 36.2 years) without a history of injuries nor diseases of the thumb in this study. To exclude subjects with degenerative joint disease, the age range was limited to 20 - 49 years.

A-0393 The inter- and intra-observer variability of wrist cineradiography in diagnosing scapholunate dissociation

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Purpose: Ruptures of the scapholunate ligament (SLL) may cause carpal instability, also known as scapholunate dissociation (SLD). SLD may lead to osteoarthritis of the radio-carpal and mid-carpal joints. With a sensitivity of 90% and specificity of 97%, cineradiography showed to be a promising tool for diagnosing SLD; however, no inter- and intra-observer variability has been evaluated. The aim of this study is to evaluate the inter- and intra-observer variability of wrist cineradiography in diagnosing SLD.

Methods: Records of 50 consecutive wrist cineradiographies performed in 25 patients were re-assessed by a musculoskeletal radiologist, a plastic surgeon and a trauma surgeon. To determine the intra-observer variability, all wrist cineradiographies were re-assessed by the three reviewers 6 months after their first reassessment. Jackknife kappa was used to assess inter-observer variability; Cohen’s kappa to assess intra-observer variability.

Results: The inter-observer variability of wrist cineradiography diagnosing a SLD was excellent ($\kappa = 0.84$). The intra-observer variability for the plastic surgeon was excellent ($\kappa = 0.80$), and good for the radiologist ($\kappa = 0.72$) and the trauma surgeon ($\kappa = 0.76$).

Discussion: Cineradiography was shown to have excellent inter-observer and good-to-excellent intra-observer variability in diagnosing SLD. Type of study/level of evidence: Diagnostic Level III.
The angles of flexion and extension of the MCP joints were measured with a goniometer at an interval of 1°. Statistical analyses of flexion angle, extension angle, differences between men and women, and differences between the right and left sides of individuals were carried out, using Mann-Whitney U tests. A P value of < 0.05 was considered statistically significant.

**Results:** The average flexion angle was 59.1° (range, 16°- 90°). The average extension angle was 7.9° (range, -32°- 58°). Both the flexion and extension angles were greater in women than in men. The average difference in the flexion angle between right and left was 4.8° (range, 0° - 28°). The average difference in the extension angle between right and left was 6.4° (range, 0° - 38°). For a p-value of 0.05, the one-sided 100th percentile results indicated the normal ROM of the MCP joint. After rounding up the decimals to a unit, the one-sided 100th percentile results indicated that flexion loss of more than 11° and extension loss of more than 15° were suspicious for contracture of the MP joint, and that flexion loss of more than 16° and extension loss of more than 21° strongly suggested contracture of the MP joint.

**Conclusions:** The difference between the maximum flexion angle of 90° and the minimum flexion angle of 16° was 74°. The difference between the maximum extension angle of 58° and the minimum extension angle of -32° was 90°. Due to these large differences in the flexion and extension angles, it appeared that some angles could not be determined as normal; however, the average flexion and extension differences between the right and left sides of the same individual were 4.8° and 6.4°, respectively. These differences are small enough for the contralateral normal side to be a useful indicator of the normal ROM of the MCP joint. After rounding up the decimals to a unit, the one-sided 100th percentile results indicated that flexion loss of more than 11° and extension loss of more than 15° were suspicious for contracture of the MP joint, and that flexion loss of more than 16° and extension loss of more than 21° strongly suggested contracture of the MP joint.

**Discussion:** In severe CTS with impairment of thumb opposition, function may be reconstructed with an opponensplasty. If recovery of thumb opposition was predictable at the time of the carpal tunnel releases, we could determine whether opponensplasty should be applied or not. Although some reports investigated the recovery of thumb opposition, it remains obscure due to the small number of subjects or short follow-up periods. In this study, the durations of disease preceding surgery was remembered for 50 hands; it did not differ significantly between the hands that recovered (30.9 months) and the hands that did not recover (29.3 months). Thumb opposition recovered in all 11 hands of those under 50 at the time of carpal tunnel release. Thumb opposition recovered in 10/20 (50.0%) patients whom were 50 - 59 years of age. Thumb opposition recovered in 17/36 (47.2%) patients whom were 60 years of age or more.

**A-0398 Postoperative follow-up of severe carpal tunnel syndrome**

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**Purpose:** Carpal tunnel syndrome (CTS) is the most common upper extremity entrapment neuropathy. Symptoms include paresthesia and numbness over the sensory distribution of the median nerve, weakness and hand clumsiness. In the most advanced stage, the thenar muscle atrophy is severe, with a resultant inability to oppose the thumb. In such cases, nerve conduction studies demonstrate undetectable compound muscle action potentials of the abductor pollicis brevis (APB-CMAP) following stimulation of the median nerve at the wrist. This study assessed postoperative recovery of thumb opposition in severe carpal tunnel syndrome in those who underwent carpal tunnel release alone.

**Methods:** Between February 2001 and July 2010, carpal tunnel release was performed on 693 hands. Of 693 hands, 194 hands had undetectable APB-CMAPs on preoperative nerve conduction studies. We reviewed 67 hands from 73 patients with undetectable APB-CMAP (mean age, 59.8 years old) 1 year or longer after carpal tunnel release (mean follow-up period, 39 months). We excluded secondary CTS patients who were undergoing hemodialysis and patients with other conditions associated with neuropathy, diabetes or joint contracture. We evaluated thumb opposition by performing a pulpal pinch between the thumb and the little finger. We used the Mann-Whitney U-test for statistical analysis. P < 0.05 was considered significant.

**Results:** Thumb opposition recovered in 38 hands (56.7%), in all of which APB-CMAPs were detectable (mean amplitude, 4.26 mV). Thumb opposition was not recovered in 29 hands (43.3%), among which the APB-CMAPs were detectable in 17 hands (mean amplitude, 0.28 mV) and remained undetectable in 12 hands. Duration of disease preceding surgery was remembered for 50 hands; it did not differ significantly between the hands that recovered (30.9 months) and the hands that did not recover (29.3 months). Thumb opposition recovered in all 11 hands of those under 50 at the time of carpal tunnel release. Thumb opposition recovered in 10/20 (50.0%) patients whom were 50 - 59 years of age. Thumb opposition recovered in 17/36 (47.2%) patients whom were 60 years of age or more.

**Discussion:** In severe CTS with impairment of thumb opposition, function may be reconstructed with an opponensplasty. If recovery of thumb opposition was predictable at the time of the carpal tunnel releases, we could determine whether opponensplasty should be applied or not. Although some reports investigated the recovery of thumb opposition, it remains obscure due to the small number of subjects or short follow-up periods. In this study, the durations of disease do not correlate with the recovery of thumb opposition. On the other hand, ages correlated partially. Good recovery of thumb opposition can be expected with carpal tunnel release alone, in patients under 50 years of age; however, recovery was still unpredictable in patients 50 years of age and more. Further studies, such as second lumbrical CMAP, may be required to properly predict the recovery of thumb opposition in severe CTS.
A-0400 Evaluation of pronator teres muscle transfer to both radial and ulnar wrist extensors to improve hand grip strength in tendon transfer for radial nerve palsy

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Introduction: In making a closed hand fist, ulnar deviation of the wrist is concomitant with wrist dorsiflexion and both movements are mandatory to obtain a strong hand grip. In contrast to the extensor carpi ulnaris (ECU) tendon, which induces some ulnar deviation, the extensor carpi radialis brevis (ECRB) tendon has no wrist ulnar deviation momentum, because the latter is inserted along the capitate (the center of radio-ulnar deviation) into the second metacarpal. A suggestion was made to transfer the pronator teres (PT) tendon to both ECRB, to exert dorsiflexion; and to the ECU tendon, to induce ulnar deviation, to increase hand-gripping strength on making a closed fist.

Patients and methods: We treated 29 patients with radial nerve palsy with a tendon transfer: 21 patients had humeral shaft fracture and 8 patients had failed nerve repair. They were divided into two groups: the first group (18 patients, average age 34 years old) had a PT transfer to both ECRB, to exert dorsiflexion; and to the ECU tendon, to induce ulnar deviation, compared to 2º radial deviation in second group (p = 0.09); the first group returned to their previous jobs, compared to 20% of the second group (p = 0.09); the first group had an average postoperative DASH score of 78 points, compared to 64 points for the second group (P = 0.04). The post-operative average hand power grip was 80% of the normal side in the first group, compared to 61% in the second group (P = 0.02). On making a fist, the average postoperative ulnar deviation was 18º in the first group, compared to 2º radial deviation in second group (p = 0.03). A total of 66% of patients in first group had Grade 4 wrist extensor power, compared to 83% of the second group, whom had Grade 3.

Conclusions: PT tendon transfer to ECRB and ECU tendons improved ulnar deviation, with a significant increase in hand-gripping strength.

A-0401 Cubital tunnel syndrome: results after subcutaneous anterior transposition

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Introduction: Cubital tunnel syndrome is the second most frequent entrapment neuropathy, second to carpal tunnel syndrome. The aim of the study is to review and classify preoperatively the patients that underwent sugery by subcutaneus anterior transposition at our hand unit, and study the final outcome after surgery.

Materials and methods: We reviewed 35 cases in 34 patients that underwent surgery for subcutaneus anterior transposition, by a retrospective study: there were 20 male and 14 female subjects, with a mean age of 44.7 years (range, 23 - 71). Diagnosis was based upon clinical findings and electrodiagnostic tests. The McGowan modified classification was used for preoperative scoring of patients: 8 cases were classified as McGowan Grade I, 4 cases as Grade IIA, 8 cases as Grade IIB, and 15 cases as Grade III.

Results: No complications were registered peroperatively. Clinical outcomes were classified as excellent (16 cases), good (11), fair (7) and poor (1). Three out of eleven patients improved in claw or first web atrophy. According to the preoperative McGowan classification, the results were: 7 excellent and 1 good in Grade I; 2 excellent and 2 fair in Grade IIA; 4 excellent, 2 good and 2 fair in Grade IIB; and 3 excellent, 8 good, 3 fair and 1 poor in Grade III.

Conclusions: Subcutaneous anterior transposition for cubital tunnel syndrome was a useful surgical technique in our series. Only 27% of patients recovered from muscular atrophy, such as first web atrophy or cubital claw. Patients with less impairment at the
time of surgery are better suited for an excellent recovery and final outcome.

A-0406 Use of a medial femoral epicondyle vascularized bone graft in the treatment of scaphoid non-unions that are accompanied by an avascular necrosis of the proximal pole and carpal collapse

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Objective: To determine the certain indications and evaluate the results of free vascularised bone grafting from the femoral medial epicondyle, in treatment of scaphoid non-unions with an avascular necrosis of the proximal pole and carpal collapse.

Methods: For the period from June 2010 till September 2013, we used the free vascularised bone graft from the medial epicondyle of the femur in the treatment of scaphoid non-union in 16 patients (14 men; 2 women), 18 - 54 years old. Surgical treatment was performed 14 - 58 months after injury. In all cases, non-union was accompanied by an avascular necrosis of the proximal pole and a significant humpback deformation, which led to advanced carpal collapse. Dimensions of the vascularised bone graft ranged from 1.1 x 0.8 x 1 cm to 1.5 x 1.2 x 1 cm. The mean length of the vascular pedicle was 3.3 ± 7.4 cm. In all cases, both arterial and venous anastomoses were performed with a palm branch of the radial artery and its venal commitantes, in an end-to-end fashion. Osteosynthesis was performed with compression screws and K-wires in 9 and 6 cases, respectively.

Results: We evaluated the results according to radiographic, ultrasound (evaluation of vascular anastomoses), computed tomography (CT) and magnetic resonance imaging (MRI) studies, for a period of 2 months to 3 years. Comprehensive functional assessment was carried out by a DASH questionnaire, active range of motion (ROM) of the wrist joint, pain assessment by the VAS scale, power grip and key pinch measurements. In 15 cases, healing was achieved within 8 weeks postoperatively.

Conclusion: The benefits of vascularised bone grafts in the treatment of a non-union included relatively rapid healing, with possible revascularisation of the necrotic bone. The medial femoral epicondyle provides an easily modifiable vascularised bone graft, massive enough to restore the length and shape of the scaphoid. Other advantages include: minimal donor site morbidity, constant vascular anatomy and a relatively simple harvesting technique. Treatment of the scaphoid non-union using a vascularised bone graft from the medial femoral epicondyle is fairly promising. This method allows us to obtain not only the healing of the non-union in adequate terms, but also to restore the carpal height.

A-0407 Treatment of complex hand injuries using the dorsal ulnar artery perforator flap

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Introduction: Functional disorders due to tendon adhesion and scar tissue around nerves arise as complications after the initial treatment of incomplete amputation and severe crush injury of the forearm and wrist lacerations, by vascular reconstruction, etc. We recently used dorsal ulnar artery perforator flaps (DUAPF) to cover the tendons and nerves during initial treatment, as well as to repair soft tissue defects after elimination of scars during secondary tenolysis and neurolysis, in cases of complex hand injuries. The flap, first reported by Becker et al., uses the dorsal ulnar artery as the pedicle. Our clinical experience with the flap is reported.

Subjects and methods: We studied 15 patients with complex hand injuries. The injury was caused by an electric saw in five patients, a press in eight patients, and the so-called ‘spaghetti wrist’ by self-laceration in two. The patients ranged in age from 16 - 47 years old (mean, 30 y). We used the DUAPF during the initial surgery in six patients and during the secondary tenolysis or neurolysis in nine patients. The DUAF was prepared as follows: first, a small skin incision, about 2 cm long, was made over the ulnar axis 2 cm proximal to the pisiform bone, and then the flexor carpi ulnaris muscle was pulled with a retractor. The posterior ulnar artery, which serves as the vascular pedicle, was identified. The vascular pedicle usually divides into three branches within the flexor carpi ulnaris muscle, and one of them is an ascending branch running proximally. After identifying this branch, the ultimate design of the flap was determined. The flap was rotated once and placed over the
site of the soft tissue defect and scar elimination around the hand joint, while covering the tendon and the nerves. In five patients, a vein in the flap was anastomosed with the cutaneous vein on the recipient side.

**Results:** The vascular pedicle could be identified in all cases. The postoperative results we assessed according to Chen’s classification were: Grade 3 in five patients, Grade 2 in four patients and Grade 1 in six patients. A DUAPF was used as the pedicle flap in all cases, and as the fascial flap in three of them. Strong adhesion of the flap to the underlying tissues was not observed postoperatively, so none of the patients required re-detachment of the tendon and nerves.

**Discussion:** Treatment of complex injuries becomes difficult if hard scars occur at the site of the injury on the palmar side and the tendons or nerves adhere to the skin. It therefore seems best to use a flap with good circulation, to cover the site in the early stage whenever possible; however, it is not always possible to obtain a free flap, and free skin grafts are associated with the risk of adhesion. This technique, which uses a pedicle flap that can be obtained from the same surgical field without sacrificing the main artery, is believed to be very useful.

**A-0412 Correlation between the Patient-rated Wrist and Hand Evaluation Questionnaire (PRWHE) and Rosen-Lundborg score for nerve repair in the hand**

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**Introduction:** Nerve injuries can result in dysfunction affecting young men all over the world at their most economically productive life phase, and also their quality of life, demanding a long time to return to work. Variables such as the patient’s age, tension of repair, time of repair, level of injury and scar formation following surgery can affect the functional prognosis. Evaluating disability, dysfunction and outcomes of these patients after nerve repair are essential, because this provides information about sensorimotor deficits and function. Many tools are described to assess the outcome after nerve repair. Questionnaires are outcome measures that can bring information about functionality.

**Objective:** The objective of this study was to correlate the Patient-Rated Wrist and Hand Evaluation (PRWHE) and the Rosen-Lundborg score for nerve repair.

**Methods:** Correlation of the motor, sensory, pain/discomfort and appearance domains of PRWHE and Rosen-Lundborg score were analysed through Pearson’s correlation coefficient (r) in a convenience sample of 32 patients after their long-term nerve repair.

**Results/discussion:** This sample was mostly men (78.1%), with a mean age of 42.28 (SD 15.51) years, right-handed [90.6%], and with the median and ulnar nerve injury through being cut by glass, a knife or a tool (84.4%), with primary nerve repair (68.8%) by the use of a microscope (78.1%), by 9-0 nylon suture to nerve reconstruction (50%), and most on the same day or within the first 2 weeks after the trauma. Others structures were also involved in the hand, like tendons and vessels, both arising from full and partial laceration between 2001 - 2008. The mean time between the surgery and the study was 5 years. This sample of assessed patients was submitted to rehabilitation in most cases (81.3%), with use of a splint in 62.5% of the cases. The functional subcomponent of the PRWHE was inversely and moderately correlated to the Rosen-Lundborg score motor (r = -0.55) and the sensory domains (-0.56).

**Conclusions:** The PRWHE and the Rosen-Lundborg score and its subdomains were shown to be correlated, to assess disability in patients with nerve repair in the hand.

**A-0419 Side-to-side repair in peripheral nerve surgery: histomorphometric results**

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**Introduction:** Proximal nerve injury with a large gap between the nerve ends is a challenging situation in nerve repair surgery. In our previous study, functional results between side-to-side repair and end-to-side repair did not differ; however, contrary to the end-to-side technique, side-to-side nerve repair offers a tool for further reconstruction procedures, as both nerve ends remain available. Only a few studies were published dealing with the side-to-side technique. In the present study, we compared axon regeneration distal to the operation site after end-to-end, end-to-side and side-to-side repair.

**Methods:** The left common peroneal nerve of 80 female Wistar rats was transected. The repairs were performed either with end-to-end (ETE), end-to-side (ETS) or side-to-side (STS) technique. In the negative control group, the injury was left unrepaired. In the
sham operated group, the sciatic nerve trunk was revealed and was left intact. There was also an intact control group. Follow-up periods were 6 or 26 weeks. Immunohistochemically stained (with neurofilament antibody), whole nerve cross-sections were analysed digitally. The following outcomes were measured: count of axons, axon density, mean axonal area, total axonal area and nerve area. Muscle biopsies of long peroneal muscle were analysed qualitatively.

Results: Axon count values of the ETE group were significantly higher, compared to the other groups, at both follow-up periods. At 26 weeks, there were no significant differences between ETS and STS groups. Values of the negative control group were significantly lower, compared to the other groups. Mean axonal area increased in all three groups, from 6 to 26 weeks. Total axonal area did not differ significantly between ETS and STS groups, at 6 weeks and 26 weeks. All the intervention groups reached higher total axonal area values than the negative controls. In muscle biopsies, there were only focal signs of mild atrophy in the ETE group. In the ETS and STS groups, the histological findings resembled each other closely: muscular atrophy was mild, but the changes were a bit wider compared to the ETE group. The overall size of muscle cells seemed to be a little smaller in the STS group, compared to the ETS group.

Conclusions: The STS nerve repair technique showed promising histomorphometric results and the capability of regeneration was comparable to ETS technique. Further investigations are warranted to clarify this technique in details.

A-0425 Emergency all-in-one reconstruction in the upper limb
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The use of top-quality tissue in covering post-traumatic tissue loss, and the precocity in restoring function, are major prerequisites for obtaining a good surgical result. Nowadays, the employment of more aggressive techniques has become the rule in dealing with emergency reconstructive interventions. The current availability of a great number of both simple and complex flaps, both as free or as local/regional flaps, has spurred the development of the concept of the ‘emergency all-in-one reconstruction’. Lister promoted the concept of emergency free flaps, referring to those flaps used within 24 hours following debridement. Godina extended that time to 72 hours (‘early free flap’). In 1999, Ninkovic introduced the ‘primary free flaps’ (12 - 24 hours from debridement). We added to these classifications a new category: the immediate emergency flaps, which means performing a flap together with the reconstruction, within the same surgical stage. The use of immediate emergency flaps is recommended in very complex lesions with partial or complete amputation of a limb segment, because it avoids difficult iterative surgeries. In the upper limb, the earlier the reconstruction of the limb segment, the better the final functional result. The debridement must be carefully performed to achieve preservation of lasting function: it should respect the involved structures, but should be sufficiently aggressive so as to insure the preservation of only those tissues with a certain degree of viability. The tissues preserved are not yet affected by any inflammatory phenomena, so they can be reconstructed and covered immediately, preventing the irreversible desiccation and potential necrosis of the denuded elements. For coverage, the free flaps are the most recommended, but sometimes also a local or regional flap can be successfully used. In very complex defects, a flow-through or piggy-back procedure can be used, but also functioning muscle transfers or composite flaps, including bone, tendons and nerves. The sooner the coverage was done, the less numerous the complications we encountered and the better functional results we obtained. There were no significant differences between the microbial contamination of wounds covered immediately and those covered after 24 - 72 hours, but there was an increased tendency for vascular spasm in direct relation with the time elapsed until coverage was noticed. Hospitalisation lasted from a mean of 18 days for immediate reconstruction, to 24 days for a primary reconstruction, 28 days for an early reconstruction and 33 days for a delayed reconstruction. This method ensures good coverage, allowing the primary reconstruction of all affected anatomical elements.

A-0426 Muscle-rib flap in upper limb reconstruction
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Purpose: Because the large vascular supply of muscle flaps improves local healing conditions, and the use of a vascularised bone graft increases fracture consolidation, it seems logical to use a compound osteo-muscular flap, i.e. latissimus dorsi (LD) or serratus anterior (SA) or both, as composite flaps in complex defects of the upper limb.

Method: The study refers to 23 patients with acute or sequelar traumatic composite bone and soft tissue...
defects. There were 5 female and 18 male subjects, with an average age of 33.4 years. The etiology was acute trauma (9 cases), and post-traumatic complications (14 cases). The length of the bone defect was 4 - 9 cm and the surface of the soft tissue defect was 6 - 475 cm². The flap used was SA-R in 14 cases, LD-R in 5 cases and LD-SA-R in 4 cases. The flaps were used as free flaps in 18 cases and as pedicled flaps in 5 cases. A skin island was included in two cases.

Results: The average follow-up was 23.1 months. In 96.6% of cases, we had complete flap survival. We registered a rate of primary bone union of 97.8%, with an average time of 4.9 months. The time to obtain hypertrophy was 4 - 12 months.

Conclusion: The vascularised rib(s) used as part of a composite flap represents a good indication in the impossibility of using the fibula and if the patient doesn’t accept a fibula transfer, but also in bone defects that are associated with large soft tissue defects.

A-0427 Emergency local perforator flaps in the upper limb
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Introduction: Due to their great frequency and functional impact, forearm and hand traumas have a lot of important social and economical consequences. Generally, it is accepted that the best way in managing such cases is the use of free tissue transfers, done as soon as possible after debridement. We will try to demonstrate the advantages of doing the all-in-one reconstruction in the same step with the debridement, and also the possibility of using, in well-selected cases, the local/regional perforator flaps to cover tissue defects.

Patients and methods: From 1999 until now, more than 700 cases were treated in our service for acute traumas with complex tissue defects of the forearm and hand, and more than 200 out of these were treated by using local or regional perforator flaps. The age of the patients was between 4 – 87; and 85 were male and 52 female subjects. In a few cases we performed a regional perforator flap, but in the majority of cases, a local perforator flap was performed: anterior interosseous perforator flap, posterior interosseous perforator flap, radial perforator flap and ulnar perforator flap. All the cases were solved in emergency as an immediate procedure, by performing the all-in-one reconstruction in the same operative step with the debridement. The post-operative rehabilitation began very early after surgery, allowing patients to obtain a good functional recovery.

Results: The follow-up was between 2 months and 2 years. In all cases, the extremity was salvaged and a useful, functional recovery was obtained. A very good evolution, with complete survival of the flap, was recorded in 95% of our cases. We completely lost a local radial perforator flap. Minor complications were registered in 13 cases.

Conclusion: We think that local perforator flaps represent a good and safe indication for small and medium defects in the forearm, but even for the largest defects, and especially for those in the distal one-third of the forearm; the main condition is that the lesions are not very extensive, and if incisions and fasciotomy are to be performed, these should be very attentively planned. The main advantages of local perforator flaps are: the same operative field, the replacement of like with like, the respect of the main vessels, and the possibility of harvesting of such flaps even based on disrupted and/or sutured vessels.

A-0429 A Clinical decision rule for the use of radiography in acute wrist injury: development and external validation of the Amsterdam Wrist Rules
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Introduction: Wrist trauma is one of the most frequent reasons for visiting the emergency department (ED). In most hospitals, patients with wrist trauma are routinely referred for radiography. There are no guidelines regarding this referral, and physicians trust their instinct or gut feeling. A clinical decision rule regarding wrist injury may avoid a substantial number of unnecessary x-rays. The primary aim of this study was to develop and validate a clinical decision rule that helps determine the need for the radiography of patients with wrist trauma.

Methods: This cross-sectional study was conducted in the EDs of five Dutch hospitals. It consisted of two components: The development of a clinical prediction model and the external validation of the model in a new patient population. We included all consecutive adult patients whom presented at the ED with pain following wrist trauma. Patients were evaluated for 24 clinical variables defined by the patient characteristics, mechanism of injury, physical examination and functional testing. The reference standard was a fracture of the
radius, ulna or one of the carpal bones, diagnosed from conventional x-rays at presentation, similar to clinical practice. Analysis: data from the first hospital were used to develop a prediction model. A logistic regression model with 24 predictors was fit and then reduced, using stepwise backward elimination. Internal validation of the performance was estimated with bootstrapping. Subsequently, this model was validated with data from the other four hospitals (geographic validation), to support its general applicability.

Results: In the first hospital, 438 patients were included, with a median age of 48 (interquartile range, 29 - 60). Women were slightly over-represented (57%). In 227 patients (52%), a fracture of the radius, ulna or one of the carpal bones was identified on conventional radiographic series. The final model included the predictors of age; direct trauma; swelling of the distal radius; visible deformation; painful palpation of the distal radius and a painful radioulnar drawer test. Subsequently, this model was validated in 346 new patients. The Area Under the Receiver Operating Characteristics Curve (AUC) of this external validation was 0.8. An optimal cut-off point was determined, to formulate a clinical decision rule.

Conclusion: In a new patient population, the Amsterdam Wrist Rules displayed the ability to adequately discriminate between patients with and without a fracture. The Amsterdam Wrist Rules therefore provide a clinical tool for all physicians and substantiate the indication for radiography in patients with wrist trauma.

A-0430 Costal osteochondral grafting for cartilage defects in finger joints

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Purpose: For the purpose of achieving anatomical reduction as precisely as possible, we performed osteochondral grafting from the costo-osteochondral junction in 51 patients (52 joints) with cartilage disorders or defects in fingers, due to trauma and other causes. The purpose of this study is to introduce costal osteochondral grafting for articular cartilage defects in the finger joint as a new treatment modality. This procedure can give successful and satisfactory results in the treatment of a severely damaged finger joint.

Patients and methods: We treated 52 finger joints (9 MCP joints, 37 PIP joints, 3 IP joints and 3 DIP joints) in 51 patients with articular cartilage defect or disorder after trauma, infection or bone tumor with arthroplasty, using a osteochondral graft harvested from the costo-osteochondral junction. There were 46 male and 5 female subjects, ranging in age from 5 - 68 (mean, 32) years. The defect accounted for 50 - 100% of the entire articular surface. Partial joint replacement was performed in 34 joints and total joint replacement was undergone in the remaining 18 joints. We based clinical assessment on the range of motion (ROM) and DASH-JSSH. Two-sided paired t-test was utilized to compare pre- and post-operative ROM and DASH-JSSH score. Surgical procedures: the dorsal or volar approach was applied. The collateral ligament was preserved, where possible. Since the bony part of the graft had to be large enough to achieve firm fixation, the graft bed was enlarged sufficiently by curettage. The harvested costal osteochondral graft was trimmed to fit the defect, and then fixed as firmly as possible, using mini-screws. After surgery, the finger was immobilized with a splint for approximately 1 week, followed by ROM exercises.

Results: The mean clinical follow-up was 28 months (range, 6 - 160). Radiographs demonstrated complete union of the bony part of the grafts in all patients and there was no evidence of bony bridging, nor narrowing of the joint space. The donor site in the rib did not demonstrate any problems, except for scarring. The mean arc of motion was 8° before surgery, versus 67° after surgery (p < 0.001), with a mean increase of 59°. Five cases needed an additional collateral ligament reconstruction and another two cases needed tenolysis. The donor site in the rib did not cause any pain nor any other problems. Mean pre-operative DASH-JSSH score was 38 (range, 24 - 58), improving significantly to 12 (range, 2 - 19) post-operatively (p < 0.001).

Conclusion: Arthroplasty using costal osteochondral graft demonstrated anatomical and biological reconstruction with successful and satisfactory results in the treatment of articular cartilage defect or disorder in the finger joint.

A-0431 Efficacy of axillary nerve block in elbow arthroscopic surgery: a randomized trial

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Purpose: Very few studies have been conducted on the pain level or pain control after arthroscopic elbow surgery. The purpose of this study is to evaluate early post-operative pain levels after arthroscopic elbow surgery.
surgery under general anesthesia, and to determine whether an axillary nerve block would provide additional pain management benefit, as compared with local anesthetic injection at portals.

**Methods:** We randomized 36 patients undergoing arthroscopic elbow surgery under general anesthesia to either a study group receiving axillary nerve block (Ax group; n = 18) or a control group receiving local anesthetic injections at portals (Lo group; n = 18). During the first 48 hours after surgery, pain visual analog scale (VAS) scores [0 - 100], total amount of oral analgesics required and patient satisfaction were assessed. Prospective power analysis determined that a minimum of 17 subjects were required in each group. The Student’s t-test and chi-square or Fischer’s exact test were used for statistical analyses. P < 0.05 was considered to be statistically significant.

**Results:** Among all 36 patients, mean pain VAS scores (± SD) at rest were 37 ± 28, 18 ± 19 and 9 ± 14 at the first 12-hour-period, and 24 and 48 hours after surgery, respectively. The mean VAS scores during physiotherapy were 47 ± 29 and 33 ± 29 at 24 and 48 hours postoperatively, respectively. No significant differences were found in the mean pain VAS scores at any time point after surgery, between the Ax and Lo groups (P value range, 0.41 - 0.87). Mean number of loxioprofen (20 mg) tablets required during the 48-hour study period was 5.1 ± 6.9 in the Ax group and 4.5 ± 9.1 in the Lo group. No significant difference was observed (P = 0.90). Among all 36 patients, mean satisfaction VAS score was 91 ± 15. The Ax group and Lo group had overall patient satisfaction scores of 91 ± 10 and 91 ± 11, respectively. No significant difference was observed (P = 0.98).

**Conclusions:**

1. Post-operative mean pain VAS scores at rest after arthroscopic elbow surgery under general anesthesia were found to be 37 at the first 12-hour period and 18 at the 24-hour period.
2. No intergroup differences were observed between the Ax and Lo groups, in terms of VAS pain scores, oral analgesics requirement and VAS satisfaction scores.
3. Post-operative pain levels after arthroscopic elbow surgery could be well managed with oral analgesics.
4. An axillary nerve block was not found to provide any post-operative pain control benefit.

**A-0439 A novel flexible elastomer conduit for peripheral nerve regeneration**

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Biomimetic scaffolds able to resemble the native architecture and mechanical properties of the target tissue can often facilitate regeneration. In this study, porous and elastic crosslinked urethane-doped polyester (CUPE) scaffolds were developed for peripheral nerve regeneration, based off the basement membrane microtube theory, and designed with multiple internal longitudinally-oriented channels and an external non-porous sheath, to mimic the native endoneural microtubular structure and epineurium, respectively. The fabrication technique allows for great flexibility in the scaffold channel geometry, porosity and mechanical properties. CUPE multichanneled scaffolds displayed an ultimate peak stress, which was in the range of native nerve mechanical properties. CUPE multichanneled scaffolds were also evaluated in vivo for the repair of 1-cm rat sciatic nerve defects. After 8 weeks of implantation, CUPE multichanneled scaffolds compared favorably with nerve autograft, in terms of myelinated fiber density and population. These studies present a platform for future studies towards the optimisation of CUPE multichanneled scaffolds for nerve tissue engineering.

**A-0442 Comparison of short wrist transverse open incision and limited open incision techniques for carpal tunnel release**

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**Purpose:** To evaluate the safety and effectiveness of short wrist transverse open incision technique for carpal tunnel release (CTR) [Group B], when compared with a limited open technique [Group A].

**Methods:** The patients who underwent either single distal wrist crease or limited open incision for isolated carpal tunnel syndrome between June 2006 and May 2010 by a single surgeon were studied prospectively. The limited open method was performed in 55 hands in 50 patients, and the short wrist transverse open method was performed in 45 hands in 42 patients. The patients were routinely evaluated at 2 weeks, 6 weeks, 3 months, 1 year and 2 years after surgery. At every follow up, we evaluated the Brigham and Women’s Carpal Tunnel Questionnaire (BWCTQ), scar pain and subjective patient satisfaction. We performed a minimal transverse incision at the distal crease of the wrist and used a Metzenbaum scissors to divide the flexor retinaculum in Group B.
**Results:** Both groups had similar BWCTQ Symptom Severity and Functional Status Scores, and subjective satisfaction scores at the statistical comparison points at postoperative 1 - 2 years follow-up evaluations. Incidence of the scar pain did not show any significant difference between the two groups at the serial post-operative follow-ups. At last follow-up, 1 hand in group A reported mild pain and Group B did not have any scar pain. No vascular nor neurologic complications were observed in any patients.

**Conclusions:** Short wrist transverse open and limited open release showed similar results in scar pain, clinical and functional results and in subjective satisfaction; therefore, short wrist transverse open release might be an acceptable option that has efficacy equal to that of the limited open release technique.

**A-0447 Functional and radiological outcomes of a single-center series of 17 wrist prostheses**

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**Purpose:** Our objective was to retrospectively investigate the functional and radiological outcomes of a single-center series of total wrist prostheses implanted between 2001 and 2011.

**Methods:** Nine women and seven men underwent wrist arthroplasty during this period, including bilateral surgery. We analysed 17 implants. Two types of unconstrained anatomic implants were used: Universal Total Wrist® - KMI™ (2001 - 2007) and Remotion® - SBI™ (2007 - 2011). The average patient age was 59 years old. The indications were: seven cases of inflammatory arthritis, eight cases of post-traumatic osteoarthritis, one Kienböck disease and one septic arthritis sequel. The assessment was based on clinical, radiological and functional scores.

**Results:** Fifteen prostheses were reviewed. Mean follow-up was 5.2 years. Four patients had postoperative complications requiring revision surgery. Wrist arthrodesis was performed in three patients. For patients still wearing an implant, clinical evaluation revealed good pain control [Visual Analog pain Scale = 2 /10]. Patients reported that they were mostly satisfied or very satisfied; however, the strength of the operated wrist was lower than the contralateral side. The motion was reduced and below that of the contralateral side (mean wrist flexion/extension arc = 33° and wrist ulnar/radial arc = 20°) except the pronosupination sector, which remained preserved. The Quick Disabilities of the Arm, Shoulder and Hand (DASH) score and the Patient Rated Wrist Evaluation (PRWE) scores were, respectively, 29% and 26%. The radiological analysis showed 46% of carpal implant failure rate. Implant survival rate was 93% at 5 years and 58% at 10 years, when considering implant removal as a criterion. It was 70% at 5 years and 33% at 10 years when taking carpal plate failure as a criterion.

**Conclusion:** The analysis of this series demonstrated good pain control, high satisfaction rates and a small range of motion. We report a high rate of carpal plate failure and of wrist arthrodesis.

**A-0449 The effect of radial ESWT on intrasynovial flexor tendon healing and adhesion formation: an experimental study on Zone 2 flexor tendons of cockerels**

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**Purpose:** Ongoing research exists on the treatment of flexor tendon injuries, because of its inherent complexity. The major concern is avoiding adhesion formation without risking the primary tendon repair. There is limited knowledge in the literature regarding the effect of extracorporeal shock wave therapy (ESWT) on healing of extra-synovial tendons. The aim of this study is to investigate the effect of radial ESWT on tendon healing and adhesion formation of experimental Zone 2 flexor tendon lacerations.

**Materials and methods:** Laceration and repair models were carried out in the deep flexor tendons of the central toes of 80 Ross308 Broiler cockerels. The postoperative period constituted either of the following:

1. Immobilisation in a cast;
2. Controlled passive motion (CPM), as described by Hitchcock et al.;
3. Immobilisation + ESWT on the repair site through a window on cast
4. CPM + ESWT on the repair site. ESWT was applied once a week, for three times starting from the fifth postoperative day. The first application delivered 100 pulses in 2 bars and 10 Hz, the other two delivered 300 pulses in 3 bars and 10 Hz. At the end of 4 weeks, all the cockerels were sacrificed and the central toes were disarticulated for histological and biomechanical evaluations separately. Gap
Results: The immobilisation group had none (8/10) or minimal gap formation, while the CPM+ESWT group had the most ruptures (3/9). In the immobilisation group, the inflammatory grading score of tendon healing was lower than others (P < 0.05). Qualitative adhesion scores were similar statistically, while the quantitative adhesion score of the immobilisation group was lower than the immobilisation+ESWT and CPM+ESWT groups. Failure strength, maximum deformation, stiffness and WOF results were similar between groups. The wind-up ratio was higher in the CPM+ESWT group, with statistical significance (P < 0.05).

Conclusions: The results of this study demonstrate that locally-applied radial ESWT may have some effects on intra-synovial tendon healing, by altering inflammatory responses and adhesion formation.

A-0450 Transfour portal, a new approach at wrist arthroscopy: cadaveric study and technique

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Introduction: To increase our access to lunate bone and the lunate fossa at arthroscopic surgery, we developed a new portal after cadaveric study.

Materials and methods: After a pilot study, we worked on 4 cadavers with 8 wrists, to find the probable advantages and complications of transfour portal in wrist arthroscopy. We also looked for the relationship of this portal and the tendons of the fourth extensor compartment. After insertion of the arthroscopic lens in the 3-4 portal and shaver in 6R portal, under direct vision of arthroscopy, we inserted a needle through the dorsum of the wrist exactly at the level of the lunate midpoint and directed it 45 degrees downward, toward the radio-carpal joint space. After a superficial incision of the skin, the new portal was created with a fine and blunt mosquito. A tape was passed from portal 3-4 to transfour, and another tape from 6R to transfour, as a retractor. Then a 3 mm burr was inserted and removed through this new portal, four times. The burr and the shaver were removed and the articular surface was looked at for any cartilage injury. Then the arthroscopy was removed and the skin was incised longitudinally on the transfour portal. The relationship between the portal and the extensors, and any crush of the tendons, were evaluated.

Results: We didn’t find any complication in these 8 samples with regards to this new portal, including instrument breakage, cartilage injury, or tendon crushes. The portal was between EDC 3 and 4 in four cases, between EDC 4 and 5 in two cases, and between EDC 2 and 3 in two cases.

Discussion: Improvements in wrist arthroscopy need the creation of new techniques, instruments and portals. The transfour portal is a new and safe portal, and it will increase our access to the wrist joint for more operative procedures.

A-0452 Prevention of distal radius fractures after falls in the elderly: costs of health care

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Introduction: Distal fractures of the radius and their incidence are increasing, especially among older women. These fractures are the first symptom of osteoporosis, thus occasioning further diagnosis and treatment of osteoporosis to prevent subsequent damage. Patients may be asked to undergo special training programs to avoid further accidents. The use of targeted, preventive measures will reduce the cost of therapy and follow-up.

Methods: Distal fractures of the radius are the most common fractures of the upper extremity in patients older than 60 years of age. Several therapies are available for this condition. The choice of therapy is controversially discussed, especially in the elderly. Currently, the standard treatment of unstable fractures of the distal radius consists of open reduction and stabilization by angular stable plate systems. Benefits of angular stable treatment include a lower rate of complications and the possibility of early functional treatment without cast fixation, under the guidance of a specially-trained physiotherapist. This approach significantly improves quality of life, because the operated hand can be used quite early for activities of daily living. Especially older patients are able to return early to their familiar environment, thus reducing the cost of care in the bridging period.
**Results:** Evaluation of data at Lorenz Böhler Trauma Hospital in Vienna from 2006 - 2009 revealed the following: 1762 fractures of the distal radius were registered in persons aged older than 60 years. Of these, 771 were between 60 - 70 years of age, 496 were between 70 - 80 years, 425 were between 80 - 90 years, and 70 patients were older than 90 years; 86% were women and 14% were men. Open reduction and fixation were used to treat 633 fractures, while 1129 fractures were treated conservatively. The approximate cost (pre-operative evaluation, operation, hospital costs, follow-up treatment and splinting) of radius fractures treated by surgery is 3.405 Euros, and the cost of conservative treatment is 1.202 Euros, per case. Thus, the annual costs of treating these fractures at Lorenz Böhler trauma hospital had been 851.917 Euros. A 12% reduction by preventative measures would reduce annual costs by 102.230 Euros.

**Conclusion:** Careful data analysis, including the type of fall, injuries, primary as well as secondary therapy will be needed to reduce medical costs for the treatment of radius fractures in the elderly. New aspects of cooperation between acute-care physicians and those in charge of prevention should give rise to preventive measures that will reduce the frequency of falls. Such measures should include screening for osteoporosis and training the sense of balance, as well as supporting muscles. Measures of this type will reduce the costs of medical care as well. We calculated a potential cost reduction of 102.230 Euros/year for distal radius fractures treated at Lorenz Böhler Trauma Hospital; however, as non-hospital costs are not included this figure, the final saving will probably be far in excess of this figure.

**A-0455 Reliability and reproducibility of radiological classifications of SLAC and SNAC wrist**

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**Introduction:** Radiological classifications of scapholunate advanced collapse (SLAC) and scaphoid non-union advanced collapse (SNAC) wrist have a diagnostic and therapeutic aim in conditioning the surgical indications. The lack of precision in interpreting the X-rays may be a source of pre-operative diagnostic error and often requires the systematic addition of more specific imaging such as a computed tomography (CT) or magnetic resonance imaging (MRI) scans. The aim of this study was to study the reliability and reproducibility of radiological classifications for SLAC and SNAC wrist.

**Materials and methods:** The results of 110 wrist CT-scans for SLAC and SNAC-wrist arthrosis were reviewed by a senior surgeon specialised in hand surgery, and a senior bone and joint radiologist. The stage of arthrosis was defined according to the usual classifications for SLAC and SNAC wrist. The corresponding front and profile X-rays were blind analysed by the same surgeon and radiologist, with a second reading at a 3-month interval. We studied the correspondence between the radiological and CT-scan stages of SLAC and SNAC (X-ray/TDM correspondence) as well as the inter-individual variability of the radiographic analysis. Cohen’s Kappa test (K-test) was used for the statistical analysis of the data.

**Results:** For the SLAC wrists, the inter-individual reproducibility was high (K-test, 0.63) with a poor X-ray/TDM correspondence for the surgeon and the radiologist (K-test, 0.36 and 0.38). For the SNAC wrists, the inter-individual reproducibility was moderate (K-test, 0.53) with a poor X-ray/TDM correspondence for the surgeon and the radiologist (K-test, 0.25 and 0.34).

**Discussion and conclusion:** No investigations have ever studied the reliability of radiographic classifications of SLAC and SNAC wrists. Through this study, we may note that there are large differences between the stages of SLAC and SNAC arthrosis, as defined by the analysis of the X-ray and CT-scan results. Furthermore, the radiographic interpretation presents a strong inter-individual variability. A CT scan is an examination that makes it possible to precisely analyse the arthrotic joint surfaces, so it results from this study that an X-ray is not an adequate examination, and is insufficient to define the stage of wrist arthrosis. The classification of wrist arthrosis should be based on an analysis of the CT scan.

**A-0458 Effect of wrist position on distal radioulnar joint stability: a biomechanical study**

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**Purpose:** Previous cadaveric studies investigating distal radioulnar joint (DRUJ) stability were conducted only in the wrist neutral position, and there are no reports to our knowledge focusing on the effect of change in wrist position on DRUJ stability. The purpose of this study was to investigate DRUJ stability in different wrist positions and to examine the relative contribution of each ligamentous component of the triangular fibrocartilage complex (TFCC) to DRUJ stability.

**Methods:** We used eight fresh-frozen cadaver upper extremities. The soft tissues were removed, sparing the interosseous membranes and the TFCC. The humerus and ulna were fixed to the testing apparatus with the elbow at 90° flexion, and the radius and carpus were allowed to translate palmar and dorsal directions freely, relative to the ulna. Testing was performed by translating the radiocarpal unit relative to the ulna, with the wrist fixed in five positions (neutral, 70° of extension, 70° of flexion, 25° of radial deviation and 40° of ulnar deviation), under a load of 20 Newtons in each palmar and dorsal direction. We simulated DRUJ instability in wrists with the TFCC intact and by sequential sectioning of the ulnocarpal ligament (UCL) and radioulnar ligament (RUL) at the ulnar insertions and extensor carpi ulnaris (ECU) floor. A three-dimensional (3D) space electromagnetic tracking device was used for measurement of dorsopalmar displacement of the radius, relative to the ulna. Magnitudes of displacement were analysed in each of two different motion planes (extension/flexion and radial/ulnar deviation) in intact wrists and three sequential sectioning stages, using analysis of variance (ANOVA) followed by post hoc comparisons.

**Results:** In the TFCC intact wrists, the displacements were significantly different between extension and flexion (p < 0.001) and between radial and ulnar deviation motions (p < 0.05). Displacement was significantly lower in wrist extension (p < 0.01) than that in the neutral position. The displacement was significantly lower in radial deviation (p < 0.05) than in the neutral position. In the UCL-sectioned wrists, the displacements were not significantly different between extension and flexion, and between radial and ulnar deviation motions. There were no longer any significant differences between different wrist positions. After sequential complete sectioning of the radioulnar ligaments, the displacement generally increased, compared with those in intact wrists. While the displacements were not different between the extension and flexion motion, the displacements in radial deviation were significantly lower than in a neutral position (p < 0.05). Following ECU floor sectioning, no differences were found in displacement among different wrist positions, during the extension and flexion, and the radial and ulnar deviation motions. There were no longer any significant differences between various wrist positions in this stage.

**Conclusions:** In intact wrists, stability increased in wrist extension and radial deviation. This stability could be due to possible tightening of the UCL. Although DRUJ instability occurred following a simulated radioulnar ligament tear, the DRUJ was stabilised in radial deviation, when the continuity of the ECU floor was preserved. The ECU floor stabilised the DRUJ in radial deviation in the wrists with complete radioulnar ligament tears.

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**A-0461 Distal radius fixation through a mini-invasive approach of 15 mm: a series of 144 cases**

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The volar Henry approach is becoming the gold standard for distal radius fracture fixation. It decreases the incidence of non-union, limits complications (especially Complex Regional Pain Syndrome Type I), and allows for early mobilisation of the wrist. Nonetheless, it has some disadvantages, such as the size of the incision that is not esthetically pleasing and the loss of ligamentotaxis. This is why some authors have developed a mini-invasive approach. The aim of this work was to evaluate the feasibility of the anterior mini-invasive approach of 15 mm in a clinical series of 144 cases of distal radius fracture. All patients were operated under regional anesthesia, using the same techniques, and five surgeons of the same team. According to the AO classification, there were 83 Type A fractures, 2 Type B, and 59 Type C. A volar plate [Step One®, Newclip Technics™, Haute-Goulaine, France] was used in all cases. The two proximal metaphyseal screws and the two distal central epiphyseal screws were monoaxial locking. The two distal ulnar and radial epiphyseal screws were placed in polyaxial locking at 20° angulation, maximum. Skin closure without drainage was performed. No post-operative immobilisation was prescribed and the patients were encouraged to use their upper limb immediately after the operation. No post-operative physiotherapy was prescribed. The mean follow-up period was 4.1 months. The final size of the incision was on average 16.1 mm. The mean pain score was 1.8. The Quick-DASH score was on average 25. Average range of motion (ROM) was more than 85% and global force of the hand was 67%, compared to...
the contralateral side. On X-ray, the mean radial slope was 22°, the mean radial tilt was 8.3° and the mean radioulnar variance/index was - 0.4 mm. There were nine cases of complex regional pain syndrome Type I, which all resolved. Specific complications included two secondary displacements and nine tenosynovitis cases. No tendon rupture was noted. Two intra-articular distal radioulnar joint screws had to be removed at 3 months. One epiphyseal screw required removal 1 month postoperatively, due to loosening. There were no intra-articular radiocarpal screws. Distal radius fracture fixation using a mini-invasive approach is a reliable and reproducible procedure with few complications. It allows anatomical reduction of the distal radius fractures, including intra-articular ones. It can be associated with arthroscopy, scaphoid screw fixation or even percutaneous pinning. Thus, most traumatic lesions of the wrist bony scaphoid screw fixation or even percutaneous pinning. The scapholunate joint was reduced anatomically by manual or joy-stick behavior, then the temporary fix with two K-wires and the scaphocapitate interval was fixed with one to two K-wires. The dorsal portion of the SL ligament was refreshed and a 5 mm x 10 mm x 5 mm (width, length and depth) cubic hole was made at the exact position of the dorsal portion of the SL ligament by a chisel. The proximal one-half of the CH ligament with capitale bone and hamate bone (CH BLB) was harvested as the same size of the cubic hole made at the SL ligament, then grafted to reconstruct the SL ligament, fixed firmly with 1.2-mm diameter Profile combo screws, to the scaphoid and lunate.

**A-0462 Reconstruction of scapholunate interosseous ligament using capitohamate bone-ligament-bone**

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**Introduction:** There are several options for the treatment of the scapholunate interosseous (SL) ligament, such as pinning, capsulodesis, ligament reconstruction using bone-periosteum-bone, bone-ligament-bone, free tendon and half-slip of flexor carpi radialis tendon and tenodesis; however, reconstruction of complete disruption of the SL ligament is still difficult. The capitohamate (CH) ligament is the intercarpal ligament, whose biomechanical characteristics are equivalent to the SL ligament. We reconstructed torn SL ligament using the CH for bone-ligament-bone (BLB).

**Technique:** Indications of this procedure are complete disruption of the SL ligament with DISI deformity, due to flexion-rotation of the scaphoid and scapholunate dissociation with more than 3 mm of SL gap. The extended Berger-Bishop incision was used to explore the carpus and to confirm complete disruption of the dorsal portion of the SL ligament. The detached side of the membranous portion of the SL ligament was debrided, with three to four bone anchors inserted. The scapholunate joint was reduced anatomically by manual or joy-stick behavior, then the temporary fix with two K-wires and the scaphocapitate interval was fixed with one to two K-wires. The dorsal portion of the SL ligament was refreshed and a 5 mm x 10 mm x 5 mm (width, length and depth) cubic hole was made at the exact position of the dorsal portion of the SL ligament by a chisel. The proximal one-half of the CH ligament with capitale bone and hamate bone (CH BLB) was harvested as the same size of the cubic hole made at the SL ligament, then grafted to reconstruct the SL ligament, fixed firmly with 1.2-mm diameter Profile combo screws, to the scaphoid and lunate.

**A-0467 Arthroscopic reduction and internal percutaneous screw fixation of Bennett fracture: 7 cases**

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Several techniques are used for fixation of Bennett’s fractures. The aim of this study was to evaluate the arthroscopic-assisted percutaneous screw fixation of Bennett’s fractures. Seven patients (mean age, 29 years) with three Type I fractures and four Type II fractures, according to Gedda, were operated on under arthroscopic lavage, for fluoroscopic screw fixation and arthroscopic control of the joint reduction. Arthroscopy showed satisfactory joint reduction in all cases. At 4.5 months, the mean pain score was 1 (range, 0 - 4), the Quick-DASH score was 15 (range, 0 - 61) and the Kapandji score was 9 (range, 5 - 10).
Compared to the contralateral side, the first web opening was 86% (range, 58 - 100), key pinch was 73% (range, 45 - 89) and grip strength was 85% (range, 40 - 100). Four secondary displacements were noted, two of which had a step of >1 mm. Our results showed that the use of arthroscopy for percutaneous screw fixation of Bennett’s fractures facilitates joint reduction, but does not guarantee stability of fixation.

A-0473 Conservative treatment or bouquet pinning of acute small finger metacarpal neck fractures: a multicentre, noninferiority, randomised controlled trial of 85 patients

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Background: Current literature gives no guidelines regarding indication for operative treatment of small finger metacarpal neck fractures based on the degree of volar angulation.

Methods: The aim was to determine whether a conservative regime was noninferior to (as good as) bouquet pinning in a parallel group randomised trial. Noninferiority would be declared if the median patient-related Quick-DASH outcome measure (as primary outcome) 1 year after conservative treatment was not worse than after operative treatment, within a margin of 8 points. Secondary outcomes were: pain, satisfaction, range of motion (ROM) of the small finger, grip strength of the hand, life quality quantified by EQ-5D-3L™, complications and sick leave. We included 85 patients over 18 years of age with isolated, acute, extra-articular small finger metacarpal neck fractures with ≥30° volar angulation, without rotational deformities nor unacceptable ad latus in the fracture, from three hospitals. The allocation was concealed, and patients were randomised to either conservative treatment without any attempt of reducing the fracture (n = 43), or closed reduction and bouquet pinning (n = 42). There was no blinding for the treatments, neither for participants, care providers nor data collectors.

Results: Eighty-one patients received the allocated treatment. There were no crossovers, and only four patients were lost to final follow-up. Volar angulation measured mid-medullary in the lateral view at inclusion was a median of 41° (range, 30° - 58°) in the conservative group, and 40° (30° - 59°) in the operative group. At final follow-up after 1 year, the Quick-DASH median was 0 (range, 0 - 25) in the conservative group [n = 40] and 0 (0 - 41) in the operative group [n = 37, p = 0.54], establishing the noninferiority of the conservative treatment. Regarding the secondary outcomes, the only detectable differences between the groups were more and worse complications, and a four-times-longer period of sick leave, in the operative group.

Conclusions: Conservative treatment, consisting of cast treatment of a non-reduced fracture for 1 week, followed by early, active mobilisation, is as good as the bouquet pinning procedure, regarding their Quick-DASH scores and measured hand function, and gives fewer complications and shorter sick-leave. It is therefore recommended for fractures with less than 60° of volar angulation.

Other study and funding information: This study was registered at clinicaltrials.com [NCT01139528] before the inclusion of patients began. This research was supported by a grant from Sofies Mindes Ortopedi AS, Oslo, Norway.

A-0474 Early active finger flexion exhibits better short-term, but not better long-term, results than passive flexion: a prospective randomized study

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Purpose: Some publications suppose superior functional results with early active mobilisation, compared to passive exercises after primary flexor tendon suture in the fingers. Active flexion has theoretical advantages; however, the existing evidence is not robust. Most of the former comparative studies might be biased. These groups differed in suture technique, resting position or other factors. The intention of our study was to evaluate the effect of active mobilisation in a prospective randomized study, where the only difference between the groups was allowing active finger flexion or not.

Methods: We included patients operated at Oslo University Hospital with delayed primary flexor tendon repair in Zone 1, 2 or 3. Major finger injuries were excluded. The surgical procedure and the dynamic splint were standardised. Rehabilitation within the
first 4 weeks was either the traditional active extension passive flexion regime (Kleinert's group) or a modified early active regime (active group), where patients were allowed to perform controlled active finger flexion in addition. After 4 weeks, their rehabilitation was similar. We randomized 29 patients (34 fingers) to the Kleinert's group and 25 patients (40 fingers) to the active group. We excluded one patient (2 fingers) in the Kleinert's and two patients (2 fingers) in the active group, because of re-ruptures. The total active range of motion (ROM) was measured within 5° of accuracy. The patients evaluated ROM, finger function and use of the injured fingers in ADL subjectively, on visual analogue scales (VAS). Our analyses were carried out at 1, 2, 3, 6 and 12 months. Grip and pinch strength, compared to the contralateral side, were measured at 3, 6 and 12 months. The number of fingers with excellent or good function, according to Strickland-Glogovac and Tang, were analysed with the Fisher's exact test; the VAS scores and the strength measures were compared with independent sample t-test, with the significance level set to 5%.

Results: The numbers of fingers with excellent or good results in the Kleinert's and the active groups at 1, 2, 3, 6 and 12 months were: 0/32; 13/32; 16/31; 20/30; 20/29 versus 8/38; 20/36; 23/36; 27/33; 28/34, according to Strickland-Glogovac, and 0/32; 15/32; 18/31; 21/30; 22/29 versus 8/38; 21/36; 23/36; 27/33; 30/34, according to Tang. All these data favoured the active group, but only at 1 month were these differences significant. The mean VAS score for finger function was 4.9 (SD 2.6) and 6.8 (SD 2) at 1 month; and for use in ADL was 5.9 (SD 2.6) and 7 (SD 1.6) at 2 months; while the pinch strength was 73% (SD 23) and 86% (SD 19) at 6 months in the two groups, respectively, significantly favouring the active group; however, further registered differences were insignificant.

Conclusions: We found significantly better objective and subjective results with early active mobilisation, compared to Kleinert's regime, in the early rehabilitation phase; but these differences became insignificant later. We were not able to prove that adding active finger flexion to traditional Kleinert's regime could improve the long-term results.

A-0475 Minimally-invasive surgery of distal radius fractures combining a volar plate fixation through a 15 mm approach and a wrist arthroscopy: about 20 cases

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Under the recently introduced concept of minimally invasive fixation of the distal radius fractures, this study assessed the outcomes of a surgical treatment combining a minimally invasive volar plate fixation and wrist arthroscopy. This is a retrospective study of 20 distal radius fractures in physiologically young patients with a high or moderate functional demand and level of activity, with a high-energy trauma orand articular fracture line. The surgical procedure was performed in two steps: First, volar plate fixation, and then wrist arthroscopy. In every case, the skin incision was 15 mm long. The arthroscopic exploration allowed the reduction or the removal of an articular fragment in two cases, and the arthroscopic suture of a scapholunate ligament tear in six cases. At an average of 4.8 months follow-up, the pain was 1.7/10, the quickDASH score was 20.6/100, and the joint motion and the grip strength were higher than 70% of the opposite side values. On average, the volar tilt was 8.8°, the radial inclination was 20.2°, the radioulnar diastasis was 1.5 mm with no dorsal intercalated segmental instability (DISI). The only observed complications were three cases of Type-I complex regional pain syndrome. According to our outcomes, the minimally invasive surgery of the distal radius fractures, combining a 15 mm approach for the volar plate and an arthroscopy, has several benefits, including: aesthetics, ease of fracture reduction and fixation, and the arthroscopic assessment of the articular surface and ligaments. The indication depends on the patient’s functional demand, the trauma energy and the type of fracture.

A-0477 Implementing a new triage system for hand trauma referrals: the Chelsea and Westminster Hospital experience

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Aims: In response to the British Society for Surgery of the Hand’s Hand Surgery Report published in 2007, we created the first Hand Trauma Coordinator (HTC) post at Chelsea and Westminster, in 2011. This paper presents the process by which we have since developed a 24/7 HTC-delivered triage service, as well as the benefits seen, problems encountered and the experiences which we have learnt from during its implementation.

Methods and results: The Hand Surgery Report states that a HTC is essential in delivering a predominantly day case hand trauma service. Our HTCs have...
an overview of the entire service. They have an up-to-date log of all outstanding cases, they liaise with referring hospitals, pre-assess surgical patients, liaise with the patient awaiting surgery and coordinate patients, staff and theatres, thereby maximising day case procedures and reducing admissions, complaints and non-attendences. In September 2013, the Trust was asked to implement a ‘triage service’ for hand trauma, to reduce the junior doctors’ administrative workload and allow them more time for training activities. A previous audit, which showed a significant (p < 0.001) increase in income per month (£38,110/month) for the year following the first HTC’s appointment, compared to the year before, and a significant increase in the number or patients operated on as day cases (12 more/month), was used as the basis for a business plan to increase the number of HTCs, whom could also be trained to triage the calls. This was also an opportunity to develop the Hand and Wrist Unit, and so we set up daily ‘hot clinics’ where non-emergency open hand injuries were assessed within 24 hours. This reduced the number of hand trauma patients reviewed in our A&E, streamlined the patient’s pathway, reduced unnecessary admissions and represented a new income stream. Triageing hand referrals into urgent admission, review in the new ‘hot clinics’ 7/7 or closed fracture clinics, has reduced the workload for junior doctors by 55% and allowed them more time for training. We have also appointmented three new HTCs, to provide an extended ‘coordinating’ role, 7 days a week, and also to perform the initial triage; and two new consultant colleagues to staff the new hot clinics, the uncovered trauma lists and expanding paediatrics service. An audit of all hand trauma referrals has demonstrated a clear pattern (80% from 8 am - 8 pm, 10% from 8 pm – midnight and 10% from midnight – 8 am), which has allowed us to rethink the most efficient distribution of work between the junior doctors and HTCs, and to utilise their different strengths. In addition, we are developing a competency-based training programme for HTCs, by defining their core skills and developing practical competencies that will be assessed as they progress towards triaging the hand referrals. These include: splint making, dressings and triage role-play. We also created an ‘electronic referral form’ for hand trauma, which will further streamline the pathway and develop a hand trauma database for audit and research, once implemented.

Conclusion: Our new hand trauma referral pathway may be a model that other Hand Units will aspire to, but there have been challenges in making the changes.

A-0481 Italian experience of the use of Clostridium histolyticum collagenase in the Dupuytren’s contracture: 264 patients enrolled in 18 hand surgery departments

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Over the past 30 years, much progress has been made regarding the molecular mechanisms and pathophysiology underlying the transformation of the palmar aponeurosis into a fibrotic cord. This new knowledge allowed the development of new treatment protocols for the disease, such as a new, minimally invasive, targeted treatment with bacterial collagenase. Soon after the European Medicines Agency approved a purified Clostridium histolyticum collagenase treatment for Dupuytren’s contracture, a compassionate-use program in Italy allowed for expanded access for patients otherwise excluded from any treatment. The study enrolled 264 patients [mean age, 65.2 years] who were followed up at 1 and 3 months after the final injection. At the 1-month visit, the clinical success rate (reduction in contracture to 0 - 5° of normal) was 81.7% of all joints (223/273), which was 86.8% of those with mild contracture and 74.6% of those with severe contracture; 83.9% [183/218] of metacarpophalangeal [MP] joints and 72.7% [40/55] of proximal interphalangeal [PIP] joints. This was sustained at the 3-month visit: all joints having a clinical success rate were 80.1% [218/272], MP joints were 81.2% [177/218], and PIP joints were 75.9% [41/54]. Clinical improvement (≥ 50% reduction from baseline in the degree of contracture) at both follow-ups was ≥ 95% for all joints, regardless of their baseline contracture severity. No major treatment-related adverse events (AEs) were observed. This uncontrolled study showed better results for C. histolyticum collagenase when used in routine clinical practice in an unselected population, as compared with randomized trials. This innovative, in-office pharmacological option is gaining increasing credibility as the first choice for non-surgical treatment of Dupuytren’s contracture.

A-0483 Ultra-high field ex-vivo MR microscopy of fetal ossification of the forearm and wrist

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FESSH abstracts

Purpose: Evaluation of fetal ossification requires histological workup; and therefore, can only be performed ex vivo. Ultra-high field magnetic resonance (MR) imaging allows the acquisition of images with a spatial resolution within the µm range (MR microscopy or MRM). The aim of this study was to correlate MRM of fetal ossification with conventional histology.

Material and methods: MRM was performed in eight ex vivo fetal forearms and wrists, between the 8th and 12th gestational week, using a 7.1T MR system (ClinScan, Bruker, Etlingen) with a 1 cm small loop coil for signal detection. A three dimensional (3D) T2-weighted sequence, with a spatial resolution of isotropic 39 µm, was acquired in all specimens. Imaging time was 17 min per specimen. Afterwards, all specimens underwent conventional histological work-up with hematoxylin and eosin (H&E) staining and a dedicated stain for the evaluation of ossification centers.

Results: Ossification of the forearm can be visualised starting at the 8th gestational week, whereas ossification of the metacarpal bones can be visualised at the 10th gestational week, within the metaphysis; however, ossification centers of the carpal bones can be visualised at the 8th gestational week. There was excellent correlation between MRM and conventional histology.

Conclusion: MRM allows for the non-invasive assessment of fetal ossification of the forearm and wrist, with excellent correlation to conventional histology. With the increasing availability of ultra-high field in vivo MR scanners, MRM may play an important role in preclinical research.

A-0484 Immunomodulation with adipose- and bone marrow-derived mesenchymal stem cells in vascularised composite allotransplantation

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Reconstructive transplantation has become a clinical reality over the past decade. Life-long immunosuppression is mandated to sustain graft acceptance, with coincident adverse effects (AEs). Cellular therapies incorporating bone marrow or adipose tissue-derived mesenchymal stem cells (BM-MSCs or ASCs, respectively) have shown promise as immunomodulatory strategies in autoimmune disease, and experimental models of solid organ and vascularised composite allotransplantation (VCA). In this study, Lewis (LEW) rat recipients received fully mismatched Brown-Norway (BN) limb transplants. BM-MSCs or ASCs were isolated and cultured. Specific stem cell markers (CD29+CD73+CD90-CD45-) were used to characterise these MSCs. BM-MSCs or ASCs were tested for their suppressive function in mixed lymphocyte reaction (MLR) assays, incorporating the BN donor lymphocyte stimulation of the LEW responders. In addition, stimulated peripheral blood mononuclear cells (PBMCs) were co-cultured with BM-MSCs or ASCs. Both BM-MSCs and ASCs exhibited immunosuppressive function; however, the ASCs demonstrated superior efficacy. In in vivo experiments, the rats were treated 1 day post-transplantation with ASCs or BM-MSCs (10⁶ cells/animal). For all cells, 50% of the animals treated with ASCs or BM-MSCs showed long-term acceptance of the transplanted hindlimb, with survival >120 days. These findings were correlated to microchimerism in the marrow, spleen and inconsistently, in the lymph nodes. In summary, our results confirmed that ASCs and BM-MSCs have immunomodulatory effects that may be beneficial in reducing the intensity, frequency or duration of immunosuppression in VCA. The high cell yields of ASCs, combined with the insights supporting the superior immunomodulatory potential of ASCs versus BM-MSCs, truly advocate for adipose-based cellular therapies. It still remains to be defined if paracrine effects are also involved in the tolerogenic or immunomodulatory effects in transplantation.

A-0490 Combined transfer of the medial triceps branch to the infraspinatus branch of the suprascapular nerve and the axillary nerve, and use of the cutaneous branch to reinnervate infraspinatus, for restoration of shoulder abduction and external rotation: a case study

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Complete injury to the C5/6 roots of the brachial plexus results in loss of shoulder abduction, shoulder external rotation and elbow flexion. The results of nerve grafting of upper trunk ruptures are variable, due to post-traumatic axonal loss, axonal misdirection and
The original traction injury. Power et al. have recognised an incontinuity lesion of the infraspinous targeting to the more proximal supraspinatus; or an unrecognised incontinuity lesion of the infraspinous branch of the SSN at the spinoglenoid notch, due to the original traction injury. Power et al. had previously explored the option of separate, targeted reinnervation of the infraspinatus branch of the suprascapular nerve, through a direct nerve transfer from the medial triceps branch of the radial nerve. The original description of radial to axillary nerve transfer used a long head of the triceps branch and the nerve was coapted directly to the anterior division of the axillary nerve after mobilisation. A modified approach, using the medial triceps branch to the main trunk of the axillary nerve, was described, and due to the additional length and diameter of the donor nerve, the coaptation was made to the main axillary nerve trunk. There is the potential to improve the external rotation, as there is the potential for reinnervation of the nerve to the teres minor, through the posterior division of the axillary nerve. This paper describes a further modification of this technique, which provided further improvement to external rotation. This was achieved by medial triceps branch transfer to the main axillary nerve, to reinnervate both the deltoid and teres minor; however, motor axons may be ‘lost’ down the cutaneous branch. We have successfully re-routed this branch to the infraspinatus and present the first clinical case to use this technique. The patient demonstrated full shoulder abduction and external rotation. This new technique improved on our previous one by using what was previously thought of as an unwanted effect of transferring to the axillary nerve, which is a motor axon ‘loss’ down the cutaneous branch, to further improve our clinical outcomes.

A-0491 Is the UK ready for hand transplantation?

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Aim: With the advent of hand transplantation in the UK, what was once lab-based theory is now a clinical reality. The aim of this paper is to examine the attitudes towards hand transplantation in the general public (GP), as well as in tomorrow’s clinicians, medical students (MS), and to see if the concept of donating ones’ hands or giving up life years for a transplanted hand, detract people from the concept of donation.

Methods: A survey regarding organ transplantation and hand transplantation was distributed throughout the University of Birmingham medical school and the GP, which identified their demographic data and opinions on solid organ transplantation. Respondents’ knowledge of hand transplantation, their perceptions of its benefits, the level of risk they would be willing to take (in life-years sacrificed) to have the operation, and the indications for hand transplantation were also investigated.

Results: A total of 200 MS and 200 members of the public were interviewed. Of the MS questioned, 91% supported organ transplantation, which was significantly more than the 63% of the GP that did (p < 0.001). Among the GP, opinions over hand transplantation were divided as follows: 63% in favour, 21% against and 17% undecided. MS were significantly more positive about hand transplantation (p < 0.001), with 80% in favour, 5% against and 15% undecided. MS participants were willing to forgo significantly more years of their life than the general population, in order to receive a hand transplant (p < 0.001); however, only 19% of MS and 3% of the GP were willing to sacrifice 11 or more years. When looking at who should get a transplant, a large proportion of MS (69%) and GP (48%) did not agree with the current medical consensus that they should only be offered to bilateral amputees. In both groups it was found that if the respondent lost both hands, then the majority (MS = 81%, GP = 66%) would be willing to have a transplant, even if the risk of failure was 50%. The majority (70%) of MS would be willing to donate, reflecting similar earlier results of solid organ transplantation, whilst 50% of the GP were willing to donate hands. The importance of the donor hands’ skin colour was significantly more important to the GP than MS (p < 0.001), with 51% and 21%, respectively, considering this an important consideration.

Conclusions: This survey suggests that there is support for hand transplantation, both among the GP and MS. Both groups would be willing to donate, despite the challenging concept of donating ones’ hands. Both groups would also be willing to receive hand transplants, but balance comes when more than 11 years is lost from life expectancy, due to the effects of immunosuppression. If hand transplantation is to become a clinical reality, rather than an experimental reality.
exercise, then better population information will be needed, but we found that opinion does not vary greatly from solid organ transplant, despite the more apparent and disturbing concept of donating one’s hands.

A-0493 Hand dominance a myth? Grip and pincer strength analysis: a North Wales population-based study

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Introduction: Common practical belief dictates a hand dominance pattern with a 10% rule applicable to the grip strength. The literature is still divided, with Petersen et al. (1989) demonstrating that the 10% rule is only applicable to the right hand dominant population and the left hand dominant population demonstrating no such predilection. Incel et al. (1994) and Crosby et al. (2002) confirm the 10% dominance theory outlined by Peterson et al., but also state that the non-dominant hand was 50% stronger in left-handed individuals. Bohannon (2003) conducted a review of 10 studies, concluding that though all 10 studies suggested grip strength of the dominant right side to be stronger, the available information was insufficient to make a judgment. The aim of our study was to investigate the 10% rule as per the literature. The objective was to evaluate the grip and pincer grip strength differences between the dominant and non-dominant hand, using the objective parameter of the dynamometer.

Methods: The study design was prospective, including 114 right- and 6 left-hand dominant healthy volunteers [hospital staff]. Grip strength was measured using a Jamar calibrated dynamometer. Pincer grip strength measurements were performed by the manual pinchmeter.

Results: The mean age of the cohort was 39.7 [range, 20 - 67]: there were 62 female and 58 male subjects. There was a statistically significant difference between the grip and pincer strengths for sex, with male predominance. The percentage of stronger dominant grip strength was 3.1% and 0.3% for right and left-handed groups, respectively (p = 0.54). The results for pinch grip showed a stronger nondominant by 4.9% and 6.6%, for right and left-handed subjects, respectively (p = 0.90).

Conclusions: Contrary to the literature, we concluded that there is no significant difference in strength between the dominant and non-dominant hands, in both grip and pinch strength.

References

A-0495 The vascularity of the lunate: a micro-computed tomography study

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Background: The lunate is the second most frequently injured bone in the carpus and the only carpal bone generally undergoing total avascular necrosis. Both traumatic and non-traumatic causes for avascular osteonecrosis of the lunate are described. The primary scope of this study was to assess the intraosseous vascular anatomy of the lunate with high-resolution micro-computed tomography (CT) and to potentially identify safe zones for surgical interventions in the lunate. Our hypothesis is that the high incidence of traumatic and non-traumatic avascular necrosis of the lunate is due to poor vascular distribution of the intraosseous blood vessels.

Methods: Thirteen fresh cadaver wrists were obtained from the Department of Anatomy at the Mayo Clinic, Rochester, MN, USA. None of the extremities had any known previous trauma or disease. Both the ulna and radial artery were cannulated with a 20-gauge catheter. The pedicles were flushed with heparinised saline and formalin, and then injected with a lead-based contrast polymer (Microfil MV-117) under a physiologic pressure of 140 mmHg, monitored by a pressure monitor. After 48 hours, the polymer was set. The lunate bone was transected and scanned at 20-μm voxel resolution, using a custom bench-top micro-CT scanner. The micro-CT scanner generates three-dimensional (3D) images, consisting of up to a billion cubic voxels, each 5 - 25 μm on a side. Tomographic reconstruction algorithms applied to these recorded images, were used to generate 3D images of the specimens.

Results: Thirteen lunate specimens were scanned and incorporated into a 3D rendering: 10 specimens had consistent nutrient vessels entering the bone from dorsal and volar, 1 specimen had no volar nutrient vessels.
and 2 specimens had no dorsal nutrient vessels. The branching pattern of the intraosseous blood vessels was consistent between all specimens. The main connecting blood vessels could be classified as X-, Y- and I-shaped, as described by Gelberman et al. The distribution in this series was 15% X-, 23% I- and 62% Y-shaped. The average number of side-branches from the main connecting vessel was 6.3 side-branches (range, 3 - 10). The side-branches were significantly smaller than the centrally-located main connecting vessel. This main connecting vessel was situated in the center or the distal one-half of the lunate. Two lunate specimens had a more ulnar-volar entering nutrient vessel, where one of the side-branches was supplying the entire radio-volar portion of the lunate.

Conclusion: This study used a novel digital technique to assess the blood supply with high-resolution micro-CT. A consistent, main connecting vessel between nutrient vessels entering from both dorsal and volar characterises the vascular architecture. The smaller side-branches from the main connecting vessel are inconsistent, and in some cases, they supply a significant portion of the lunate. Disruption of the main connecting vessel by surgical intervention or other mechanism would create one terminal nutrient vessel, thus creating a high risk of partial avascular necrosis after future injury to the lunate. Safe zones for surgical interventions in the lunate bone were identified, which will help in minimising iatrogenic avascular necrosis of the lunate bone, by respecting the intraosseous blood supply of that lunate bone, changing our surgical approach accordingly.

A-0498 Complex regional pain syndrome: a closed-loop audit of fracture clinic guidelines

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Background: Patients with complex regional pain syndrome (CRPS) may be seen in fracture clinics by orthopaedic surgeons, although subtle symptoms may be missed. Diagnosis can be difficult, as it is not easy to differentiate how much pain is due to the concurrent injury itself. In our practice, orthopaedic surgeons who suspect CRPS usually write to the patient’s General Practitioner (GP) to ask them to investigate, treat or refer on to the pain team, as required. Patients are also referred to a physiotherapist. We investigate how many patients were being diagnosed with CRPS in the fracture clinic and the duration from diagnosis to commencement of anti-neuropathic medication and CRPS-specific physiotherapy. We present a closed-loop audit, investigating the impact of new guidelines for CRPS treatment.

Methods: We determined the number of patients diagnosed with CRPS in our hospital over a 3.5-year period, by collecting data prospectively and retrospectively from physiotherapy departments and the pain clinic. We conducted a search of patients’ medical and physiotherapy notes, to determine the delay from the start of CRPS symptoms and diagnosis to the start of appropriate treatment. Progression of symptoms was recorded. New CRPS guidelines were introduced to the fracture clinic in January 2013, in which the Budapest Criteria aided diagnosis. Questionnaires were collected regarding patients’ symptoms and orthopaedic surgeons were encouraged to prescribe nortriptylline or pregabalin, depending on the patient’s age. Referral to physiotherapy is to be made and patients are then reviewed in the fracture clinic after 6 weeks. Referral to the pain team was only made if the symptoms did not improve. A re-audit of these guidelines was performed.

Results: The first audit cycle found 11 patients diagnosed with CRPS, within 3.5 years. Only one patient was referred from the fracture clinic. The mean delay to anti-neuropathic medication from diagnosis of CRPS was 4.7 months (range, 2 - 7 months). Several different anti-neuropathic medications were being prescribed, and different physiotherapy modalities were offered, with no standardisation. Two patients received psychotherapy, one required intravenous pamidronate, three were admitted for nerve blocks and aggressive physiotherapy and two referred for spinal cord stimulators. After implementing the guidelines, the re-audit found 13 patients with CRPS within 6 months: 10 came from the fracture clinic, 2 from their GP and 1 from physiotherapy. All but one patient had received anti-neuropathic medication on the day of diagnosis. Two patients were lost to follow-up. The other 11 patients all markedly improved, 4 - 12 weeks following diagnosis. No patients required escalation of treatment, admission nor referral to the pain team.

Conclusions: The new guidelines increased the pick-up rates of CRPS by orthopaedic surgeons. Diagnoses were made at an earlier stage in the course of the patient’s symptoms. Physiotherapy modalities remained extremely varied, despite a positive diagnosis of CRPS. Despite this, earlier commencement of anti-neuropathic medication by orthopaedic surgeons led to a rapid improvement in symptoms in all cases. The limitations of the study are that the outcomes were measured retrospectively and subjectively, from medical and physiotherapy notes; however, physiotherapists were blinded to the study, so they recorded...
unbiased accounts of the symptoms. Initial results are encouraging, as a pilot for further prospective research.

A-0505 Articular shape of the thumb carpometacarpal joint differs with age, but not sex
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Introduction and background: Thumb carpometacarpal joint osteoarthritis (CMC OA) is often considered a mechanically-mediated disease. Joint incongruity increases contact stress and cartilage degradation. The higher prevalence of CMC OA in women and increasing incidence with aging implicates potential sex and age differences. Conflicting reports on CMC joint curvature and its relationship to OA exist [1,2,3]; small sample sizes and investigation with older cadaveric specimen limit current literature.

Purpose: We evaluated the CMC joint shape in vivo, related to sex and age, using a large cross-sectional experimental design. We hypothesized that articular shape varies with sex and age.

Materials and methods: We enrolled 65 healthy subjects without pathology, grouped by sex and age (Young: 14 males/16 females, aged 18 - 25 years; and Old: 16 males/19 females, aged 45 - 75 years). High-resolution [0.625 x 0.4 x 0.4 mm3 voxel size] three-dimensional (3-D) volume images of the trapezia and first metacarpals, obtained with a 16-slice computed tomography (CT) scanner (GE LightSpeed 16). Bone segmentation, mesh surfaces and articular delineation from the CT scans were performed and computed [Mimics v12 and Geomagic® Studio]. We computed an order 5 polynomial fit to articular surface points and the average principal curvatures (kmin and kmax). Group comparisons of curvature and scaling were performed, with statistical modeling of size and curvature parameters, as a function of sex and age.

Results: Our findings showed that with aging, the trapezium becomes more curved in the radio-ulnar [kmin] direction and less curved in the dorso-volar [kmax] direction, whereas the metacarpal becomes less curved in the radio-ulnar [kmax] and more curved in the dorso-volar [kmin] direction. Whole bone surface areas and articular facet surface areas were significantly greater in young male than in young female subjects, for both bones; however, the surface area ratio of articular to whole bone was not different between sexes. The average kmax for the trapezium was significantly higher in females, a difference that disappeared after scaling.

Discussion: No difference between the articular shape of male and female joints, after accounting for size, is consistent with the finding of Marzke [3], but refutes Ateshian [1], who found that female trapezia were more curved than male, even after normalisation; and North and Rutledge [2], who conversely found female joints to be flatter. No previous studies report a quantitative analysis of joint shape differences with aging. These findings, along with geometric differences of the trapezium as more curved in the dorso-volar direction and the metacarpal in the radio-ulnar, suggested that the articular surfaces conform with age. Joint congruence requires geometric conformity as well as positioning, which requires further investigation. We postulate that trapezial flattening in the dorsal-volar direction with aging may accompany the oft-reported laxity in this direction.

Conclusions: Aging, not sex, affects the articular surface shape of the CMC joint. If articular shape plays a role in the pathogenesis of CMC OA, it is a mediating, rather than a leading one. Funding: NIH AR059185 and ASSH Resident seed grant.

References

A-0519 Reconstruction of traumatic dorsal loss of the thumb: four different surgical approaches
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Introduction: Traumatic dorsal loss of the thumb presents a difficult reconstructive problem. There are different surgical techniques for dorsal thumb reconstruction, including partial great toe transfer or pedicle flaps. This work outlines our current methods for thumb reconstruction following major dorsal skin, nail and bone loss, with intact palmar skin.

Methods: In the period between 1990 - 2012, we treated 25 patients between 19 - 58 years of age for dorsal thumb defects, employing four different surgical techniques. Five cases of dorsal compound traumatic bone loss were reconstructed by custom-made free vascularized toe transfer, including the nail complex and the bone. In eight patients presenting skin...
defects localised between the MP joint and the nail of the thumb, reconstruction was achieved by means of the Kite flap (in two cases, reconstruction was accomplished with an iliac bone graft). Five patients with dorsal skin and nail loss located at the distal phalanx level were covered with the homodigital flap, with reverse flow vascularisation. Finally, five cases suffered extensive dorsal skin loss and reconstruction was done using different forms of the radial forearm flap (cutaneous, fascial and osteocutaneous).

**Results:** Flap survival was obtained in all cases. No vascular complications occurred in the cases treated with free vascularised compound toe transfer. Bone union was established in all patients.

**Conclusions:** Custom-made partial great toe transfer could be employed in selected young and well-motivated patients with extensive dorsal thumb loss. The Kite flap is particularly indicated in skin loss, located at the proximal phalanx of the thumb with an intact nail. The reverse homodigital island flap is a good solution for dorsal distal skin loss, in patients refusing microsurgical reconstruction. The pedicle fascial radial forearm flap represents a simple solution in cases with extensive skin defects.

**A-0520 LCP fixation, iliac bone grafting and autologous platelet concentrate in the management of ulnar non-unions**

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Few reports have been published to help in guiding the treatment of diaphyseal forearm non-unions, and in particular regarding isolated ulnar non-unions. Between 2004 – 2012, we treated 15 patients with isolated established ulnar non-unions, with a corticocancellous iliac graft, a dynamic compression plate and injection of autologous platelet gel. The inclusion criterion for this study was having a non-union with a segmental defect measuring between 1 - 5 cm in length, secondary to a traumatic fracture of the ulna. We excluded patients with non-traumatic ulnar non-unions, associated non-unions of the radius, infected non-unions or with an associated neurological impairment of the ipsilateral upper extremity. There were 11 men and 4 women, with a mean age of 36.9 years (range, 16 - 50 y). The mean time between the initial fracture and surgery was 11.5 months (range, 7 - 32 mo). Eight patients had a motorcycle accident, five patients reported a fall and in the remaining two cases, the trauma occurred after a sports injury. Initially, the fracture was treated with plate and screw fixation in 11 of the patients, intramedullary nail fixation in three patients and cast immobilization in one case. The patients were all treated with osteosynthesis, using a dynamic compression plate (LCP) and a biological enhancement of the consolidation, using a bone graft and autologous platelet injection. The follow-up included clinical and radiographic assessments. To assess the functional outcomes, we used the Visual Analogue Scale (VAS) for pain and the Disability Assessment for the Shoulder and Hand (DASH) questionnaire. The mean time of follow-up assessment was 21 months. Considering both clinical and radiological criteria, bony union was achieved in 14/15 cases, in a mean period of 4 months. According to the Anderson’s Score, the results were excellent in nine patients, satisfactory in three cases and unsatisfactory in two cases. One patient showed failure. At follow-up, the mean VAS score for pain in the upper limb was 1 [range, 0 - 4] at rest and 2 [range, 0 - 7] during activities. The physical function and symptoms of the upper limb, evaluated with the DASH questionnaire, scored 17 points. Corticocancellous iliac graft, a dynamic compression plate and injection of autologous platelet gel represented feasible procedures for the treatment of acquired, aseptic, isolated ulnar non-unions.

**A-0524 Penetration of the dorsal cortex by drill-bit and downsized screw fixation, during Volar Locking Plating for unstable distal radius fractures**

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**Purpose:** This retrospective case-control study aimed to analyse the difference in (a) the length of distal screws; (b) the change of radiologic parameters and (c) the frequency of extensor impairments, after the two different surgical procedures of volar locking plating for unstable distal radius fractures, the penetration of only near-cortex followed by unicortical screw fixation; and the perforation of dorsal cortex by drill-bit, followed by the fixation with the screws downsized by 2 mm after gauging. 

**Materials and methods:** We retrospectively reviewed 255 patients with unstable distal radius fractures, treated with standard-sized Acu-Loc® VDR Plates from April 2009 to September 2013. Two different surgical procedures were performed: Group I: unicortical fixation without the penetration of dorsal cortex by...
A-0531 Contributing factors of static and dynamic ultrasound in cubital tunnel syndrome

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Introduction: Electromyography (EMG) is the gold standard to confirm the diagnosis of cubital tunnel syndrome (CuTS); it informs about prognosis, but not about etiology. High-resolution ultrasound (HRUS) analyses anatomical abnormalities of the CuTS, physical properties of the ulnar nerve and its dynamic behaviour. The aim of this study was to compare HRUS data with clinical symptoms, EMG, operative findings and the literature.

Materials and methods: We included 60 patients: 31 men and 29 women; 29 right and 31 left CuTS. Mean age was 52.65 years (26 - 80 y). McGowan’s clinical classification was employed and electrophysiological severity was estimated. HRUS (16 MHz) examined nerve and elbow abnormalities near the medial epicondyle; measured cross-sectional area (CSA) of the ulnar nerve at three levels and a flattening ratio (FR) (transversal/anteroposterior diameters). Nerve stability in flexion was tested and classified into three types: stable, subluxation and dislocation. At 90°, measures were: CSA near medial epicondyle and FR.

Results: With ultrasonography, we found 2 stenosis, 29 pseudonevromas and 25 nerve disorganisations; also, peripheral infiltration in 6/44 cases where it was searched. We revealed 16 morphological abnormalities: most of them were the six epitroclearis anconeus and six osteophytics. In extension, CSA (cm²) was 0.075 in proximal, 0.112 near the medial epicondyle and 0.070 in the distal. FR was 1.549. In flexion, CSA near the medial epicondyle and FR were, respectively, 0.117 cm² and 1.827. Flexion significantly increased FR (p = 0.0063). Ulnar nerve instability was present in 19 cases (11 subluxations and 8 dislocations); 17 were unstable during surgery but there was no significant difference (p = 0.6083). Amyotrophy of the first dorsal interosseous was found in 15 cases. Twelve patients were McGowan stage 1, 21 were Stage 2(a), 18 were Stage 2(b) and 9 were Stage 3; it was consistent with the presence of pseudonevroma or nerve disorganisation at HRUS with, respectively, p = 0.2579 and p = 0.2615. At EMG: 5 patients had no abnormality, 21 had moderate abnormalities and 34 had severe, with axonal loss. Nerve disorganisation was mainly revealed when there was severity at EMG (p < 0.5). Surgery found 32 stenosis, 18 pseudonevromas and 10 epitroclearis anconeus. There were no significant differences for the presence of HRUS morphological abnormalities and surgery.

Discussion: All data matched with literature. CSA of the ulnar nerve near the medial epicondyle significantly increased when patients had CuTS. The mean CSA cut-off to diagnose CuTS is 0.092 cm². In this study, it was 0.112 cm². Flexion significantly raised the FR value. It was usually used in carpal tunnel syndrome, and it seemed to be easy for the CuTS diagnosis. In the literature, the presence of sonographic instability of the ulnar nerve in CuTS is 40% (range, 21 - 60%); in this study, it was 31.66%. HRUS matched with the sonographic and clinical

A-0531 Contributions of static and dynamic ultrasound in cubital tunnel syndrome

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Results: The mean length of the longest screws used for each patient was 18.75 mm in Group I and 21.03 mm in Group II (p < 0.001). The difference of change in radial length and inclination measured immediately and at 3 months after operation were not significant (p = 0.366 and 0.391, respectively). Extensor pollicis longus tendon rupture occurred in 3 patients, of whom one (1.8%) was in Group I and two (1.0%) in Group II. The difference was not significant (p = 0.526).

Conclusion: While the longer longest screws were used in cases with the penetration of dorsal cortex by drill-bit, followed by downsized screw fixation by 2 mm after gauging than in ones with the penetration of only near-cortex, followed by unicortical screw fixation, the superiority of the former surgical procedure in stabilisation by the drill-bit. We believe the key in the volar locking plating for unstable distal radius fracture is ultimately a meticulous surgical technique.
classifications. We found that ultrasonography is a successful tool to diagnose CuTS and its etiologies. HRUS could replace EMG for CuTS if this is isolated.

**A-0533 Carbon nanotubes and neural regeneration: preliminary in vitro research**

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The purpose of our study is to propose new insights into the direct and specific interactions between carbon nanotubes (CNTs) and neuron and glial cells’ electrochemical activity. Since 2010, our in vitro research on the application of CNTs has focused on the peripheral nervous system, to study and control cells’ biocompatibility and regeneration, in order to program a suitable axon extension after a peripheral nerve injury, which produced a degenerative cellular and molecular disaggregation at the lesion site. A series of carbon nanotube (CNT) samples have been prepared, grown on quartz substrates on a base of differently-designed patterns. Multiwalled-type Carbon Nanotubes (MWNTs) were used, vertically aligned with respect to the substrate surface, with lengths between 100 - 200 μm, and external diameters between 10 - 20 nm. Samples were prepared by using the Low Pressure Chemical Vapor Deposition (LPCVD) technique, following the designed patterns. The biocompatibility and biomimetic properties of CNTs were tested in vitro, using a glial cell line (NOBEC cells), because glial cells are the key elements of nerve regeneration. Cells were cultured for 3 days in DMEM medium, and then 10% FBS on quartz coverslips, where CNTs were grown in regularly-spaced spots. Cells were assessed as regards their survival and vitality, as well as for their interactions with the CNTs, using light and scanning electron microscopy (SEM). Light and scanning electron microscopy observations showed normal proliferation rates of NOBEC cells, and did not show any sign of cellular death at any time; yet the vitality of the NOBEC cells was maintained over all the observation period. Finally, SEM observations showed that cells grow on CNTs display numerous lamellipodes, with signs of focal adhesion close to the CNT surface. From the in vitro experiments, we also observed that glial and neuronal cells matched with CNTs showed some significant and intriguing behaviour, such as: absence of cytotoxicity; cellular and molecular interaction with enhanced cellular proliferation; cellular axonal and dendritic regeneration; electrical stimulation and cells attraction towards CNTs assemblage. Additionally, we observed the dissociative ability of glial and neuronal cells, when matched and excited, to upset the carbon nanotube arrays. Recently, in the field of neuroscience, the application of single-walled (swCNTs) or multi-walled (mwCNT) CNTs has changed the approach to nerve-related research. Today, the innovative neuroscience, through CNTs’ physical and chemical features, may enhance regenerative strategies by means of intrinsic capacity to guide, at the nanodimensional scale, the specific interactions between synthetic materials and biological cell membranes. Our study investigated the interactions between living systems and the nanomaterials at a molecular level, to check for the ability of CNTs to enhance cellular and molecular interactions on glial and neuronal performance. The biocompatibility of CNTs in our in vitro experimentation is very significant for in vivo research, as well as for future clinical applications, but at present the ways in which carbon nanotubes affect cellular function are still poorly understood.

**A-0535 Using a mini-TightRope (Arthrex) alone, to suspend the thumb metacarpal after a trapeziectomy: Is this a viable option? 1-year and 2-year results**

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**Purpose:** Based on review of the current literature, the most common procedure for painful carpalmetacarpal joint of the thumb (CMC-I) osteoarthritis remains trapeziectomy, with or without tendon suspension interposition. Recently, the use of a mini-TightRope (Arthrex) has been suggested to suspend the thumb metacarpal, replacing the need for the tendon suspension and interposition. The aim of this prospective study is to report the 1-year and 2-year results using the mini-TightRope alone, following trapeziectomy in patients with advanced CMC-I osteoarthritis.

**Methods:** We included in the study 69 patients (65 women and 4 men) with a mean age of 59.5 (range, 44 - 75) years, suffering from painful CMC-I osteoarthritis whom were previously treated conservatively for longer than 1 year. The surgical technique included an open trapeziectomy with suspension of the thumb metacarpal to the second metacarpal, using a mini-TightRope. Patients were immobilised for 2 - 3 weeks, after which range of motion (ROM) exercises were encouraged. Pain was recorded on a visual analogue scale (VAS) before surgery, and after 3, 6, 12 and 24 months. Thumb function was recorded at the same...
intervals, measuring quick-DASH, key pinch grip strength, first webspace angulation and ROM (via the Kapandji method). Radiographic measurements included the trapezial space ratio. Any complications were documented.

**Results:** All 69 patients were reviewed by 1 year, and 34 of these patients at 2 years. The surgical technique proved successful in all 69 patients, with no intraoperative complications. No devices needed removal nor caused complications. The average VAS pain improved from 7.57 pre-operatively, to 0.41 post-operatively. The average quickDASH score improved from 56.1 to 10.4. The first webspace angulation improved from 33.8° pre-operatively to 38.4° post-operatively; and the ROM improved from average 7.8 Kapandji score pre-operatively, to a 9 post-operatively. The average post-operative key pinch grip was 3.63 kg, unchanged compared to 3.68 kg pre-operatively. We found no deterioration between 1 year and 2 years. Follow-up is ongoing up to 5 years. We recorded 89% excellent, 8% good and 3% fair results. One patient, who was also treated for carpal tunnel syndrome and Dupuytrens, had persistent pain at 9 months, but this improved after revision carpal tunnel release.

**Conclusion:** Use of the mini-TightRope to suspend the thumb metacarpal following trapeziectomy was a simple procedure allowing for early mobilisation of the thumb, post-operatively. In addition, it provided significant improvement in both pain (VAS) and function (quickDASH score), improved ROM and webspace, and maintained key pinch strength. There were no complications related to the mini-TightRope. We therefore concluded, based on these 2-year results, that using a mini-TightRope is a safe and effective method to suspend the thumb metacarpal after trapeziectomy, without need for immobilisation nor tendon harvest.

**A-0537 Phalanx reconstruction after finger bone tumor resection**

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**Aim:** To assess the long-term outcome of hand phalanx tumors after resection and reconstruction of the bone and nail bed.

**Materials and methods:** Between 2000 and 2012, we operated on 34 cases with phalanx tumors, in which 14 patients had the tumors on P1 and P2, and 20 patients on P3. The tumors were enchondroma, osteoblastoma, osteoid osteoma, aneurysmal cyst, epidermoid cyst and glomic tumor with osteolysis, which required bone graft after excision or curettage. Surgical treatment of tumors of the phalanx must respect the following principles:

1. Complete excision of tumor tissue, preventing relapse;
2. Reconstruction of the phalanx length, preserving joint biomechanics;
3. Preserving the functional and/or reconstruction of flexor tendons and extensor apparatus;
4. Avoidance of digital nerve damage and scar pulp; and
5. Preserving the aesthetics of the finger (nail and pulp).

The amount of bone graft was determined pre-operatively (dimension and geometry), by imagistic examination (radiologically, CT, MRI with 3D reconstruction) and was harvested from the distal epiphysis of the radius and iliac crest.

**Results:** In 14 patients with P3 tumors, the pulp and nail aspect and size was perfectly preserved. In 6 patients with P3 tumors, it was necessary to resect ¾ distal of the phalanx and a longitudinal strip (3 mm width) from the nail bed. We used, in addition, a tinfoil nail splint for recovery of the nail bed, but the aesthetic result was unsatisfactory.

**Conclusions:** We consider that the final result quality depended on preserving the nail bed, dorsal cortical portion and the base phalanx joint, followed by an anatomic (geometric) reconstruction with bone graft.

**A-0539 Reverse wedge osteotomy (RWO) of the distal radius in Madelung’s deformity: about 12 cases**

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**Introduction:** Surgical procedures to improve aesthetics and function for Madelung’s deformity are numerous and difficult to assess, as the disease is uncommon. We evaluated an original technique based on a reverse wedge osteotomy of the distal radius (RWO) in a retrospective study of 12 cases and tried to modelise the procedure.

**Materials and methods:** Seven women with bilateral Madelung’s deformity were treated from 1992 to 2011. The 12 cases (5 bilateral, 2 unilateral) were reviewed, with an average follow-up of 8 years (range, 7 months - 18.9 years). Surgery was motivated by aesthetic and functional discomfort at the average age of 27, before any complications. RWO was developed to reorient...
the radial joint surface, while reducing overall radius length as little as possible. Osteotomy was performed through an antero-radial or radial approach, with an average time of 106 min. The wedge was harvested from the excess cortical on the dorsal and radial aspect of the radius. The wedge was then removed, turned round and put back into the osteotomy, to insure closing on cortical excess and lengthening on the opposite side. Fixation was achieved by an anterior plate. An associated osteotomy of the ulna was necessary to avoid an ulno-carpal conflict for 3 cases of very severe deformity. Objective (morphology of the wrist, range of motion (ROM) and grip strength) and subjective (quick-DASH and PRWE) data were analysed. Radiological settings were taken from McCarroll’s study in 2005. A vector model of the procedure has been established, to estimate the osteotomy angles from two McCarroll’s indexes. The nonparametric Wilcoxon test (alpha = 0.05) was used for statistical analysis.

Results: All cases achieved fusion at 3 months; 8/12 cases had the plate removed. There was no complication, except hypoesthesia on the radial side of the thenar eminence for two cases. Aesthetics and ROM improved. Improvement was significant for flexion, pronation and supination, as well as McCarroll’s radiological parameters: significant correction of the palmar and ulnar deviation of the radial epiphysis, as well as the rising of the lunate and palmar displacement of the carpus. The average score of the quick-DASH and PRWE was less than 30/100 at review. All patients were satisfied aesthetically and functionally.

Discussion/conclusion: This osteotomy was based on the principle proposed by Watson in this deformity. In this technique, the wedge was only taken to the ulnar part of the distal radius and was not circumferential. Furthermore, a surgery on the distal radioulnar joint was always associated, whereas no associated surgery on this joint has been done in RWO. The corrective power of RWO is well adapted to the severe Madelung’s deformity. Clinical and radiological results are convincing, and it meets the patients’ expectations. RWO has a special place among the techniques proposed so far. The vector model allows pre-operative planning that should optimise realisation.

A-0543 Modified Suzuki Frame for the treatment of difficult Rolando fractures

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Introduction: Rolando fractures with very comminuted and small fragments could be a challenge for the hand surgeon. We present our further experience with a modified Suzuki frame, with no rubber bands, for the treatment of these fractures in 12 cases, following a case report we published in 2011.

Methods: From April 2011 to October 2013, 12 severely comminuted Rolando’s fractures in 12 consecutive patients were treated by closed reduction and fixation with a modified Suzuki frame, with no rubber bands. Functional mobilisation of the thumb and the CMC joint was started within 1 week. X-rays were taken at 2 weeks and at 1 month, in order to control and possibly correct the amount of distraction and then to verify bone consolidation. The Kapandji score, grip strength and K-pinch strength were measured at the last follow-up, at an average of 62 days (range, 49 - 92) after surgery. Any mid-term complication as residual pain or stiffness was also recorded.

Results: All the fractures healed within 5 weeks. Fracture reduction was maintained in all patients. No inadequate fixation, loss of reduction nor rotational deformity was observed. The frame was removed at an average of 33 days (range, 27 - 41) post-operatively, by verified radiographic consolidation. At 2 months, all patients showed a good ROM at their last follow-up, with a Kapandji score in 7 cases that was equal to the contralateral thumb. In 5 cases, the Kapandji score was 1 point less than the contralateral thumb. No residual pain was recorded. At 2 months, grip strength was 86% of the contralateral hand (range, 70 - 96%). The K-pinch strength was 76% of the contralateral hand (range, 57 - 92%). One patient needed a modification of the tension of the frame after 2 weeks, because of excessive distraction. The fracture then healed with no further complications. One patient developed a radial sensory palsy that resolved in 3 months. One patient had a superficial infection after 25 days, that was successfully treated with oral antibiotics. In this case, the frame was removed at 32 days.

Discussion: The modification of the Suzuki’s frame that we present is a relative simple and mini-invasive technique that allowed immediate mobilisation of the thumb after surgery. The frame can be removed in the clinic without anesthesia, and the risk of tendon adhesion is minimised by the absence of surgical exposure and by the absence of metal under the tendons. This limited series suggested the efficacy of the Suzuki frame in the treatment of difficult Rolando’s fractures.

A-0546 Assessment of quality of pre- and post-operative information documents concerning carpal tunnel syndrome

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Amputation of a spastic, paralysed arm after a stroke: prosthetic supply and functional outcome

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Background: Amputation of a spastic, paralysed arm after a stroke and prosthetic supply afterwards is unusual and to our knowledge, not described previously.

Purpose/aim of the study: Amputation of a spastic, paralysed arm and prosthetic substitution may open opportunities for better quality of life and better physical function in patients after right hemisphere stroke.

Material and methods: Eight years after a severe right hemisphere stroke a man aged 63 years was referred to the orthopaedic surgery clinic for evaluation of possible amputation of his paralysed and spastic left arm. He wanted to replace his left useless arm with a prosthetic arm, to be able to accomplish ‘two hand activities’. To make sure he would be able to use a prosthetic arm, his ability was assessed by a neurologist, neuropsychologist and a temporary artificial arm was produced by the prosthetist and tested under supervision of the occupational therapist. Subsequently, his left arm was amputated 10 cm proximal to the elbow, the prosthetic arm added and he was trained in using it.

Findings/results: The amputation had a positive impact on the patient’s body balance, ADL activities, mood and sleep. Two years after the amputation, he still used his prosthetic arm daily in ‘two hand activities’.

Conclusions: Prosthetic substitution of a spastic, paralysed arm after a stroke can improve patients’ function and well-being.
evaluated weekly for the first month by the surgeon and dressings were also changed. In the meantime, patients started the rehabilitation and the scar treatment, as soon as allowed by the clinical conditions. In our series, more than 170 patients with advanced Dupuytren’s contracture (Tubiana’s Stage II or higher) underwent surgical treatment using a McCash approach from January 2008 to January 2013. All the patients were operated on by a single surgeon and treated by the same hand therapist. All patients were then called for clinical evaluation between August and November 2013: 83 of them attended the visit. We performed measurement of the recurrence rate, delayed complications and scar evaluation. A DASH score was also given to the patients, as well as a VAS questionnaire. The follow-up time ranged between 1-5 years [mean, 2.96 y].

**Conclusion:** With this work, the authors wanted to share their experience on the treatment of Dupuytren’s contracture using a safe and reliable technique such as the McCash approach. Only patients with advanced stages of Dupuytren’s contracture willing to undergo to a radical treatment were included in this study. Our results showed how the McCash procedure should be considered as a safe alternative for the treatment of difficult cases.

**A-0553 Arthroscopic excision of wrist ganglions: difference between the trans-cystic portal technique and the cyst-sparing portal technique**

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Arthroscopic excision of wrist ganglions recently became popular for the treatment of wrist ganglions; however, the preliminary results were contradictory. Maybe the approach to arthroscopic excision of wrist ganglions plays an important role. We analysed two surgical approaches to arthroscopic excision of wrist ganglions. Between April 2009 and October 2012, 47 consecutive patients with wrist ganglions who underwent arthroscopic excision in our institute were classified to two treatment groups retrospectively, the trans-cystic portal technique and the cyst-sparing portal technique, according to the surgeon’s preference. The VAS, Mayo wrist and Disabilities of Arm, Shoulder and Hand (DASH) scores were recorded for clinical assessment. Recurrence, residual pain and complications were evaluated at the final follow-up. There were no significant differences between the groups, with regard to demographic data, preoperative clinical assessment and duration of follow-up. There were also no significant differences between the groups with regard to operative time (p = 0.627), postoperative VAS (p = 0.666), Mayo wrist score (p = 0.677), DASH score (p = 0.919), recurrence (p = 0.491), residual pain (p = 0.696) and complications (p = 0.611). Recurrence was found in 3/47 (6.4%) patients: one in the trans-cystic portal technique group and two in the cyst-sparing portal technique group, respectively. Transient extensor tendonitis was the most common complication. One was noted in the trans-cystic portal technique group and two in the cyst-sparing portal technique group, respectively. Residual pain was noted in three patients with intraarticular pathology. We found no statistically significant difference in the clinical outcomes, recurrence, residual pain and complications, between the trans-cystic portal technique and the cyst-sparing portal technique while performing arthroscopic excision of wrist ganglions. Surgeons can perform the arthroscopic excision of wrist ganglions with their familiar techniques; however, the extensor tendon should be seen perfectly at the end of the operation with care and the intraarticular pathology should be treated simultaneously.

**A-0556 Simulation based assessments of hand trauma coordinators: a need for training**

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**Introduction:** The majority of hand injuries (unlike other trauma) can be managed semi-electively in the outpatient setting or as day-cases. The British Society for Surgery of the Hand’s *Hand Surgery Report* (2007) states that hand trauma coordinators (HTCs) are necessary to provide this service. The role allows a point of contact for both patients and members of staff to streamline the patient pathway. It is now emerging that there may be scope to extend the role of the HTCs and for the coordinators to become involved in the initial triage of referrals. As this role evolves, the concept of simulation should be embraced. Current evidence suggests that skills acquired through training with simulators positively transfers to the clinical setting and improves outcome. This is not exclusive to surgeons and the role for simulation should extend. Our aim was to assess the training and learning needs of HTCs, through the use of low-cost simulation, and to design a competency-based curriculum.

**Materials and methods:** We designed three simulation scenarios based on real patient referrals that had previously been accepted to Chelsea and Westminster Hospital. Patient X-rays were available to view on the
imaging system. HTCs were assessed according to a mark scheme and a senior doctor acted as the referring party. The mark scheme assessed five main domains: (a) administration and patient details; (b) X-rays; (c) assessment and management of the wound; (d) triaging; and (e) professionalism and communication. The HTC and referring party were placed in separate rooms and the phone referral was on loudspeaker, to facilitate marking by another independent doctor, who sat in with the referring party.

**Results:** We assessed 4 HTCs in total, from different backgrounds; a recovery nurse, a physiotherapist, a radiographer and a burn care nurse. Of these, 3 HTCs had a background of working in a plastic or orthopaedic surgery department, 2 HTCs had a background of working in a hand unit. All HTCs scored >83% on administration and patient details (range, 83 - 100%) in every scenario, with one HTC scoring 100% for 2/3 scenarios. Only one-half of the HTCs were able to appropriately assess X-ray images. The assessment and management of the wound had the lowest score achieved for all HTCs in every scenario (range, 33 - 54%). In addition to this, the majority of scenarios were not triaged appropriately to the correct clinic, theatre list or for admission.

**Discussion:** Without the appropriate training, patient safety may be compromised. In order to assess hand injuries and their management, one must have the appropriate knowledge base. Simulation enables the participant to assess their strengths and weaknesses and to tailor their learning. The HTC role requires training to acquire skills to undertake it successfully and safely. To triage patients, one must appreciate the diagnosis, management and consequences of a hand injury. Without this appreciation and knowledge, there is great scope for mistakes to occur. Low-cost simulation scenarios, in addition to structured teaching and a competency-based curriculum, can provide excellent training.

**A-0559 Comparative study between vascularised and non-vascularised bone grafting in non-union of scaphoid fracture**

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Thirty male patients with scaphoid non-union were randomly divided into two groups and were operated on with vascularised bone grafting and non-vascularised bone grafting. The epidemiological data (age, sex, side of involvement, time since injury, mechanism of injury etc.), radiological data (scapholunate angle, capitolunate angle, scapholunate gap, scaphoid length and Nattrass carpal height index) and clinical data (grip strength, visual analogue score, range of motion (ROM) and Cooney’s modified wrist score) were noted preoperatively. All patients were followed at monthly intervals, for 6 months, and were compared to each other at the postoperative month 4, 5 and 6 after completion of the study. All fractures united in both the groups, the mean time of fracture union was 12.66+1.44wks for nonvascularized bone graft group and 8.00+1.30wks for vascularized bone graft group (P value <0.0001). There was no significant difference in other radiological data (P value >0.05). There was a significant difference at postoperative month 4, in the visual analogue score (P value <0.004), grip strength (P value <0.001), scar tenderness (P value <0.005), flexion (P value <0.001), ulnar deviation (P value <0.001) and Cooney’s modified wrist score (P value <0.05). There was no significant difference between the two groups at postoperative month 6. We determined that vascularised bone grafting is a better procedure than non-vascularised bone grafting for scaphoid non-union, achieving earlier union, better grip strength and ROM of wrist.

**A-0560 Scaphoid reconstruction in non-union, using intraoperative 3D-reduction guides based on CT-Scans**

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**Background:** The aims of scaphoid reconstruction in non-union are to achieve bony union and restore the correct anatomic shape of the bone, because malunion may lead to an impaired outcome. Due to the complexity of scaphoid anatomy and the other carpal bones overlying it in conventional x-rays and fluoroscopy, it is difficult to assess the quality of reconstruction intraoperatively.

**Objective:** To develop a reconstruction procedure using patient-specific reduction guides that may be used during operation and that facilitate anatomic reconstruction.

**Methods:** In a first step, a three-dimensional (3D) reconstruction, based on computed tomography (CT) scans of the uninjured scaphoid, is mirrored. A 3D-reconstruction of the affected scaphoid is then virtually osteotomised, leading to a proximal and a distal pole fragment. These fragments are then fitted to the mirrored contralateral scaphoid-model, which defines correct position to each other and thus,
should allow for an anatomic reconstruction of the original shape. Next, using a 3D printer, a patient-specific 3D plastic template is made, which fits exactly to the palmar surface of the deformed scaphoid. Through this template, two K-wires are drilled into the proximal and distal pole, each in a predefined direction. The template is then removed and the zone of non-union is resected. Now a second pre-defined template is put over the four K-wires, forcing them and the proximal and distal poles attached to the wires into the correct position. The defect zone can now be determined, and filled with cancellous, cortico-cancellous or even vascularised bone graft, and the fixation performed with screws or wires. After fixation, the second template and wires are also removed, and the wound closed. Before introducing this procedure in clinical cases, it was tested in vitro with nine plastic scaphoid models. By comparing 3D-surface-scans of the templates with their computer 3D-models, the manufacturing quality of the templates was assessed. Comparing 3D-surface-scans of the scaphoids obtained after reconstruction with the preoperative computer 3D-models, the quality of the reconstructions was tested.

**Results:** A reproducible planning sequence using different software could be developed, allowing planning a reconstruction within about 2 hours. The manufacturing quality of the templates was found to be very high, with maximal differences of less than 0.2 mm. The in-vitro tests revealed a high precision of the reconstructions, with maximal differences of +/- 1 mm. Our experience with the first three clinical cases proved that the system is easily applicable and facilitates the surgical procedure itself. The achieved precision was good with differences of about +/- 1.5 mm.

**Conclusion:** The procedure we present allows for good reconstruction of the scaphoid’s shape, when treating non-unions in vitro. The results of the first three clinical cases are promising and will be tested in a larger series. With a reasonable planning effort, the surgical procedure can be facilitated.

**A-0562 Phalanx bone defect reconstruction**

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**Introduction:** Reconstruction of phalanx bone defect has several origins and still can be a challenge in hand surgery. The aim of our work is to analyse the various therapeutic methods used in our practice and their results, and then to deduce the indications and limitations.

**Materials and methods:** This is a retrospective study of phalanx bone defect reconstruction cases, collated in the Plastic, Reconstructive and Hand Surgery service at Kassab Institute, Tunisia, over a period of 6 years between 2007 and 2012. We selected 140 cases we could exploit that answered the inclusion criteria.

**Results and discussion:** The mean age of our patients was 36.5 years, with a male predominance (85% of cases). The phalanx bone reconstruction was indicated mainly in post-traumatic bone defects (75.5% of cases), most commonly manual workers in the framework of an industrial accident. Infectious causes were observed in 13% of the cases and tumor resection in 11.5% of patients. Reconstruction of the skeleton of phalanx bone was performed in one-third of cases, and an osteoarticular reconstruction in two-thirds of cases (joint arthrodesis of PIP in 70% and DIP, 30%). Cancellous autograft was used the most as a therapeutic choice (93% of cases), taken from the olecranon in one-half of the cases, and the rest from other donor areas (iliac crest bone, bank finger, etc.) The means of stabilisation most often used was an external fixator. We report a low complication rate. The most common post-operative complication was local infection, estimated at 15%. At a mean of 9 months, 100 fingers were followed up with clinical and radiological controls. Bony consolidation was noted at a mean of 10 weeks. Good results were reported in 53% of subjects; nevertheless, malunion cases were observed in 38%, which was generally well tolerated by the patient, and poor results in 9% of patients was represented by non-union cases.

**Conclusion:** We often use the cancellous autograft technique for the reconstruction of phalanx bone defect and restoration of its length. This technique is simple, reliable and reproducible.
rates up from 93 to 100%. The aim of the present study was to determine whether arthroscopically-assisted management for the treatment of scaphoid non-union has similar effectiveness on wrist functionality and radiological outcomes, compared with those of scaphoid fractures. Furthermore, we aimed to evaluate the technical limitations of this minimally-invasive technique for scaphoid non-union with substantial bone loss.

**Materials and methods:** We enrolled a total of 57 patients who were treated by arthroscopically-assisted reduction and percutaneous screw fixation for scaphoid fractures and select non-unions, between April 2006 and July 2012, and we followed them up for > 12 months. These were: 5 women and 52 men, with a mean age of 29.9 years (range, 16 - 64 y). Patients were followed up for a mean of 19.3 months (range, 12 - 54 months). We treated 31 patients for scaphoid fractures (Group I) and 25 for non-unions (Group II). Their averages for time from injury were 16 and 351 days, respectively. We recorded subjective and functional outcomes with radiological parameters, including union, carpal angle, time to union, union rates and complications.

**Results:** Bony union was achieved in 30/31 patients (97%) in Group I, and in 19 (76%) in Group II (p = 0.016). Preoperative and postoperative radiographic parameters showed no significant difference between the two groups, except bone defects measured in the ulnar deviation radiographs, which were an average of 3.5 mm in the non-union group (Group II) and 1.1 mm in the fracture group (Group I) (p < 0.01). Exclusion of seven failure cases of bony union helped draw the conclusion that DASH and PRWE scores, as well as functional outcomes including range of motion and grip strength, did not show significant differences between the two groups. No patient had developed arthritis by the last follow-up, either in the fracture or non-union groups.

**Conclusions:** Although minimally-invasive techniques can be used to satisfy the critical requirement for maintaining a blood supply in acute scaphoid fractures, it has shown limited success for treating scaphoid non-unions. Understanding the biomechanical forces within the carpus and applying tricortical bone graft and rigid internal fixation to counteract bending forces and shear will optimise the environment for chronic crumbled fragments of the scaphoid to unite.

**A-0566 C botulinum toxin Type A in the treatment of Raynaud’s phenomenon, due to systemic sclerosis**

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**Introduction:** Raynaud’s phenomenon is a vasospastic disorder of the extremities that can lead in the hands to pain, disability, ischemic ulcers and digital chronic ischemia. The current medical and surgical treatments are not fully effective, while causing side effects. Recent studies emphasized the value of *Clostridium botulinum* toxin Type A (BTX A) in the management of primary Raynaud’s phenomenon. The originality of Raynaud’s syndrome, secondary to systemic sclerosis, is to combine both arterial vasospasm and sclerosis of the arterial wall, what is supposed to reduce the BTX A effects. The purpose of this work is to evaluate BTX A efficiency in patients with Raynaud’s phenomenon, secondary to systemic sclerosis.

**Patients and method:** We performed a prospective study for 24 months. Patients with severe Raynaud’s phenomenon due to systemic sclerosis received perivascular injections of 100 UI of BTX A in the two hands. Evolution of ischemic ulcers, QuickDASH score, O2 partial pressure and pain were measured before and 30 days after the injection.

**Results:** We treated 42 patients. We noticed a complete healing of ulcers 30 days after injection, the QuickDASH Score improved from 42.1 to 20.6, the O2 partial pressure went from 18 to 42 mmHg, and the pain from VNS went from 6.4/10 to 1.8/10.

**Conclusion:** Like in primary disease, BTX A appears to improve Raynaud’s phenomenon symptomatology significantly, in patients with systemic sclerosis, despite the component of arterial sclerosis.

**A-0571 ISIS trapezio metacarpal prosthesis: a review of 59 cases with 42-month follow up**

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Since the congress in Monaco in 2011, prosthetic arthroplasty has become the reference treatment for trapezio-metacarpal joint arthritis. We report on 59 ISIS trapezio-metacarpal prostheses, which includes a 42-month follow up: 48 patients had no pain at follow-up, either in the fracture or non-union groups.

**Conclusions:** Although minimally-invasive techniques can be used to satisfy the critical requirement for maintaining a blood supply in acute scaphoid fractures, it has shown limited success for treating scaphoid non-unions. Understanding the biomechanical forces within the carpus and applying tricortical bone graft and rigid internal fixation to counteract bending forces and shear will optimise the environment for chronic crumbled fragments of the scaphoid to unite.

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**Conclusion:** Like in primary disease, BTX A appears to improve Raynaud’s phenomenon symptomatology significantly, in patients with systemic sclerosis, despite the component of arterial sclerosis.
A-0572 Lunate revascularisation by Hori technique in Kienböck disease: a contrast-enhanced dynamic MRI-based study

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Introduction: Kienböck disease is an idiopathic pathology inducing the necrosis of the lunate, with its progressive collapse and degenerative changes of the whole wrist. Hori described in 1979 a new surgical approach by a revascularisation with the second dorsal intermetacarpal vascular pedicle, associated with a transitory carpal fusion. The authors present their experience in the treatment of this disease by this technique, particularly followed up by the contrast-enhanced dynamic magnetic resonance imaging (MRI), useful to detect the signals of bone marrow and generally more sensitive to evaluate a response to this specific treatment.

Materials and methods: Four patients (two male and two female subjects), with a mean age at the time of surgery of 25.1 years (range, 19 - 39), affected by a Kienböck disease (two at Stage II, two at Stage IIIa, based on the Lichtman classification), were treated by the technique proposed by Hori. The transitory fusion of the wrist was obtained by fixation with Kirschner wires. The right wrist was interested in three cases, the left wrist in one case. All patients were studied by a clinical examination with a range of motion (ROM) evaluation and a dynamometer analysis. The Visual Analogic Scale (VAS) for the assessment of pain, the quick Disabilities of the Arm, Shoulder and Hand (quick-DASH), and the Patient-Rated Wrist/Hand Evaluation (PRWHE) for the functional evaluation were administered to all subjects. The pre-operative and post-operative imaging was conducted by a standard x-ray evaluation and by the contrast-enhanced dynamic MRI: clinical and radiological follow-up was then conducted at 3, 6 and 12 months after surgery.

Results: The mean follow-up was 17.5 months (range, 12 - 26). All the patients reported significant satisfaction after surgery, with full functional recovery. The VAS score was very low after treatment, with a mean value of 0.75 (range, 0 - 2). The post-operative DASH score reached a mean value of 10.30 (range, 2.20 - 16.18), while the PRWHE was 14 (range, 0 - 31). Postoperatively, the ROM evaluation revealed a mean flexion of 40.0°, a mean extension of 48.0°, a mean radial deviation of 18.0°, and a mean ulnar deviation of 30.0°. In all cases, pronosupination was complete and the Jamar testing was improved to a value of 31.0 Kgs. The radiological study by standard x-ray and the dynamic MRI showed an improvement of the quality and vitality of the lunate, with a good and wide circulation by the new pedicle.

Conclusions: Lunate revascularisation by the second dorsal intermetacarpal vascular pedicle, associated with a transitory carpal fusion, has to be considered a reproducible and viable technique for the treatment of Kienböck disease at Stages II / IIIa, in terms of patients' satisfaction, pain relief and functional recovery. Dynamic contrast-enhanced MRI may represent sensible and specific imaging to evaluate the bony perfusion and tissue vitality after the surgical treatment.

A-0573 Prosthetic replacement of the wrist

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Purpose: Current indications for total wrist arthroplasty include patients with symptomatic end-stage post-traumatic wrist arthritis, rheumatoid arthritis, PRC failures and Kienböck disease. Arthroplasty may have an advantage over arthrodesis, because of the ability to retain motion. The purpose of this study was to evaluate the mid-term clinical outcomes and complications of two different devices: Universal 2 (23 implants) and Re-motion (10 implants) total wrist arthroplasty.

Methods: We report the results of a retrospective review of 29 total wrist prostheses implanted in 27 patients (2 bilateral). Patient satisfaction, the Visual Analog Pain score, range of motion (ROM) and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaires were evaluated. We reviewed radiographic parameters
(stress shielding at the radial component, osteolysis around the screws, radiolucency lines, bone resorption and implant loosening) and complications.

**Results:** At a mean follow-up of 58 months, the DASH score was 36 (after being 68, pre-operatively). Mean pain scores improved from 8.75 to 1.6. The mean wrist flexion-extension arc was 75° [30° preoperatively]. Radiographs revealed radiological evidence of aseptic implant loosening (subsidence of the carpal component) in five cases. Early complications occurred in one patient only, consisting in marginal skin necrosis. Late complications that led to secondary surgery occurred in 5/33 patients: in two cases, a revision of the distal carpal component had to be performed; two cases were converted to a wrist Swanson silicon spacer; one had resection of the ulnar head, for pain on the ulnar side of the wrist.

**Conclusions:** Total wrist arthroplasty performed for pancarpal arthritis represents a good alternative to arthrodesis; it is more appealing for the patient as it provides pain relief and retains joint motion. Recent anatomic prosthetic models can yield successful outcomes with low mid-term failure rates.

**A-0576 Altered displacements of the median nerve and tendons in carpal tunnel syndrome**

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**Introduction:** Carpal tunnel syndrome (CTS) is the most commonly diagnosed compression neuropathy. It has been hypothesized that fibrotic changes of the subsynovial connective tissue may alter the dynamics of structures within the carpal tunnel. Altered longitudinal displacements of structures in the carpal tunnel have been found; however, no study has been conducted relating the severity of CTS to possible altered dynamics of structures within the carpal tunnel.

**Methods:** In this prospective study, we included 128 patients referred with a clinical suspicion on CTS and 42 controls. Clinical severity of CTS was assessed based on the Hi-Ob classification. All patients underwent a nerve conduction study (NCS). Results of the NCS were classified according to the criteria of Padua et al. Controls were assumed to have normal NCS results. Ultrasound was used to measure longitudinal excursion of the median nerve and flexor digitorum superficialis (FDS) and profundus (FDP) tendon of the middle finger.

**Results:** There was no significant difference for age, gender and body mass index (BMI) between the patient and control group. Based on the clinical Hi-Ob classification, we found less longitudinal median nerve displacement in patients with a diurnal tingling sensation in the median nerve area, without (p = 0.003) or with sensory deficits (p = 0.005). No significant difference for median nerve displacement was found between patients with only nocturnal tingling sensation and controls. Based on the NCS classification, we found less median nerve displacement in patients with mild (p = 0.016), moderate (p = 0.001) or severe (p = 0.001) CTS, compared to the control group (4.2 mm versus, respectively, 3.1 mm, 2.5 mm and 2.3 mm). In addition, less FDP displacement was found in patients with mild CTS (p = 0.048) (28 mm versus 24 mm). In the controls, the FDS and FDP moved relatively more independently from each other, compared to patients with severe CTS (p = 0.002) (mean difference of excursion between tendons was 12.4 mm versus 7.9 mm).

**Conclusions:** The motility of the median nerve is decreased and the superficial and deep flexor tendons become more adherent in patients with CTS. These changes become more profound, with increasing severity of CTS. These findings may support that fibrotic changes occur, causing the median nerve to become adherent to the carpal tunnel and in severe cases, that even the tendons are more closely attached. This may have implications for the clinical evaluation of CTS.

**A-0577 Collagenase dose-related correction of flexion deformity in Dupuytren’s contracture: a prospective randomized study**

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**Introduction:** Collagenase injections have been used in treatment of Dupuytren’s contracture. The recommended dose is 0.58 mg per cord. We hypothesized that by increasing the collagenase dose, we might be able to increase the likelihood of correcting the flexion deformities.

**Methods:** A prospective randomized study was conducted to compare two groups of patients with Dupuytren’s contracture. Patients were selected randomly, for either injection of 0.58 mg of collagenase or injection of 0.9 mg. Informed consent and Institutional Review Board (IRB) approval were obtained.
The injection technique was the same for both groups. Patients were seen after 24 hours for the extension procedures under local anesthesia. There were 37 digits in 27 patients in Group I, who were injected with 0.9 mg collagenase; and 34 digits in 29 patients in Group II, who were injected with 0.58 mg collagenase. Group I averaged 58 years in age and Group II averaged 61 years. There were 23 males in Group I and 26 males in Group II. Isolated Metacarpophalangeal (MP) joints were involved in 21 digits in Group I and 18 digits in Group II. Isolated Proximal Interphalangeal (PIP) joints were involved in four digits in Group I, compared to six digits in Group II. Both MP and PIP joints were involved in 12 digits in Group I, compared to 10 digits in Group II. Flexion deformities of MP joints averaged 69 in Group I, compared to 72 in Group II, while PIP joint flexion deformities averaged 41 in Group I, compared to 39 in Group II.

**Results:** All patients in both groups exhibited bruising and swelling of the involved hand after injection, with no significant difference in both groups. Correction of flexion deformities of MP joints to 0 – 5 was achieved in 26 digits (79%) in Group I, compared to 17 digits (61%) in Group II. Correction of PIP joints to 0 – 5 was achieved in 10 digits (63%) in Group I, compared to 8 digits (50%) in Group II. When the two groups were compared, the differences were statistically significant for MP (P = 0.01) and PIP joints (P = 0.02). Patients who did not achieve full correction of the flexion deformities had improvements of the flexion deformities. The mean improvement in MP joints was 40 in Group I, compared to 28 in Group II (P = 0.02). The mean improvement of PIP joints was 27 in Group I, compared with 17 in Group II (P = 0.02). Complications: One patient in Group I had axillary lymphadenopathy that improved in 1 week; 4 patients in Group I and 1 patient in Group II had skin tears that healed within 2 weeks. Patient satisfaction was similar in both groups.

**Conclusion:** Higher doses of collagenase can be used safely for injections of Dupuytren’s contracture cords, and they may increase the success rate of correcting the flexion deformities.

**A-0581 Skin tears during treatment of Dupuytren’s contracture with collagenase injections: a prospective cohort study**

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**Background:** Treatment of Dupuytren’s contracture (DC) with collagenase from Clostridium histolyticum (CCH) by injection is given in two sessions: injection of CCH into the cord, followed after 1 or 2 days by finger manipulation (extension) under local anesthesia. Skin tears may occur during finger extension. In the first multicenter randomized CCH trial (finger extension done without anesthesia), the skin tear rate was 11%. Others have reported higher rates. We aimed to determine the rate and characteristics of skin tears occurring during CCH treatment.

**Methods:** Between December 2012 and November 2013, 164 consecutive patients with DC (mean age 70 years, 82% men) participated in this prospective cohort study. The eligibility criteria were a palpable cord and total extension deficit of ≥ 30° in the metacarpophalangeal (MCP) and/or proximal interphalangeal (PIP) joint. A hand surgeon injected CCH into multiple sites in the cord. Finger extension was done after 1 or 2 days, as schedule permitted. The assisting nurse documented the occurrence of skin tears and recorded their size and location. The same nurse conducted a telephone follow-up after 2 - 4 weeks, inquiring about healing of the skin tear and residual pain. For statistical analysis, Fisher’s exact test and t-test were used.

**Results:** A skin tear occurred in 66 patients (40%), of whom 12 patients had two tears. Patient age and sex were not associated with the likelihood of skin tear. Of the 137 patients who underwent finger extension 2 days after injection, 52 (38%) sustained a tear, compared to 14/27 (52%) patients with a 1-day interval (P = 0.20). The mean pre-treatment MCP extension deficit in patients who sustained a tear was 59° (SD 26), and in patients who did not sustain tear was 32° (SD 23); and the mean total (MCP and PIP) extension deficit was 101° (SD 34) and 64° (SD 26), respectively (P < 0.001). A skin tear occurred in 21/24 patients with MCP contracture ≥ 75° and in 29/32 patients with combined MCP and PIP contractures >105°. The skin tear involved the small finger in 39/66 patients (59%), ring in 18 (27%), middle in 8 (12%) and index in 1 patient; the tear’s location was the palm in 20 patients (30%), at the inter-digital web crease level in 27 (41%) patients and in the finger distal to that level in 19 (29%) patients. The tear’s size was ≤ 5 mm in 30 (45%), 6 - 10 mm in 22 (33%) and >10 mm in 14 (21%) patients. All tears healed: the time to complete healing was <1 week in 13 (20%), 1 - 2 weeks in 37 (56%) and > 2 weeks in 16 (24%) patients. No infections occurred and no patient had residual pain.

**Conclusions:** 40% of patients with Dupuytren’s contracture treated with CCH injections sustained a skin tear during finger extension. A skin tear was significantly more likely in patients with severe MCP joint contracture. In almost one-half the patients, the tear
was smaller than 6 mm and in 3/4 patients, the tear healed within 2 weeks. All tears healed without complications.

**A-0582 Post-traumatic arthritis of the wrist: proximal row carpectomy versus four-corner arthrodesis**

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**Introduction:** Proximal row carpectomy (PRC) and four-corner-fusion (4CF) are both widely accepted treatment options in patients with post-traumatic wrist arthritis following scapholunate ligament injuries (SLAC wrist) and scaphoid non-unions (SNAC wrist). According to the literature, PRC generally provides a slightly faster post-operative rehabilitation and a better range of motion (ROM), while 4CF seems to give a better grip strength and, in the long-term follow-up, less secondary arthritic changes at the lunate fossa. Especially in patients with a SNAC/SLAC wrist at Stage II, both procedures are valuable treatment options. Choosing one technique to be superior over the other is frequently dependent on the surgeon’s personal preference.

**Methods:** Patients who were surgically treated with a PRC or 4CF due to a scapholunate advanced collapse (SLAC) or a scaphoid non-union advanced collapse (SNAC) over a period of 10 years were invited for a clinical follow up. Grip strength and the arc of flexion-extension of the wrist were measured. Pain during daily activities was rated on a visual analogue scale (VAS). To rate the subjective outcome, the Patient-Rated Wrist Evaluation (PRWE), and the quickDASH were used. Standard ap and lateral radiographs were taken, to determine the degenerative changes in both groups and signs of loosening in patients with 4CF. 4CF was performed with two different fusion plates (additional cancellous bone graft was not used).

**Results:** Until November 2013, 56 patients (61 wrists) were assessed clinically and radiologically. PRC was performed in 24 wrists and 4CF in 37 wrists. The mean follow-up was 4.8 years (± 2.5). In the 4CF group, the flexion-extension arc was 55° (± 16) and 60° (± 23) following PRC (p > 0.05). Patients after 4CF had an average grip strength of 25 kg (± 10), compared to 23 kg (± 11) in the PRC group (p > 0.05). Pain during daily activities was almost equal in both groups, with 2.1 (± 2.7) for the 4CF group and 1.9 (± 2.6) for the PRC group, respectively (p > 0.05). Signs of loosening were shown by 30% of the wrists treated with 4CF; however, in the PRWE and quickDASH, a better average rating was found for patients of the 4CF group (p ≤ 0.05).

**Conclusion:** While PRC is a motion-preserving treatment option for painful wrist arthritis according to a SNAC wrist Stage II, 4CF can be chosen for both, SNAC/SLAC wrist Stage II and III. In our study, the 4CF group showed a significantly better subjective outcome. Keeping in mind that long-term arthritic changes at the lunate fossa are expectably higher in patients with PRC, 4CF might be preferable in patients with Stage II arthritis, due to both arthritic and subjective reasons; however, the surgical technique is demanding and signs of loosening can be present if non-locking screws are used. An additional use of cancellous bone transplant is not necessary to obtain high fusion rates.

**A-0584 A 20-year prospective outcome study for the treatment of dynamic scaphoid instability**

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**Background:** There is a plethora of short-term results for the surgical treatment of scaphoid instability due to a scapho-lunate ligament tear; however, the reported long-term results have not been acceptable. A contributing factor may be that a ‘one procedure fits all’ approach has been used, without regard to the pathology of the instability. We present the 20-year follow-up of a prospective outcome study of a procedure specifically designed for the treatment of dynamic instability of the scaphoid.

**Methods:** We treated 104 patients (107 wrists) with dynamic scaphoid instability and an arthroscopically confirmed SLIL tear by Dyna-desis. Dyna-desis is a soft tissue procedure with two components: first is a dynamic tendon transfer to the scaphoid, using 2/3 of the ECRL through the reduced distal scaphoid, providing active extension of the scaphoid; second is a tenodesis of the scaphoid by securing the FCR to the distal-volar scaphoid, creating a tenodesis of the scaphoid to the metacarpal. Sixteen patients (17 wrists) had reached 20 years (range, 20 - 22 years) since treatment with Dyna-desis and were re-examined for function, strength, motion and pain. Questionnaires were completed, including the SF-36 and standardised pain questionnaires. Outcomes were assessed using a Modified Mayo Wrist Scoring System and x-rays.

**Results:** The average grip strength improved from 45 pounds (range, 10 - 90) pre-operatively to 68 pounds (range, 26 - 119) at final exam. After 20 years, the
mean wrist flexion-extension arc decreased by 12°, radial deviation decreased by 3°, and ulnar deviation increased by 2°. At 20 years, wrist x-rays in four views showed no radiocarpal arthritis, and six wrists with pan-trapezial arthritis, one with first CMC arthritis and one with STT arthritis. There was one complication, a fracture through the drill hole, which required no treatment. After 20 years, patients reported an 86% improvement in pain level, with 71% reporting no pain at all. We found 76% of patients had a good to excellent result, as measured by the modified Mayo Wrist Scoring System (the patient with the fractured scaphoid rated in the excellent group) and 100% of patients were satisfied with their results, would undergo the same procedure on the other wrist if needed, and would recommend the procedure to others.

Conclusions and relevance to hand surgery: Based on our long-term (20+ years) prospective outcome study, we recommend Dyna-desis to treat dynamic instability of the scaphoid. We recommend a re-evaluation by the scientific community of the ‘one procedure fits all’ approach to treatment of scaphoid instability, as different stages might require different surgical treatments. We do not recommend using Dyna-desis for static scaphoid instability.

A-0586 Limited excision for Dupuytren’s contracture

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Introduction: The treatment for Dupuytren’s contracture is evolving, with the re-assessment of previously held convictions on treatment resulting in alternative options to complete fasciectomy. We hypothesize that using several simple, small transverse incisions to excise multiple 1 - 1.5 cm segments of a Dupuytren’s cord yields similar results to conventional approaches, with far less operative time, post-operative hand therapy and complications.

Methods: A total of 75 consecutive patients underwent limited open excision of select portions of Dupuytren’s contracture. Multiple transverse 1 - 1.5 cm incisions were used to excise a 1 – 2 cm segment of diseased cord at each incision (average, 3.5 incisions per patient). Average duration of pre-operative symptoms was 36 months. Post-operative photographs were taken of all patients in full flexion and extension, at an average follow-up examination of 2.4 years (range, 12 - 49 months). Hand therapy was offered only if requested or if a significant pre-operative proximal interphalangeal (PIP) contracture existed. A PIP contracture was present in 22 cases (ave 35°). A metacarpophalangeal (MCP) contracture existed in 34 cases (ave 50°). Patients self-graded the outcome as better, same or worse for overall finger function.

Results: The average age at surgery was 63 years, with 56 male and 19 female subjects. The dominant hand was involved in 55% of patients. Digit involvement was 32 in small, 44 in ring, 14 in middle, 3 in index and 5 in thumb (some in multiple digits). Patient outcome score for finger function were 56 better, 13 same and 6 worse. Patients with same or worse outcomes were mostly those with significant pre-operative PIP contractures. Patients had full flexion in 73 individuals and full extension in 52, with 23 being limited. A total of 17 patients noted some persistent contracture or scar tissue and 11 patients noted some contracture tissue recurrence at final follow-up. One patient had a transient digital neuropraxia, which resolved at 6 months. The number of post-operative hand therapy visits averaged 1.4 per patient (range, 0 - 12 visits) with 37 patients had no therapy.

Summary: Limited open excision of Dupuytren’s cords via multiple small, transverse incisions appears to be a viable alternative with several advantages: shortened operative time, simple technique, reduced post-operative hand therapy, avoids wound healing problems, and provides direct visualisation of neurovascular structures.

A-0593 An aggressive plating strategy is effective with a low complication rate, but is not cost-effective in a health district in Norway

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Introduction: Fracture of the distal radius is one of the most common fractures in Norway, about 30% of all fractures. According to the actual incidence-rate, there are 10,000 distal radius fractures in Norway per year. Although current surgical treatment concepts use a more aggressive plating strategy, there is to date no treatment consensus. In a very controlled setting, in a Norwegian health district (110,000 inhabitants, one trauma hospital), a prospective protocol was implemented to document the operative treatment of distal radius fractures in this geographic entity. In an 18-month period, 260 consecutive patients were analysed.
Objectives: The main outcome measure was the q-DASH at 3, 6 and 12 months. Mean treatment costs were calculated with respect to individual hardware used, pre- and post-operative costs (CAT-scan, X-ray and polyclinic follow-up), hospital stay and patient travel. These were compared to the individual coded DRG-income per patient and transferred from NOK to Euro.

Methods: We treated 260 patients with distal radius fractures surgically, between November 2010 and July 2012. In all patients with intra-articular fractures, pre-operative CAT-scan was performed. All patients were followed for a minimum of 1 year. In addition to standard demographic data, all fractures were classified after OTA/AO, standard range of motion (ROM), grip strength, quick-DASH, intra- or post-operative complications, and a radiologic score in addition to specific parameters in intra-articular fractures were recorded. All costs and income related to the treatment period were recorded.

Results: The average age in the cohort was 45 years (range, 16 - 87 years). The majority of patients did receive a volar plate osteosynthesis (two modern multi-angle stable systems were used). We treated five patients with major soft tissue compromise first with 'spanning' external fixation, followed by internal osteosynthesis. In 10 stable A fractures, revision of the extensor pollicis tendon and with casting was performed. A total of 245 patients [91 A3, 11 B2 and B3, 17 C1, 73 C2 and S3 C3] were treated with a standard palmar plate [220], fragment-specific radial [12], palmar [13] or dorsal plate [15], and 15 patients received double-plating. We recorded 32 complications in the cohort, 2 patients suffered from failure of the osteosynthesis, 20 patients from moderate post-operative dystrophy, and there were 4 superficial infections (no deep infection). Also, 10 patients were operated on secondary to a complication (> 4 %). Mean qDASH was 16.5, mean GS was 80% of the GS of the uninjured contralateral side. The mean cost-income balance was negative, with a mean of -600€ per patient (range, 300 - 1500€).

Conclusions: A differentiated operative treatment concept gives good patient- and surgeon-related results, with a moderate to low complication rate, but is far from cost-effective. A correction of the DRG-value controlled income in this treatment setup is necessary, in order to use aggressive plating in this fracture entity efficiently.

A-0599 Which results can we hope for with total dènervation of the wrist? A review of 46 cases

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In osteoarthrosis of the carpus, partial arthrodeses of the wrist are the most common indication. They give the advantage of indolence and stabilisation of the wrist, but the disadvantage of significantly reduced range of motion (ROM). The other option is the total denervation of the wrist (TWD), with the purpose to improve the function and painful phenomena without losing strength nor mobility. The aim of this retrospective single-center study was to assess the reliability of this technique through time. This series includes 46 denervations in 45 patients (37 men and 8 women) treated between January 1995 and May 2010. The average age was 45 years. The etiologies were: 23 SLAC, 11 SNAC, 5 Kienbock disease and 6 sequelae of fracture
of the distal radius. The surgical technique was based on the principles described by G Foucher [1989], but using only two approaches, dorsal and palmar. The assessment was done on visual pain evaluation, which is the main criterion for patients, the Quick-DASH, measurement of force by Jamar dynamometer type, and worsening of osteoarthritides evaluated by standard radiographs. Four patients were lost to follow-up, after 2 months of decline. They were considered failures of the method, despite very satisfactory initial results. Mean follow-up was 40 months (range, 12 - 161). We found that 21 patients were manual workers. VAS was 1 at rest and 3 after effort, at the last follow-up, but it was 7 pre-operatively. We obtained excellent and good results in 78% of patients, there was no loss of grip strength nor decrease of ROM of the wrist. The quick-DASH was 23/100 post-operatively. It has not been demonstrated that there is a difference in results between different etiological groups or according to patient age. Subjects < 50 years old also had as good results as older subjects. Similarly, OA stage, assessed according to the modified Watson classification, did not influence clinical outcomes. The clinical benefit was that it was fast and seemed long-lasting. We identified 10 patients whom had the longest follow-up (mean, 96 months), whom were very satisfied with their surgery. The mean VAS score was 1 at rest and 2 during exercise and the Quick-DASH was 18. In this group, no patient had presented radiographic OA aggravation. Only 7% of patients were not improved and 7% of patients had pain symptoms that reappeared after a period of improvement ranging from 4 months to 1 year. There was no neuroarthropathy. This study confirmed the expected results of this surgery: indolence, preservation of ROM without loss of strength after a technically accurate but simple procedure and results without significant complications. TWD is a reliable and durable surgical solution for treating many painful wrists of various etiologies. This treatment option does not cut off the bridges that might be needed for future surgery. TWD is not a simple salvage method, the goal is to obtain the most indolent wrist, without changing any other clinical parameters. It can be proposed for the treatment of chronic wrist pain in young patients, and manual workers whom want to keep up their good mobility and strength.

**A-0603 Outcomes from the expanded enrollment and additions of contemporary controls for a multicenter registry study utilising processed nerve allografts**

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**Introduction:** The RANGER® registry captures utilization and outcomes data for processed nerve allografts [Avance® Nerve Graft, AxoGen, Inc] in sensory, motor and mixed nerve repairs. In 2013, the registry was expanded and contemporary control groups [MATCH cohort] were added to the registry, to allow for comparisons of outcomes between nerve allograft and tube conduit. Here we report the registry expansion and our early findings from these control groups, as compared to the active database and historical literature.

**Methods:** The RANGER® registry, consisting of 18 centers with 36 surgeons, is designed to continuously monitor and incorporate injury, repair, safety and outcomes. Currently there are 230 subjects with 300 repairs enrolled in the registry. Within the registry, MATCH participating centers conducted screening of medical records to identify potential subjects presenting with nerve gap injuries in the upper extremity distal to the elbow, repaired with either nerve allograft or nerve tube conduit. Identified records meeting inclusion/exclusion criteria with sufficient follow-up were assigned a unique identifier, according to the internal review board (IRB) approved protocol. The contemporary control was analysed and comparisons were made between treatment groups, by site. Response to treatment was defined as reported improvement from baseline. Meaningful recovery was defined by the MRCC scale at S3/M3 or greater, for sensory and motor function.

**Results:** From the registry expansion, 101 subjects with 125 nerve repairs reported sufficient outcomes data to assess a response to the treatment with processed nerve allograft. Overall meaningful recovery of S3/M3 or greater was reported in 88% of these repairs. Subgroup analysis of MATCH participating centers included 50 subjects with 67 nerve injuries in the upper extremity distal to the elbow [34 processed nerve allograft, 20 tube conduit and 13 nerve allograft]. There were 52 sensory and 10 mixed nerve repairs in the dataset. Subject demographics, medical history, and concomitant injuries were comparable between these treatment groups. The average nerve gap between the groups varied at 24 +/- 12 mm,
13 +/- 5 mm, and 58 +/- 42 mm for a processed nerve allograft, conduit or nerve autograft, respectively. In this subset, quantitative data reported meaningful levels of recovery in 80% of nerve allografts, as compared to 50% of tube conduits. There were no reported adverse events related to the treatment groups.

**Conclusion:** Expansion of the registry has found that outcomes remained consistent. Processed nerve allograft continues to demonstrate meaningful functional recovery in sensory, mixed and motor nerve injuries that are between 5 and 50 mm. Outcomes are comparable to nerve autograft and exceed those for nerve conduit, in both historical and contemporary matched controls. The MATCH control arm of the RANGER registry remains ongoing; additional clinical data collected from participating sites will allow for further understanding and comparison of these three treatment modalities.

**A-0604 A novel minimal invasive technique for autogenous cancellous bone graft harvesting from the iliac crest: early clinical outcomes**

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**Background:** Open iliac bone harvesting techniques can result in significant complications and residual morbidity. The aim of this study was to describe a novel minimal invasive technique of bone harvesting for reconstructive and grafting procedures, in which a small volume of autogenous cancellous bone graft is required, such as in hand surgeries.

**Methods:** We retrospectively reviewed 19 cases that underwent hand surgeries in which bone grafting was required, between January and May 2013. A novel minimal invasive iliac crest bone graft harvesting procedure technique was used in these patients. In this technique, a Jamshidi needle was penetrated with a 0.5 cm mini-incision, manually posterior to the anterior superior iliac spine, with a depth of 2 cm. The required amount of bone graft was obtained in this way, which is determined according to the primary surgery site. The clinical evaluation was analysed comparatively, using the VAS scoring system pre-operatively and at post-operative month 6.

**Results:** There was no post-operative complication in any patient. The wound healing of all patients was without any problem. In the final outcome, there was no tenderness, superficial wound infection, scar and pain at the graft harvesting area. The VAS scores were found to be significantly improved in all patients. The results were found to be statistically significant.

**Conclusion:** This novel minimally invasive technique for bone harvesting from the iliac crest resulted in good clinical outcomes. It may be used in small joint or bone surgeries requiring bone grafting. The result of this study should be supported with prospective randomized studies. This technique can be use for tibial, olecranon, distal radius and the other bone graft harvesting.

**A-0605 Ulna shortening using the oblique intra-articular osteotomy (Comtet-Sennwald osteotomy): a review of 77 patients with an average of 28 months’ follow up**

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The oblique intra-articular osteotomy method, designed by JJ Comtet and G Sennwald, has been affirmed in resolving the ulnar impaction syndrome. We report on 77 cases which includes an average of 28 months follow up. Pain decreased from 2.79 to 0.59, on a scale of 4. Range of motion (ROM) in flexion-extension and in pronation-supination has not been significantly modified. This functional result was obtained an average of 5.45 weeks later, with self-mobilisation in 60% of the cases. The early immobilisation used a splint for 3 weeks only. Bone healing was obtained in a mean of 5.4 weeks. Pain, in particular, was improved. The rapidity with which the results were obtained is, in and of itself, a major argument for the effectiveness of this method. We previously reported a smaller series, with only 1 year of follow up. These results show that encouraging early results are maintained long term. This technique has greatly simplified ulnar shortening, with rapid post-operative results. This method is recommended for ulnar shortenings < 4 mm.

**A-0606 Anatomic PIPJ replacements: a comparison of the Avanta and Ascension implants at the 6-year follow-up**

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**Introduction:** Proximal interphalangeal joint (PIPJ) replacement has become increasingly popular. There is little published long-term clinical data. We present our mid-term experience with the Avanta SR and Ascension © Pyro-carbon PIPJ replacements.
**Methods:** Between 2002 and 2008, we treated 38 PIPJ in 21 patients (21 Avanta and 17 Ascension). Patients were prospectively followed, including: range of movement (ROM), radiographs, outcome scores and patient satisfaction. The mean age at surgery was 61 years and the average follow-up was 6.1 years (range, 3 - 11 yrs).

**Results:** Almost all patients reported relief of pain and the majority of the patients were satisfied with the results of surgery. Overall, patients showed a modest improvement in joint ROM. Avanta patients had improved arc of movement of 7°; Ascension patients had an improved arc of 13.5°. Four Avanta implants were revised (two revision joint replacements and two fusions), and there were three other re-operations of Avanta implants, for stiffness. Four of the Ascension implants were revised to new Ascension implants (one for early dislocation and three later revisions for loosening); in addition, two dislocations required closed reduction, and one an extensor tenolysis, for stiffness. We saw early implant migration in the Ascension implants, but only a minority progressed. In our hands, the Ascension implant appeared to perform better than the Avanta. Our implants Avanta, Ascension and total numbers were, respectively, 21, 17 and 38; for dislocation they were 2, 2 and 4 (11%), respectively; for tenolysis 3, 1 and 4 (11%); for loosening 2, 3 and 5 (14%); for those revised 4, 4 and 8 (22%); and for total re-operations 7, 7 and 14 (36%).

**Conclusions:** We found this to be a technically demanding procedure and experienced difficulty with dislocation, stiffness and implant migration in some patients. Overall, we found our mid-term results to be acceptable and believe this gives better functional results than arthrodesis of the PIPJ. We intend to continue with this technique, but believe that patients undergoing the procedure must be kept under review.

**A-0610 A comparison of the Patient Evaluation Measure, DASH and Quick-DASH questionnaires**

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**Introduction:** There is an increasing focus on patient-derived outcomes in hand surgery. This paper assesses two of the most popular questionnaires across a range of common conditions, and compares the performance of the 11-question Q-DASH with the longer 30-question DASH.

**Methods:** We administered the Patient Evaluation Measure (PEM) and DASH questionnaires in 106 patients both before and 3 months after surgery (51 carpal tunnel, 21 Dupuytrens, 15 trapeziectomy and 19 trigger fingers). We correlated the pre-operative scores, compared the responsiveness of the questionnaires to changes following carpal tunnel release, and correlated post-operative scores to patient satisfaction. We also looked at the pre-operative responses to individual questions for different conditions: to the best of our knowledge this has not been done before.

**Results:** There was very good correlation between the pre-operative DASH and Q-DASH scores (r² = 0.92); and there was a good correlation between the DASH and PEM scores (r² = 0.62). There was also good correlation between patient satisfaction and the change in scores. The PEM (effect size 1.37) was more responsive to change than the DASH or Q-DASH (effect size 0.99).

**Conclusions:** The measures showed a very strong correlation with each other, and the changes in score correlated with patient satisfaction. The DASH and Q-DASH performed similarly, confirming that the shorter 11-item Q-DASH is a satisfactory outcome measure. There were significant differences in the response to individual questions between conditions, suggesting that these questionnaires are not simply a measure of patient satisfaction.

**A-0611 The dorsal arthroscopic capsulodesis: is it the treatment of the sole SL instability?**

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Scapholunate (SL) stability isn’t assumed with the only interosseous SL ligament (SLIOL). Some extrinsic ligaments play a complementary role: the radioscapophodepliate, the scaphotrapezial and the dorsal intercarpal ligaments (DIC). The dorsal capsulosephalopatel ligament (DCSS) is a newly-described anatomical structure, which links the dorsal radius to the lunate, scaphoid and dorsal SLIOL. The section of the DCSS (on cadaver wrist) provokes a pre-dynamic instability. In some cases of dorsal ganglion in the living wrist, with disruption of the DCSS on magnetic resonance imaging (MRI), there is also a pre-dynamic SL instability. The DCSS appears thus as a scapholunate stabilizer that participates in a scapholunate stabilisation complex. When the wrist presents a SL instability due to a lesion of the dorsal SL complex, a dorsal capsulodesis could be used to reinforce a scapholunate suture. We performed sequential cutting of the DCSS, SLIOL and DIC on 10
Skin rupture. At 12 months, patients were satisfied or very satisfied in 83% /57% of the treatments in the groups with/without skin rupture. In the skin rupture group, 90% of patients had a need for extra visits to the out-patient clinic.

**Discussion:** Our results showed that skin rupture is an adverse event in Xiapex® treatment of DC and has no consequence on the reduction in contracture, improving hand function and patient satisfaction, but demanding visits to the out-patient clinic.

A-0616 Is basal joint arthritis of the thumb really linked to carpal tunnel syndrome?

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**Background:** Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy. The etiologic factors of CTS are numerous, but several authors acknowledged the coexistence of CTS and arthritis of the basal joint of the thumb, radiocarpal or mediocarpal. The goal of this study was to specify the etiologic association of these degenerative changes in joints with CTS.

**Materials and methods:** Two groups of patients were formed and compared: the inclusion criteria in the first group was a clinical and electrically proven CTS, treated surgically in our institution. During 7 months, 95 patients were included prospectively and consecutively. These patients underwent posteroanterior and lateral X-rays of the wrist of the operated limb (CTS Group 1) and the exclusion criteria was any previous CTS surgery. The second group was made during the same period of time: we included all patients viewed in our institution with a history of wrist traumatism whom underwent wrist X-rays without a fracture or ligamentous injury (Control Group 2): 102 patients were prospectively and consecutively included in Group 2. Group 2 exclusion criteria were symptomatic CTS, or a recent wrist fracture or ligamentous injury. All radiographs were examined by two independent examiners, to assess the presence of post-traumatic changes, osteoarthritis and its location, and signs of metabolic or inflammatory diseases.

**Results:** We matched 68 patients [17 men and 51 women] from the groups by age and sex. The mean age was 57 years old. A statistically significant relationship existed between the presence of a radiological anomaly [arthritis, metabolic or inflammatory changes] and the patient’s age ($p = 0.001$), but it never modified the strategy of treatment of CTS. The incidence of radiolunate, radioscaphoid or capitulonate arthritis was significantly higher in Group 1 ($p < 0.0001$), whereas basal thumb joint arthritis incidence...
was not different between the two groups (p = 0.65). Moreover, arthritis, regardless of its location, was significantly more severe in Group 1. On the other hand, incidence of post-traumatic changes or other radiological anomalies was not significantly different between the two groups.

Discussion/conclusion: Irrespective of the nature of the radiological anomalies, they never had an influence in the treatment of CTS. Thus, we believe that without serious argument in the medical history or during physical examination suggestive of a tumour or infectious disease, a systematic X-ray exploration of the wrist is unnecessary before surgical treatment of CTS. The occurrence of CTS seemed to be favored by radiocarpal or mediocarpal arthritis, and its severity should also have an importance in the development of CTS. The association of CTS with basal thumb joint arthritis was fortuitous and probably due to the fact that these two diseases appear at the same age. Moreover, considering the high incidence of these two pathologies, we believe that it is important to look for CTS when treating a basal thumb joint arthritis, and conversely.

A-0623 Hot clinics: a novel approach to traumatic hand injuries

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Hand injuries represent 10% of emergency attendances in all hospitals; however, there exists a lack of knowledge and understanding of the functional morbidity of hand injuries. They are often trivialized, as these injuries are rarely life- or limb-threatening. These patients are triaged as low priority, to the end of the queue, and are often assessed and managed by junior staff. Inadequate assessment and delays in initiating proper definitive treatment can result in significant morbidity and poor outcomes. We have instigated a new approach in our unit, to ensure that injuries to the hand are assessed and managed by senior and experienced staff. This ensures that appropriate decisions for treatment are made in a timely manner, with minimal inconvenience to the patient. We present our 1-year experience of the ‘Hot Clinics’ in the Birmingham Hand Centre, UK. The clinics are held daily for 2 hours and are staffed by a Senior Hand Fellow and a Specialist Hand Coordinator Nurse. We will describe the journey of the patients from their presentation in the hospital, until the start of definitive treatment. These clinics have handled nearly 1000 patients so far, and we have received excellent feedback that will be presented. The advantages identified are numerous and included reduced waiting times for patients, reduced patient load in the Emergency Department, experienced assessment of injuries, timely initiation of definitive treatment, reduced morbidity and extreme patient satisfaction. We propose that this system, or a variation of it, can be established in all Hand Units, for provision of optimum patient care.

A-0625 In vivo evaluation of porcine small intestine submucosa-based extracellular matrix nerve connector as an alternative to reconstituted collagen tube or direct suture repair in a sciatic nerve model

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Introduction: Use of a nerve connector as an alignment device could lead to optimal primary repair outcomes, as a connector provides optimized tension-free nerve stump approximation, relocation of sutures away from the nerve ends, protection from wound bed scarring and a reduction in collateral sprouting, fiber misalignment and neuroma formation. This study was conducted to evaluate the regeneration potential, remodeling and revascularisation properties of porcine extracellular matrix (pECM), derived from porcine small intestine submucosa [AxoGuard® Nerve Connector, AxoGen Corporation, Alachua, FL, USA], a reconstituted collagen tube [NeuraGen, Integra Life Sciences, Princeton, NJ] and direct suture repair.

Materials and methods: A unilateral transection of the left sciatic nerve was performed for each rat. The nerve stumps were repaired with direct repair (N = 5), pECM (N = 10), or a reconstituted collagen tube (N = 10). Animals were explanted at 28 and 56 days. All nerve repairs were performed with 8-0 nylon sutures, remaining nerve gaps were recorded. At explant, the gross appearance of soft tissue attachments was evaluated. The repaired sites were excised and prepared for nerve/tissue section, staining with hematoxylin and eosin (H&E), Masson’s trichrome, toluidine blue and neurofilament immunohistochemistry. Qualitative microscopic evaluations included: inflammation, revascularisation, presence of collagen, remodeling, stray axons, fascicular axon growth, axonal fiber density, decrease in myelinated fiber density and axonal/myelin degeneration. Evaluation of soft tissue attachments were performed with a semi-quantitative scale. In addition, fibrin cable formation was evaluated at 56 days post-implant.
Alder Hey experience toxin injection for upper limb spasticity: the Clostridium botulinum A-0628 Ultrasound guidance of collagen tube repair.

**Results:** Nerve gaps measured were less than or equal to 2.5 mm. Subacute/chronic inflammation was noted between the nerve stump in all groups. The inflammatory response noted within the pECM and reconstituted collagen groups was minimal to mild. Minimal granulomatous inflammation was noted surrounding the sutures in all groups, with the direct repair group showing the greatest level of scar deposition. Adhesion tenacity and quality scores were similar at all timepoints. There was increased axonal growth in the pECM and direct repair groups; however, there was an increase in aberrant axons in the direct repair group. The reconstituted collagen group showed a disorganised meshwork of axons. There was no notable difference in axonal/myelin degeneration between groups. Fibrin cable formation was greater in the pECM group, compared to the reconstituted collagen group, at 56 days post-implant. The pECM group showed integration and vascularisation into the epineurium at both time points; however, the reconstituted collagen did not remodel nor incorporate through 56 days post-implant.

**Conclusions:** Overall, evaluations showed that pECM performance was equivalent to reconstituted collagen and direct repair. The pECM Group showed lower number of aberrant axons, equivalent axon growth, and greater organisation within the fibrin cable. In addition, the pECM Group remodelled and incorporated into the epineurium of the nerve, whereas the reconstituted collagen remained in situ. This study found that pECM is a safe and effective material for connector-assisted nerve repair. The clinical application of this technique may provide a more reliable alternative to direct suture or collagen tube repair.

A-0628 Ultrasound guidance of *C* botulinum toxin injection for upper limb spasticity: the Alder Hey experience

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**Introduction:** *Clostridium botulinum* toxin (Botox) has an established role in treating spastic disorders. In children with cerebral palsy, inadequate treatment results in reduced and deficient muscle growth, causing pain and progressive deformity. There is increased emphasis on accurate localisation and injection to improve functional outcomes, due to greater family and patient expectations. Ultrasound (USS) guidance of the botulinum toxin injection has been reported since 2002. Alternative techniques include EMG or palpation of the muscle mass to identify the muscle. We describe our experience of the use of USS guided Botox injection.

**Methods:** We retrospectively reviewed case notes of 215 children treated with USS-guided Botox between 2004-2011. The assessment tool for the end-point measurement used was the Abihand-Kids questionnaire and VAS. We used a multi-level and multi-site technique, targeting different limb levels and sites within muscles at the elbow, wrist and finger flexors. The dose range was 4 - 20 iu/kg.

**Results:** Mean age at first injection was 11 years (range, 3 - 16 years). In 16 cases, both upper limbs were treated simultaneously; 39 children required a second injection cycle. Mean time to re-injection was 12 months (range, 3 - 40). Eleven children required a third course, at a mean time of 34 months (range, 5 - 53) following the previous injection. Functional improvement was used to assess the response.

**Conclusion:** USS-guided Botox allowed for effective and safe treatment, by easy localisation and targeting of muscle groups; thus allowing a minimal dosage of the drug to be administered. Debate remains on the measurement and provision of sustained functional improvement; however, and so larger clinical trials are required to assess these tools further.

A-0629 Hook Plate: A versatile tool in hand fracture fixation

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**Introduction:** There are more than 10 potential sites for avulsion injuries in each digit of the hand. These injuries, with small intra-articular bony fragments, can be a surgical challenge. Internal fixation can provide stability to these injuries, allowing early mobilisation. The use of hook plates to manage mallet avulsion fractures is well documented in literature; however, this is a versatile tool and can be utilised to manage avulsion fractures elsewhere in the hand. We present our series treating these difficult injuries using hook plates, and discuss the technical aspects and the complications encountered.

**Methods:** We have been using the hook plate in the Birmingham Hand Centre since January 2009. The hook plate is fabricated from a Synthes straight plate and is used to buttress the bony avulsion fragment. To date, we have treated 60 patients using this technique. Injuries include: bony mallets, central slip extensor avulsions, collateral ligament avulsions, volar plate avulsions, unstable PIPJ fracture dislocations and FDP avulsions. We describe a representative case
from each of these injury patterns. Complications include: nail deformities, stiffness, tendon adhesions and prominent metalwork necessitating removal.

**Conclusion:** When dealing with avulsion fractures, fixation options are not always straightforward. A fabricated hook plate to buttress the avulsed fragments provides the advantage of keeping the fixation screw away from the fracture. The involved joint can be fully mobilised post-operatively, to try and achieve good range of movement (ROM). Hook plates are versatile tools in hand fracture fixation, where the fragments are small and are attached to tendons or ligaments, and where inter-fragmentary screw fixation is difficult; however, adequate knowledge of the available instrumentation is required and it is important to understand the basic principles and the potential complications.

### A-0634 Randomised clinical trial with minimally-invasive percutaneous osteosynthesis of distal radius fractures

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**Objectives:** The purpose of this study was to compare the post-operative radiological and clinical outcomes with minimally invasive percutaneous osteosynthesis, using three implants: Volar locking plate, Intramedullary Nail System and External Fixator Nonbridging for distal radius fractures.

**Design:** Trial and prospective randomised clinical study.

**Setting:** One community teaching hospital. Surgical treatment was performed by a single surgeon.

**Patients and methods:** A total of 48 patients (A group, 16; B group, 16; C group, 16) underwent minimally-invasive percutaneous osteosynthesis of reducible and unstable displaced [Type IIB by Rayhack Classification] distal radius fractures. In the B group we used the intramedullary nail system, in the A group the patients were treated with volar locking plate and the C group was treated by external fixator nonbridging, from January 2011 to December 2012. The mean follow-up period was 12 months. Radiologic parameters, range of motion (ROM), grip strength, and Disability of the Arm, Shoulder, and Hand (DASH) score were evaluated at each examination on week 3 and 6, and at 12 months. The visual analog scale (VAS) of wrist pain and complications were assessed at the final follow up.

**Results:** The groups did not differ significantly in radiological outcomes after 12 months, but the clinical results, VAS scale and DASH score in group A (volar locking plate) and B (nail intramedullary) were statistically significant as better with the C group (external fixator nonbridging). One patient underwent an osteosynthesis with nail intramedullary and another with external fixator (C group) developed persistant pain near the site of the superficial radial nerve, because of the distal screw and pins, respectively.

**Conclusion:** In clinical parameters, significant differences in outcome were found between Group A and B after 6 weeks, versus Group C. After 12 months, the clinical results in these groups were similar.

### A-0638 Clinical results of surgical treatment of distal radius fractures: a clinical study with minimally-invasive percutaneous osteosynthesis

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**Introduction:** The use of minimally invasive techniques for the treatment of distal radius fractures has been increasing significantly over the past 3 years. It is explained due to the the increasing incidence of fractures in economically active patients and their need to obtain early return to work activities.

**Objectives:** To analyse the clinical and functional results of patients diagnosed with distal radius fracture with deviation, reducible and unstable, who underwent surgical treatment by the minimally invasive percutaneous osteosynthesis technique, using a locked intramedullary nail.

**Methods:** We evaluated 53 patients who underwent surgical treatment of distal radius fractures that were reducible and unstable, classified according to Rayhack as Type IIB, using the minimally invasive method with intramedullary locked nail in a period prescribed between January 2011 and December in 2012. The follow-up time was 6 - 24 months’ periodical evaluation of radiographic parameters, pain, range of motion (ROM), grip strength and quality of life through the DASH questionnaire.

**Results:** Through the vertical analysis, we observed a statistically significant improvement in all clinical parameters analysed. Three patients evaluated had complications (5.6%): two patients with radial sensory pain and one, less reduction palmar tilt.

**Conclusion:** The minimally invasive technique is a safe and effective procedure, presenting clinical and functional improvement and presenting superior results, when compared to other methods described on the literature.
A-0639 Optimal axon counts for brachial plexus nerve transfers

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Introduction: Nerve transfer surgery has revolutionised the management of traumatic brachial plexus injuries. While the number of described transfers continues to grow, the optimal size ratio of donor to recipient nerve has yet to be elucidated. Given its historical success, we hypothesized that the double fascicular transfer utilized to restore elbow flexion could serve as a gold standard for investigating the optimal donor-recipient nerve size relationship. We also sought to compare published clinical results of this transfer to the results obtained utilizing other donor nerves to restore elbow flexion.

Methods: Ten cadaveric specimens were utilised to obtain individual fascicular and total axon counts of median and ulnar nerves, along with axon counts of the musculocutaneous nerve branches to the biceps and brachialis muscles. Mean axon counts and relative donor to recipient counts were calculated. A literature review of previously published axon counts and clinical results following transfer to the musculocutaneous nerve to restore elbow flexion was performed, for the following donor nerves: phrenic, medial pectoral, spinal accessory, intercostal (2 and 3 donors), thoracodorsal, ulnar fascicle and double (ulnar and median) fascicular. A successful clinical outcome was defined as motor strength grade ≥ 3.

Results: The average number of fascicles identified was 3.8 in the ulnar nerve and 4.2 in the median nerve. The mean axon count within donor fascicles was 2741 per fascicle for the ulnar nerve and 3542 for the median nerve. Mean recipient nerve axon count was 1826 for the musculocutaneous biceps branch and 1840 for the brachial branch. The axon count ratio of donor fascicle to recipient nerve was 1.5:1 for the ulnar to biceps nerve transfer, and 1.9:1 for the median to brachialis transfer. Mean previously published axon counts were as follows: 2000 for thoracodorsal, 1596 for spinal accessory, 1078 for medial pectoral, 800 for phrenic and 908 per intercostal nerve. Four outcome studies (n = 52) on the double fascicular transfer had an aggregate successful outcome rate of 96%, with 10 outcome studies (n = 177) on the ulnar fascicular transfer having an aggregate success rate of 92%, while 8 studies (n = 47) on the thoracodorsal transfer had a 91% success rate. Other literature review results included medial pectoral [10 studies, n = 148, success rate 80%], phrenic [14 studies, n = 268, success rate 78%], spinal accessory [10 studies, n = 432, success rate 72%], double intercostal [6 studies, n = 135, success rate 77%] and triple intercostal transfers [3 studies, n = 124, success rate 48%].

Conclusion: The three nerve transfers with published successful outcome rates exceeding 90% (ulnar fascicular, double fascicular and thoracodorsal) all had donor-to-recipient axon count ratios of over 1:1. Only one of the five less successful transfers reviewed had a relative axon count > 1:1 (triple intercostal transfer). Based on the axon counts of historically successful nerve transfers, our findings suggest that a minimal donor to recipient axon count ratio of 1:1 may be the goal in brachial plexus reconstructions.

A-0640 Neurotization of the accessory nerve to suprascapular nerve: does it really work or is it a bandwagon effect? Critical analysis of 11 cases

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Objective: In light of recent studies, the authors critically reviewed the clinical outcome of the classical neurotization of the spinal accessory nerve to suprascapular nerve (SAN-SSN) for shoulder reconstruction in upper-type paralysis of the brachial plexus. The aim of this retrospective study was to evaluate the restoration of shoulder flexion and external rotation by SAN-SSN neurotization in adults with severe traction injuries of the brachial plexus involving C-5 and C-6 cervical roots.

Methods: We performed 11 neurotizations of the suprascapular nerve with the terminal branch of the spinal accessory nerve by direct suture, without graft interposition. Inclusion criteria were: presence of root avulsion or rupture of C-5 and C-6, suprascapular nerve and upper trunk or its subsequent divisions were not stimulable intraoperatively and post-operative follow-up period of at least 1 year. The average patient age at surgery was 28 years (range, 13 - 43). The mean interval between trauma and operation was 7 months (range, 4 - 13). The mean follow-up was 29 months (range, 13 - 60). Shoulder function was evaluated by determining the muscular strength of abduction and external rotation, according to the British Medical Research Council [BMRC, graded 0 - 5].
Results: For us, 73% of the patients (8/11) did not regain useful shoulder function after SAN-SSN. Only 3 patients reached muscle strength grade 3 or greater, and in only one (13 years old) the SAN-SSN neurotization had been the isolated procedure for shoulder reconstruction. The other two patients that recovered shoulder flexion and external rotation had an upper trunk reconstruction with sural nerve grafts, concurrently with the SAN-SSN neurotization.

Discussion/conclusion: Postoperative clinical evaluation of the SAN-SSN neurotization showed poor re-establishment of shoulder function and these results led to a critical analysis of this procedure that is classic and widely popular among hand surgeons, especially when performed in isolation for restoration of shoulder flexion and external rotation. Many factors are intrinsically related to SAN-SSN nerve transfer and may influence clinical outcome: the more distal the transection of the accessory nerve for direct coaptation with the suprascapular nerve, the greater is the decrease in motor axons to this level. Denervation of the trapezius is unpredictable and may result in medial rotation of the inferior angle of the scapula, which will reduce final abduction of the shoulder. Other factors are: a possible two-level injury of the suprascapular nerve, and bone or soft tissue injuries occurring during the initial trauma that limit the final arc of shoulder motion (fractures of the shoulder girdle, glenohumeral instability). The recovery of active flexion and external rotation of the shoulder after SAN-SSN neurotization as an isolated procedure for shoulder reconstruction in adults with severe traction injuries of C-5 and C-6 nerve roots are unpredictable. We recommend the transfer of accessory nerves to the suprascapular nerve only in patients with good hand function, when direct coaptation is possible, and when other procedures for re-innervation of the shoulder, such as grafting to the upper trunk or radial nerve transfer to axillary nerve may be performed concurrently.

A-0651 Surgical correction of diaphyseal malunion of both bones of the forearm, using preoperative 3D planning and patient-specific surgical guides and implants

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Introduction: Forearm fractures are a common injury in children and if malunion occurs, corrective surgery may be indicated to correct loss of function, pain or a cosmetic deformity. As the forearm is a functional unit, with the radius rotating around the fixed ulna, precise restoration of anatomy is required to obtain full functional recovery. Corrective osteotomy for malunion of both forearm bones is a technically challenging procedure when using conventional planning and surgical techniques. It is a three-dimensional (3D) deformity, and angulatory and rotatory malunion, as well as ulnar variance need to be restored precisely. Preoperative 3D computer planning allows precise planning of the osteotomies. Based on this planning, patient-specific surgical guides and implants can be designed and 3D-printed, to be used during the surgical procedure and to copy the planning in vivo.

Methods: Five patients with a symptomatic diaphyseal malunion of both bones of the forearm were included in a prospective study. All had a corrective osteotomy of both radius and ulna, using a new technique. Computed tomography (CT) scan data of both forearms were transformed to 3D virtual objects. Using computer software, the corrective osteotomies were precisely planned, using the mirror image of the non-affected site as a template. Based on this planning, patient-specific drill and saw guides were designed and manufactured by 3D printing. In addition, patient-specific titanium fixation plates were designed. These plates exactly matched the contour of the corrected bone, and facilitated reduction and fixation of the bone fragments in the planned position. The average age at the time of surgery was 13 years (range, 7 - 17 y). Corrective osteotomies were performed from 7 months to 9 years after the initial injury.

Results: All patients were evaluated post-operatively and the mean follow-up period was 11 months (range, 5 - 14 mo). The visual analogue scale for pain improved from 3.2 to 0.7. The range of forearm rotation was the most important functional problem pre-operatively, and it improved significantly following osteotomy: pronation from 68° to 85° and supination from 47° to 83°. Grip strength improved non-significantly from 21.5 kg to 22.5 kg. All osteotomies united uneventfully at an average time of 13 weeks (range, 6 - 24 wks), precisely in the pre-planned position. All patients and their parents were very satisfied and would have the procedure again.

Discussion: Pre-operative 3D computer planning, combined with patient-specific guides and implants for corrective osteotomies of forearm malunion results in excellent clinical and radiographic results. The material properties of 3D printed titanium fixation plates are sufficient for the fixation of forearm osteotomies in children. Further research will have to show if this technique is cost efficient.
A-0653 Encouraging results with new plates: ulna shortening osteotomy for ulna impaction syndrome

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Background: Ulna impaction syndrome is a degenerative condition of the ulnar portion of the wrist in patients with positive ulnar variance. While in the past ulna shortening osteotomy was rarely constantly effective, the development of new implants produced encouraging and reproducibly positive results. The aim of this study was to evaluate the clinical outcome of ulna shortening osteotomy, using a latest-generation ulna-shortening osteotomy plate.

Methods: We treated 21 wrists in 20 patients with idiopathic ulna impaction syndrome with an ulna-shortening osteotomy. Ulna variance was measured on an anteroposterior radiograph of the wrist, with the forearm in neutral rotation. All patients were subjected to magnetic resonance imaging (MRI), as well as to wrist arthroscopy, to determine the extent of intra-articular damage. After ulna shortening osteotomy, patients were clinically and radiographically followed for a mean of 12 months.

Results: An average pre-operative ulna variance of +2 mm (range, 0 - 4 mm) was reduced to an average of - 0.5 mm (range, -3 to +1 mm) postoperatively. All but one patient displayed a lunate edema in the MRI, which was not related to the amount of TFCC damage found at arthroscopy. Preoperatively, the DASH score averaged 52. Postoperatively, this score improved to an average of 12, with 77% of the wrists rated as excellent in the modified Gartland and Werely score by Chun and Palmer. The VAS improved by an average of 71%; post-operative grip strength was 88% of the contralateral side. There was no non-union, and all patients said they would be willing to undergo the operation again.

Conclusions: Ulna shortening osteotomy is a powerful tool to reduce ulnar sided wrist pain in ulna impaction syndrome. With the development of new implants, excellent results can constantly be achieved. While the extent of TFCC damage did not correlate with clinical symptoms, there was a correlation between the extent of lunate edema and pre-operative pain. Today, complications such as non-unions or inappropriate shortening as formerly observed can be prevented sufficiently well, which may result in an extension of the indications to perform ulna shortening osteotomy in the future.

A-0654 Clinical experience with super-microsurgery: reconstruction of the upper limb with perforator-to-perforator superficial circumflex iliac perforator (SCIP) flaps

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The evolution of microsurgery led to the advent of perforator flaps and the possibility to conduct anastomosis of vessels of less than 1.0 mm in diameter (super-microsurgery). The superficial circumflex iliac perforator flap (SCIP) differs from the classic groin flap by its vascularisation based on a single perforator pedicle to the skin arising from the superficial circumflex iliac artery system. The advantages of this flap are as follows: there is no need to conduct thorough and painstaking dissection of the main pedicle, allowing for a shorter flap elevation time and providing a thin flap, with minimal donor site morbidity, possibility of primary closure and easy concealment with garments. The disadvantages are: the dissection of minute diameter vessels and the obligation to perform anastomosis of small vessels (less than 1.0 mm) through super-microsurgical technique. The purpose of this case series is to present the authors’ experience with this innovative flap, making use of super-microsurgical techniques for vascular anastomosis in the recipient area (‘perforator-to-perforator’ flap). Six SCIP flaps were performed by the same surgeon between the period of November 2011 to March 2013. The minimum follow-up period for the assessment of clinical results was 6 months. The indication for this type of reconstruction was the need for pliable skin coverage thin enough to obtain adequate functional outcome to the upper limb reconstruction. Surgical microscope, 11.0 Nylon and separate sutures were employed in all cases. End-to-end anastomosis for both arteries and veins were used in all cases. We reviewed six SCIP flaps (five in male and one in female subjects); all were victims of traumatic injuries to the upper limbs. The perforating vessels of the flaps measured < 1 mm in diameter and the mean pedicle length was 3.2 cm (range, 2.8 - 3.7 cm). The vessels were anastomosed in the recipient area after identifying a compatible vascular pedicle, chosen as a recipient vessel: in five cases a local perforating pedicle was used and in one case, the digital artery was chosen at the metacarpophalangeal level. All six flaps...
survived completely and provided adequate functional and aesthetic results to the upper limb reconstruction. Herein we present in detail six SCIP flaps that were successfully transferred to the upper extremity for optimum reconstruction of traumatic lesions. Cases include a SCIP flap raised with vascularised bone and a small portion of the inguinal ligament, concomitantly reconstructing the skin, the diaphysis of the proximal phalanx and the extensor tendon of the injured finger. Another patient had an injury to the first web of the hand and the flap was transferred to a perforating branch of the radial artery at the level of the anatomic snuffbox. The SCIP is a very thin, purely cutaneous flap. The surgical morbidity to the donor area is minimal and the dissection does not sacrifice any important structure of the inguinal region. The ‘perforator-to-perforator’ SCIP flap is a viable option for reconstruction of the upper limbs, allowing adequate skin coverage combined with possible skeletal reconstruction concurrently, through vascularised bone grafts of the iliac crest.

A-0655 International multidisciplinary Delphi-based consensus definition of recurrence after Dupuytren treatment

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Purpose: In the literature, many different definitions of recurrence have been reported and in a systematic review, we have shown that applying these different definitions on a single dataset resulted in recurrence rates ranging from 2% to 86%. The lack of agreement on how to define recurrence of Dupuytren’s disease (DD) prevents comparability of the different recurrence reported in clinical outcome studies and randomized controlled trials. The aim of this study was therefore to achieve consensus on a universal and easy to apply definition for recurrence of DD after treatment.

Methods: A Delphi method was used, in which we invited 43 experts in Dupuytren research and treatment from 10 countries to participate; in every round the experts were asked to fill in a questionnaire. After each round, the answers were analysed and the experts received a feedback report. We defined consensus when at least 70% of the experts agreed on a topic.

Results: After four consensus rounds, we agreed on a consensus to define recurrence of DD as ‘an increase in joint contracture in any treated joint of at least 20° at 1 year post-treatment, compared to 6 weeks post-treatment’. In addition, the consensus was to advise repeated yearly measurements and to report recurrence for all treated joints individually.

Conclusion: After four Delphi rounds with an international expert group, we were able to construct a uniform definition for recurrence of DD after treatment. The definition is easy to apply and can be combined with other descriptors of Dupuytren’s recurrence, for example focusing on the presence of palpable nodules and cords. A limitation of this study is that this single clinically-relevant and easily-applicable definition for recurrence of DD after treatment may not reflect all the complexity of recurrence of DD; however, we do suggest that this definition should be the minimally-reported recurrence outcome in future clinical outcome studies and clinical trials, which would allow for better comparison of recurrence rates between different studies.


A-0656 The carpometacarpal joint after pollicization of the index finger in thumb hypoplasia: functional assessment and dynamic 4-dimensional computed tomography study

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Purpose: Thumb hypoplasia represent 3.4% of the congenital abnormalities of the hand. Index pollicisation was used in grade IIIB, IV and V of modified Blauth’s classification. Our goal was to investigate the function of the CMC joint of new thumb using dynamic 4-dimensional computed tomography (4D-CT).

Methods: We retrospectively reviewed 14 patients (7 male and 7 female) after pollicisation of the index finger was performed for thumb hypoplasia. The average patient age at the time of surgery was 19.1 months. Thumb evaluation was assessed by only one surgeon, at an average follow-up of 8.5 years (range, 3.3 – 16.3 yl). Assessment included questions concerning articular mobility, performance of activities of daily living and cosmetic and appearance of the hand. Dynamic 4D-CT was performed in all cases while a child, attempting to perform a full range opposition.
Results: Functional status of the new thumb: Kapandji’s score for the operated hand was 7.2/10 and 8.9/10 for the non-operated hand. The Percival score was excellent in 14 hands, good in 9 hands, fair in 1 hand and poor in 2 hands. Chondral surface remodelling of the palmarised MP joint was obvious in 14/23 cases, with a flattening of the metacarpal head, whereas in the remaining 9 cases, the shape of metacarpal head remained unaffected at follow-up. Our evaluation of thumb opposition: in 20/23 cases, 4D-CT evaluation demonstrated motion occurring at the CMC interval (between the head of the metacarpal and the base of the proximal phalanx) during any attempt to achieve opposition. In 3/23 cases, full opposition was obtained through motion occurring solely at the proximal interface, between the remnants of the metacarpal base and the head of the second metacarpal. In three cases, motion was recorded at both the interfaces (proximal and distal) during opposition. Patients who did not achieve bony union between the remnants of the metacarpal base and the metacarpal head still demonstrated good range of motion (ROM) and no CMC instability.

Conclusion: Functional results of index finger pollicization were good in our series, as in many other previously published series in the literature. In all cases, the reconstructed thumb was incorporated into daily living activities. Using 4D-CT scanning allowed for the first time for the reconstructed CMC joint of a pollicised index to be visualised in vivo. New data involving first time for the reconstructed CMC joint of a pollicised index to be visualised in vivo. New data involving

A-0657 Xiapex® (collagenase of Clostridium histolyticum): treatment of patients with Dupuytren’s contracture 1-year follow-up

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Introduction: Dupuytren’s contracture (DC) is a disorder that affect the palmar fascia were a pretendinous cord causes, with time, the finger to flex resulting in impaired hand function. The aim of this study was to evaluate the efficacy of Xiapex® in the treatment of DC at least 12 months after injection. The study was initiated following a Minimal Health Technology Assessment.

Material and methods: This study was a prospective study on a consecutive series of patients with DC and flexion deformities of the metacarpophalangeal and/or proximal interphalangeal joint of >20°. The primary endpoint was reduction in contracture and improvement in hand function. All patients gave informed consent.

Results: We enrolled 218 treatments, in 181 men and 37 women, mean age 67 years (range, 22 – 83), with 92% of the treated fingers being the 4th and 5th finger. Despite 30% had skin disruption, no infections were seen. Mean pre-injection-contracture MP/PIP-joint 50/62°. Mean qDASH pre-injection was 15 (range, 0 – 52). Of 106 treatments, MP/PIP joint were 71 and 35, respectively, which were seen for follow-up after a mean of 15 months (range, 12 - 22). Improvement in contracture MP/PIP-joint: 42/32°. Mean qDASH at the 12-month follow-up was 6 (range, 0 - 57). In 5 cases (5%), there was a need for further treatment of the Xiapex®-treated finger at 12 months (unacceptable recurrence). At 12 months, 77% of the patients were satisfied or very satisfied.

Discussion: Our results are still promising at 12 months and we find Xiapex® a good treatment option for DC patients with a palpable cord. The treatment is effective and with an acceptable recurrence at 12 months.

A-0658 Accumulative cost of needle aponeurotomy, collagenase injection and open selective fasciectomy for Dupuytren’s contracture

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Introduction: The treatment of a single palpable Dupuytren’s cord causing digital flexion contracture remains a subject of debate, with percutaneous needle aponeurotomy, collagenase injection and open selective fasciectomy as suitable treatment options. A cost analysis evaluating the impact of re-operations rates on the management of Dupuytren’s contracture have not been previously published. We hypothesise that the lesser initial cost of procedures needle aponeurotomy may be off-set by added surgical cost in addressing recurrences in the longer term.

Methods: An accumulative treatment cost model was constructed, to evaluate total treatment cost over a 5-year period. Initial treatment modality evaluated included needle aponeurotomy, collagenase injection and open selective fasciectomy: each was represented with an independent treatment arm. Due to a paucity of data regarding re-operation rates in Dupuytren’s contracture, an assumption was taken based on the Foucher et al. (2003) study, in which 41% of patients presenting with recurrence of Dupuytren’s contracture required further surgical treatment1.
Recurrence rates were derived from published data. Re-operations were in the form of partial fasciectomy across all treatment arms. Costing was based on the UK National Tariff for 2012 - 2013, used for financial remuneration of procedures carried out within the National Health Service (NHS) in the UK. Costs were as follows: needle aponeurotomy, £990; collagenase injection, £1827; and partial fasciectomy, £3774.

**Results:** Recurrence rates at 5 years used in this model: 85% for needle aponeurotomy, 34% for collagenase injection and 21% for partial fasciectomy. Initial treatment costs of 100 cases: needle aponeurotomy, £99,000; collagenase injection, £182,700; and partial fasciectomy, £377,350. Re-operation rates [41% of recurrence rates]: needle aponeurotomy, 35%; collagenase injection, 14%; and partial fasciectomy, 9%. Re-operation costs (number of re-operations multiplied by cost of partial fasciectomy): needle aponeurotomy, £132,073; collagenase injection, £52,829, and partial fasciectomy, £33,962. Total treatment costs at 5 years: needle aponeurotomy, £231,073; collagenase injection, £182,700; and partial fasciectomy, £411,312.

**Conclusion:** Despite reduced costs accrued from repeat procedures within the partial fasciectomy treatment group, due to high procedural costs, it remained the most costly treatment option at 5 years. Current cost-effectiveness models have shown selective fasciectomy to be not cost-effective. The finding of this study indirectly parallels this. This study provides an alternative view in guiding the choice and commissioning of treatments for Dupuytren’s contracture and this will be discussed along with limitations of the study model.

**References**

**A-0659 Volar plating of distal radius fractures (AO: B3, C1, C2, C3) multivariant analysis: 4 - 10 year follow-up**

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**Introduction:** Fractures of the distal radius are common orthopaedic injuries with a bimodal age distribution. Several of these fractures are unstable, with intra-articular involvement. Surgical fixation by means of open reduction internal fixation has become popular over the last years, due to better restoration of articular anatomy. Volar plating has gained widespread acceptance recently and tends to prevail compared with dorsal plating.

**Patients and method:** We retrospectively reviewed 80 patients (45 men and 35 women) treated in our institution with volar plates for distal radius fractures, with a mean age of 47.6 years (range, 13 - 90). We took into account the energy of the fracture. Fractures were classified according to the AO/ASIF classification system (23-B3:25, 23-C1:20, 23-C2:15, 23-C3:20). We used grafts in 11 patients (four autografts and seven allografts). Additional external fixation devices and Kirschner wires were applied in 11 and 39 patients, respectively. Radial inclination, radial tilt and articular step-off were measured in X-rays. Grip strength; Disabilities of the Arm, Shoulder and Hand (DASH); and patient-rated wrist and hand evaluation (PRWHE) scores were used to evaluate the functional outcome. Potential complications were recorded. Energy of injury, AO classification, use of external fixation and K-wires, use of grafts, DASH and PRWHE scores, and radiological parameters (volar tilt and radial inclination) were analysed statistically.

**Results:** At final evaluation, average volar tilt was 3.5° and average radial inclination was 19.4°. Average DASH score was 6.02 and average PRWHE score was 9.5. Mean grip strength of the injured side was 91% of the contralateral side. Two patients underwent secondary surgical procedures due to loss of reduction. All patients showed gradual improvement of DASH and PRWHE scores. Ten patients underwent hardware removal. One patient suffered from carpal tunnel syndrome with thenar atrophy, which was treated with palmaris longus transfer (Camitz transfer).

**Conclusion:** The use of volar plates combined with accurate articular reduction can be an effective technique for the treatment of distal radius fractures. Energy of injury cannot predict fracture...
pattern according to AO classification. K-wires assist in maintaining distal radioulnar joint (DRUJ) stability. 23-C3 fractures have a higher predisposition for DRUJ instability without statistical significance, compared to 23-B3, 23-C1, 23-C2 fractures. In addition, augmentation with external fixation assisted significantly in maintaining reduction in cases with metaphyseal comminution (23-C2 and C3).

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A-0660 Early results of scapho-lunate instability treatment with Mathoulin arthroscopic capsulodesis

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Purpose: Evaluation of results of the treatment of scapho-lunate instability by Mathoulin arthroscopic capsulodesis. We propose that the treatment of scapholunate dissociation with Mathoulin technique will improve the wrist function of the patients, with the advantages of a minimally invasive surgery procedure.

Methods: A series of 31 patients (21 male and 10 female subjects), average age 32 years old (range, 18 - 63), with scapholunate dissociation was treated with Mathoulin arthroscopic capsulodesis, between March 2011 and March 2013, with a median follow-up of 18 months (range, 32 - 39 months). We used the dry arthroscopy method described by Pinal. Surgery was made by the 1-2, 3-4, 6R, MCR and MCU portals and a final stabilisation with two Kirschner wires was always used. Patients were evaluated pre-operatively and post-operatively at 1, 3 and 6 months, with the Modified Mayo wrist score, VAS scale and radiologic evaluation.

Results: There were dissociations: 3 Geissler Grade II, 16 Grade III and 12 Grade IV. We found 10 associated lesions (5 TFCC B, 2 SLAC II, 2 radius fractures and 1 TFCC A). As complications, we have 2 ruptures of EPL, 3 algoneurodystrophies and 1 superficial infection. Mayo score improved from 51 points pre-op to 81 post-op. Pain decreased from 5.7 to 2.6 points in the VAS score. Function improved from 9.8 to 22 points at 6 months. Mobility improved from 16 points pre-operatively, to 22.4 points afterwards. Force had less improvement, from 10.3 pre-operatively to 15 points at 6 months after the operation.

Conclusions: At the 6-month follow-up, we found a good range of motion (ROM), less pain and return to previous work in 28/31 patients. Wrist strength was less improved in this short post-operative period. Arthroscopy can provide intra-articular evaluation of SL instability, and a final treatment for Geissler Grade III and IV with Mathoulin capsulodesis technique. Because this series had a short follow-up time, further studies are needed to evaluate the long-term results of this technique.

A-0661 Outcome of 70 fingertip amputation injuries with a semi-occlusive dressing

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Treatment of fingertip amputation injuries with a semi-occlusive dressing has been known for a long time. The results are usually outstanding. Nevertheless, this treatment is still not included in major textbooks. The therapy is even controversially discussed by some major centers. Particularly controversial is the indication of this therapy in the case of exposed bone, where local flaps offer an established alternative. During a period of 2 years, we treated all 70 amputations in the distal phalanx by the semi-occlusive protocol. After a mean follow-up of 15.6 months, we conducted an examination regarding scar formation, 2-point discrimination, sensibility with monofilament and subjective acceptance of treatment. The extent of soft tissue regeneration was determined sonographically and by x-ray. The mean treatment duration of the semi-occlusive dressing was 5.4 weeks. All patients were very satisfied with the results. An actual scar formation could only be detected in a few cases. The regenerated fingertips show aesthetic forms, papillary ridges and are resilient. The static 2-point discrimination was 4.8 mm (SD 1.9 mm), the dynamic 2-point discrimination was 3.7 mm (SD 1.6 mm) and the sensibility tested with the monofilament showed a mean filament size of 2.98, which represents almost normal perception. The soft tissue regeneration showed an extent of 85%. In view of the very good results, the occlusive dressing therapy is our gold standard for all amputations in the distal phalanx. We will present our treatment technique and protocol, as well as our results, to contribute to a greater acceptance of this treatment.
A-0662 Comparison of nerve defect reconstructions committed by placing vascular endothelial growth factor (VEGF) or mesenchymal stem cells into the vein graft lumen in conjunction with nerve fragments

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Introduction: Nerve graft use is considered as a gold standard method in nerve defect reconstruction; however, alternative reconstruction methods are still being investigated, due to the donor site morbidity caused by the harvest of the graft from a healthy nerve. The aim of this study was to reconstruct a nerve defect without causing morbidity, by using a vein graft filled with nerve fragments, taken from the distal segment of the defect, in conjunction with either vascular endothelial growth factor (VEGF)-loaded microspheres or mesenchymal stem cells.

Materials and methods: After preparing the VEGF-loaded microspheres and bone marrow-derived mesenchymal stem cells, 48 Sprague-Dawley rats were divided into six groups. In all groups, a 1.6 cm long defect was created on the peroneal nerves of the rats. Reconstruction methods employed to repair the defects were: empty vein graft, nerve graft, nerve fragments including vein graft, nerve fragments and blank microspheres including vein graft, nerve fragments and VEGF-loaded microspheres including vein graft, nerve fragments and stem cells including vein graft. The nerve fragments used in defect reconstruction were taken from the nerve segment at the distal end of the defect. At week 8 after the reconstruction, we performed walking track analysis and nerve conduction studies in all groups. Nerve biopsies were taken, to count axons. Results were statistically compared.

Results: Statistically, there was no difference between nerve graft group nerve fragments and VEGF-loaded microspheres, including vein graft group and nerve fragments including the vein graft group, nerve fragments and blank microspheres including the vein graft group. Most successful healing was determined in both the nerve graft group and the nerve fragments and VEGF-loaded microspheres, including the vein graft group. The second most successful healing was determined in the nerve fragments and stem cells, including the vein graft group.

Conclusions: Nerve fragments, taken from the segment distal to the nerve defect, were placed in the vein graft lumen in conjunction with VEGF-loaded microspheres. By means of this treatment method, which can be an alternative for autogenous nerve graft without taking a graft from a healthy nerve, we achieved a successful nerve reconstruction.

A-0663 Dorsal capsuloligamentous repair for acute scapholunate ligament tears

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Introduction: Scapholunate ligament (SL) tears are difficult to diagnose and lack of treatment generates chronic instability with arthrogenic evolution. Arthroscopy became an essential tool in the diagnosis and treatment of these lesions, especially at the early stage. The encouraging results of the capsuloligamentous repair for SL chronic lesions led us to perform this technique arthroscopically in acute cases, thus avoiding the pitfalls of open surgery. We report the results of this technique, with a minimum follow-up of 1 year.

Materials and methods: All patients were operated on an outpatient basis, under local regional anesthesia. The exploration is performed in the radio and mediocarpal joint. The stage is evaluated according to the EWAS classification. The principle of the technique is to make a suture between the dorsal capsule and the dorsal portion of the SL ligament, provided there are still remnants of ligament attached on both bones, scaphoid and lunate. Absorbable suture is used. We treated nine patients by this technique, within 45 days from the accident, with 1 year minimum follow-up, between May 2010 and September 2012.

Results: There were 5 men and 4 women, of a mean age of 40 years old (range, 27 - 61). The procedure was performed on average at 28.2 days after the accident (range, 14 - 40). The lesions were divided: two Stage 3B, four Stage 3C and three Stage 4, according to EWAS classification. The suture alone was able to stabilise the dissociation in the majority of cases; only one case required pins. The lesion was isolated in one case, associated with a lesion of the TFCC and also repaired in 6 cases, associated with a radius osteosynthesis with a screw in one case, and a scaphoid osteosynthesis with screw and graft in one case. A splint was worn on average 48 days (range, 40 - 60).
Fine motor skills are necessary for a plethora of daily activities and are thus an indispensable feature of the human hand. Reduced fine motor manipulation capacities tremendously affect patients after hand surgery. Despite this apparent importance, there is only little information available on how to objectively assess fine motor skills in hand surgery patients. With the goal in mind to improve post-operative rehabilitation protocols, in this study we evaluated fine motor skills after wrist arthroscopy, using a newly-developed testing device.

**Materials and methods:** We tested 20 patients before and after wrist arthroscopy, regarding their hand fine motor skills. As controls, we tested the unaffected hand, as well as 10 healthy individuals. The test setup consisted of a common fine motor skill test (9-hole peg test) and three different measurements, using a newly-developed computer-assisted measuring tool. This Bluetooth-controlled device is capable of accurately measuring grip force over time, an increase in velocity, and posture within space. It was equipped with different surfaces, in order to assess finger tip forces applied while lifting an object.

**Results:** The new device tested revealed significant changes regarding the patient’s fine motor skills after wrist arthroscopy. This was especially true when lifting objects with different surfaces in the early post-operative phase.
A-0668 Does the personality of the surgeon influence the level of pain of the patient?

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**Purpose:** We were interested to find out if there is a correlation between the surgeon and the level of pain evaluated by the patient in the same pathology structure.

**Materials and methods:** We performed a prospective randomized study in which during 3 months, all the operations of the seven hand surgeons of our Hand Surgery Center were evaluated. Evaluation was done using visual analogue scale (VAS) from 1 - 10 (1 was no pain; 10 the highest level of insupportable pain). Every patient was interrogated 2 hours, 1 day and 1 week after the operation. The level of pain was separately asked about, from the operation itself and the actual pain level at the time of interrogation.

**Results:** During the 3 months of survey, a total of 382 operations were performed. The average number of operations performed by a single surgeon was 54 (range, 41 - 67). The operation itself resulted in values from 1.8 - 2.29 VAS. One day later, these results changed to 1.13 - 1.63 VAS and 1 week later, to 1.10 - 1.57 VAS. The pain at the time of investigation gave results from 1.00 - 4.42, at 2 hours after the operation, but 3.22 - 4.13 at 1 day later and 2.71 - 3.78 at 1 week after surgery.

**Discussion:** It was clearly demonstrated that there is a difference in pain felt by the patients, related to the surgeons’ person. There are surgeons with patients showing lower pain immediately after the operation, and increasing pain 1 day and 1 week later. Other surgeons’ patients present high pain immediately after the operation, and this diminishes 1 day to 1 week later. Unfortunately, we don’t have the data to what parameters are related to such differences, as the average number of short and long, easy to complex procedures are almost the same for every surgeon. The memory of the surgery itself in every case shows a decreasing value that demonstrates that memories are getting nicer as time goes on. Further investigations should be conducted, in order to find out what factors contribute to the difference amongst surgeons.

A-0680 Four-dimensional assessment of hand disability

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**Introduction:** Careful assessment of patients’ pre-operative complaints is key to a successful outcome following elective hand surgery. This study employed a simple, visual questionnaire to evaluate the different aspects of hand disability in patients attending surgery.

**Methods:** Patients scheduled for surgery for common hand conditions were invited to complete a short questionnaire, grading the severity of their pain, dysfunction, deformity and cold intolerance of their hand(s) on a 4-point scale (where 0 is normal and 3 is severe). Patients also completed a QuickDASH questionnaire for comparison.

**Results:** We had 311 patients complete the study. Diagnostic groups undergoing surgery were: nerve compression (n = 69), Dupuytren’s disease (n = 86), ganglion (n = 25), other lumps (n = 14), trigger finger (n = 32), TMCJ/STT osteoarthritis (n = 27), rheumatoid disease (n = 13), other wrist pathology (n = 9), post traumatic (n = 10) and miscellaneous (n = 26). The four-dimensional (4D) assessment method correlated well with the QuickDASH scores (r = 0.80), though it revealed differences in perceived disability between the diagnostic groups that were not detected by QuickDASH. Of note, pain was the chief complaint of patients with ganglia, and deformity the greatest impact on rheumatoid patients. Cold intolerance was an important symptom for patients with nerve compression.

**Conclusions:** The 4D assessment is an effective method of demonstrating differences in patient perception of hand disability, between different diagnostic groups. The 4D assessment illustrates these differences at a glance, in a way that cumulative score questionnaires such as DASH cannot.

A-0686 Surgical management of scapholunate instability: a study of 143 cases

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**Aim:** The evaluation of a simple surgical technique, dorsal anchorage carpal instability control (DACIC), which has been used for the last 14 years as the only surgical procedure for acute and chronic carpal instability.

**Materials and methods:** A simple surgical technique was used in 143 patients (90 men and 53 women), between 1998 and 2013. The average follow-up time was 96 months. Patients who underwent surgery were symptomatic at least 1 year, with work disability. The Watson or shearing test was positive and Jamar values of grip strength were significantly low in all cases. Arthoscanner confirmation of a partial or total scapholunate ligament tear was available for all
Conclusions: first 8 months in 3 cases. and material avulsion after an accident within the Revision was needed for material failure in 5 cases. Salvage procedure for arthritis was needed in 4 cases. women. Further surgery was needed in 12 cases. of wrist flexion motion was present mostly in affected of 3 years. Loss of 10° (83%), 25° (10%) and 35° (7%) the contralateral side (25% of cases), in a maximum and finally was equal (75% of cases) or 10% less than quick DASH score, 16.4). Grip strength was improved careers, returned to their previous work (average age was 34 for the quick-DASH and 64 for the MAYO management (p < 0.005). The functional assessment average was 34 for the quick-DASH and 64 for the MAYO wrist scores. ROM in flexion-extension and pronosupination were, respectively, 95° and 137°, and strength with 80% of the contralateral, before hardware removal. We had 20 patients with plate removal in a mean of 7.8 months, with an improvement in score assessment. We found an EPL tendon rupture, a breaking plate, an early secondary displacement and seven tenosynovitis. Conclusion: Surgical management of intra-articular shear beyond the watershed line of the radius fracture, using a specific intra-articular plate, seemed to be an advantage with good reduction results; however, a higher rate of tendon irritation needs to limit indications to some specific cases, when usual plates are not effective.

A-0688 A volar plating beyond the watershed line: can it be an advantage in complex articular fracture?

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Introduction: Many studies have reported the successful use of volar locking plates in various distal radius fractures, with good results on functional outcome and radiological reduction criteria; however, there are some situations in which most of volar plates seem limited, especially in the intra-articular shear beyond the watershed line. The main purpose of this study was to evaluate the usefulness of open reduction and internal fixation using specific implants placed beyond the watershed line.

Materials and methods: Between 2011 and 2013, we treated 29 patients, with a mean age of 49 years, for complex radius fracture, by using an intra-articular plating system. The mean follow-up period was 13 months. There were 3 A3, 2 B3, 4 C1, 12 C2 and 8 C3. Clinical evaluation was performed in the range of motion (ROM) and grip strength. Radiographic measurements were made pre-operatively and after post-operative reduction, and then statistical analysis was performed using the Student t test, to compare X-ray values. Objective functional assessment was obtained through the quick-DASH and Mayo Wrist scores. The delay and the reason for hardware removal was also collected, the same as complications related to the implant.

Results: All fractures consolidated at the last appointment. Two patients weren’t able to return to previous employment. Radiographs in the pre-operative and immediate post-operative period showed, respectively, a radial sagittal tilt of -21° to 5°, a radial inclination of 16° -20°, and radial height of 8 mm to 11 mm. We found statistically significant differences of radiological values, before and after surgical management (p < 0.005). The functional assessment average was 34 for the quick-DASH and 64 for the MAYO wrist scores. ROM in flexion-extension and pronosupination were, respectively, 95° and 137°, and strength with 80% of the contralateral, before hardware removal. We had 20 patients with plate removal in a mean of 7.8 months, with an improvement in score assessment. We found an EPL tendon rupture, a breaking plate, an early secondary displacement and seven tenosynovitis.

Conclusion: Surgical management of intra-articular shear beyond the watershed line of the radius fracture, using a specific intra-articular plate, seemed to be an advantage with good reduction results; however, a higher rate of tendon irritation needs to limit indications to some specific cases, when usual plates are not effective.

A-0689 Herbert ulnar head prosthesis: a viable option

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Different kinds of resection arthroplasties have been common treatment for conditions such as rheumatoid arthritis, osteoarthritis and persistent painful instability at the distal radioulnar joint (DRUJ). Outcome has often been satisfactory, especially in patients with low demand for loading, like rheumatoid or older patients. Patients with a more active lifestyle are at greater risk for failure, producing painful instability that might be even more impairing than the condition existing prior to the resection. Stabilizing soft tissue procedures, allograft interposition, radioulnar fusions and several other methods have been proposed to solve that challenging situation, but results have been inconsistent. Early results of silastic implants were good, but did not last, a reason why this concept was further developed to metallic-based implants. The first kind of this type of implant was the Herbert Ulnar head prosthesis (UHP). Initial reports of this and similar implants were promising, but few studies have been published regarding mid- to long term outcome. The purpose of the present retrospective study was to report and compare our mid-term results of a consecutive series of Herbert UHP arthroplasties. The 22 replacements were performed at our department between 2000 and 2011. Mean follow-up time for 21 reviewed wrists was 7.5 years. Five of the arthroplasties were primary procedures, and a mean of 2 surgeries had previously been performed in the other 17 wrists.

**Results:** Supination averaged 69° and pronation, 63°. Strength of grip measured by Jamar dynamometer reached 26 kg, compared with the contralateral wrist at 31 kg. The score of overall function measured with the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) was 27 and that measured with the patient-rated wrist evaluation (PRWE) questionnaire was 31. A 10 cm visual analogue scale (VAS) was used to evaluate pain and satisfaction. Mean pain during activity was 2.9 and satisfaction was 8.9. Four patients had considerable residual pain at a level over 5.0, but only one patient was dissatisfied and regrets having undergone arthroplasty. Suboptimal positions of the implants were seen on radiographs for several of the patients with persistent pain. Radiographic evaluation showed bone resorption at the distal part of the ulna and erosion of radius surface facing the head of the implant, for most patients. These changes came to a halt at the latest follow up, and no signs of aseptic loosening were found. There was one major complication. One patient required capsuloplasty 9 months after the arthroplasty, due to painful instability. Full stability was not achieved, but the pain resolved. Other minor complications responded to conservative treatment. Our mid-term results in this limited patient series showed that the Herbert UHP is a safe and efficient treatment option in selected cases of DRUJ disorders.

**A-0690 The strength of the distal radius after bone grafting: could the use of bone substitute prevent fractures in radii with 10 x 10 mm defect of the volar cortex? A biomechanical study**

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**Background:** A defect of the volar side of the distal radius, such as in volar non-vascular bone grafting in scaphoid fractures, may result in a fracture after a simple fall. To avoid this complication, a bone substitute to fill the defect may be used. We compared the strength of the distal radius after resection of a bone graft, with and without the use of a bone substitute.

**Methods:** Defects of 10 x 10 mm were made at a distance of 5 mm from the radiocarpal and radioulnar joints in 10 pairs of fresh-frozen cadaveric radial bones from patients with a mean age of 82 ± 10 years (4 male and 6 female subjects, BMD = - 3.2 ± 1.1 g/cm²). Each radius of a pair was assigned to bone substitution (Callos Inject) or non-bone substitution group. All constructs were tested by loading to failure.

**Results:** The radii with the defects filled with bone substitute resisted significantly more force (971 N) than the defects without it.

**Conclusion and discussion:** The biomechanical data indicate that use of Callos Inject bone substitute significantly increases the strength of the distal radius after bone grafting. It might prevent fractures in the osteopenic distal radius.

**A-0693 Results of 87 vascularized bone grafts, described by Zaidemberg, in scaphoid non-union: a retrospective study**

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**Introduction:** The scaphoid is the most commonly fractured carpal bone. The non-union rate in scaphoid fractures is between 5 - 10%. When there is necrosis of the proximal pole, the vascularised grafts enable consolidation ratios superior to conventional grafts.
We wanted to verify this by studying the results of grafts Zaidemberg made in our service.

**Materials and methods:** We studied 87 scaphoid non-unions treated by graft [Zaidemberg], retrospectively. The diagnosis of necrosis of the proximal pole was done either by magnetic resonance imaging (MRI) or intraoperatively, by Green criteria. The clinical criteria studied were: range of motion (ROM), the Mayo Wrist Score, Quick DASH and PWRE. The radiographs controlled the consolidation and perform a complete radiometry.

**Results:** Non-union was classified by Schernberg in Zone 3, in 33% of cases. We had 59% of Stages 2A and 2B, according to 29% Alnot classification. Fixation was performed by pin, followed by immobilisation of 2.5 months. We observed 74% success in a group consisting of fresh and multi-operated non-union. Never operated had a healing rate of 80%, higher than those already operated (56%). We had 93% consolidation in the absence of necrosis of the proximal pole, while in case of necrosis the consolidation thereof was only 63%. Intoxication: smoking had a deleterious effect, as the success rate was 61% among smokers, whereas it was 81% among non-smokers. Our patients had a Mayo Wrist Score average of 75.6%, a PRWE of 11.6% and 11.7% by QuickDASH. The analysis showed improvement in the radiometry parameters analysed. Zaidemberg grafts are indicated in cases of proximal non-union or former dorsoradial with osteophytes, or in the presence of polar necrosis. They are an appropriate solution during a surgical recovery.

**A-0694 Role of arteriovenous vascular loops in reconstructive microsurgery: details of the surgical technique and review of 10 cases**

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**Introduction:** The arteriovenous vascular loop is a versatile tool for enabling tissue transfer to recipients’ areas lacking suitable vessels for microsurgical anastomosis. Despite the proven clinical applicability, details of the surgical technique are still a subject of controversy: reconstruction in one stage (loop followed by a flap in the same operation) or in two stages (reconstruction after maturation of the arteriovenous shunt). As of today, there are no clear criteria that support the decision to perform surgery in one stage or two stages, such as injury severity and patient characteristics (ability to tolerate major surgery due to comorbidities), the factors that classically guide decision-making. Such controversies motivated the prospective analysis of 10 arteriovenous loops performed in a period of 12 months.

**Methods:** Ten arteriovenous vascular loops were performed between March 2011 and February 2012, and the following variables were evaluated prospectively: gender, age, injury etiology, comorbidities, reconstruction in one or two stages, loop morphology, pre-operative time, re-operation rate, limb salvage percentage, flap performed and recipient vessel. Inclusion criteria were:

1. Pre-operative imaging (computed tomography (CT) angiography or magnetic resonance (MR) angiography), or intraoperative assessment indicating inadequate vessels for microsurgical reconstruction; and
2. A minimum follow-up of 6 months after reconstruction.

Patients lost to clinical follow-up were excluded from the study.

**Results:** Mean follow-up period was 7.9 months. The study population consisted of 9 men and 1 woman, aged 21 - 48 years (mean, 33.7 years). The lesions were mostly of traumatic etiology (8 cases), with 1 infection (chronic osteomyelitis) and 1 tumor (squamous cell carcinoma). We performed four reconstructions in one stage and six reconstructions in two stages. The success rate of reconstruction in 1-stage operations was 75% (3/4). The 2-stage reconstructions had an interval of 2.6 days on average between the loop and final flap procedures, and were successful in only 17% (1/6) of operations.

**Discussion and conclusion:** Until recently, the literature favored 2-stage reconstruction, because of theoretical advantages obtained after arterialisation of the vein, with less tendency to collapse, and increased vessel diameter over time. Recent studies challenge this concept, trying to establish clearer criteria for the indication of arteriovenous loops. The prospective analysis of the data allowed us an objective evaluation of 11 variables, tracing an overview of the behavior of vascular loops performed in a single stage or in two stages. The correct approach should take into account the extent of the lesion and patient characteristics, mainly the patient’s ability to withstand a lengthy operation like reconstruction in one stage. Another important variable is the intraoperative status of the recipient vessels, or even the shunt, as the final flap should only be dissected in ideal conditions. This study reinforces the latest understanding that the
indication should be individualised: this procedure should be reserved for dramatic cases, being the last reconstructive option prior to amputation.

A-0699 Preliminary experiences with reconstruction of the proximal pole of the scaphoid using a free vascularised osteocartilaginous medial femoral trochlea flap

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Purpose: Destruction of the proximal pole of the scaphoid is a disastrous situation. Typically, scaphoid excision combined with a salvage procedure is required. Recently, reconstruction of the proximal pole of the scaphoid using a free vascularised osteocartilaginous medial femoral trochlear flap has been proposed, to re-establish regular carpal anatomy. We report our preliminary experiences with this method.

Materials and methods: From 01.09.2011 until 01.04.2013, we treated 30 male patients with a mean age of 28 years (range, 18 - 51 years) with a free vascularised osteocartilaginous medial trochlea flap to reconstruct a destroyed proximal scaphoid pole, resulting from Preiser’s disease in three cases and persisting scaphoid non-union in 27 cases, despite up to three previous operations, including revascularising procedures in two cases. After a mean follow-up time of 6 months (range, 2 - 19 months), we clinically and radiologically evaluated the outcome, especially with regard to healing of the scaphoid, complications and rate of reoperation.

Results: In 21/30 patients, we found that the scaphoid healed; in two more cases, the healing was not yet completed, and two patients were lost to follow up. In three patients, we found progressive bone resorption with development of a non-union and the remaining two patients had had a four-corner fusion as a salvage procedure in the meantime. One patient whose scaphoid healed needed a four-corner fusion because of osteoarthritis. One patient had to be reoperated, because of a beginning compartment syndrome. He recovered completely. Further reoperations were necessary to remove a screw in one case and an exostosis of the reconstructed scaphoid in another case. Donor site morbidity was low: we had to do one revision to remove bone wax, which had caused a reactive synovialitis.

Conclusions: The free vascularized osteocartilaginous medial femoral trochlear flap proved to be a valuable tool in replacing a destroyed proximal scaphoid pole. In 70% of our patients, we found the scaphoid definitely healed, with no clinical problems. Especially scapholunate dissociation did not develop. But on the other hand, we definitely found six failures, often due to technical difficulties in this demanding procedure. The main problem is the exact fitting and fixation of the osteocartilaginous flap and re-establishment of the natural form of the scaphoid, especially in cases with considerable deformity and a large defect after resection of the destroyed proximal pole. Fortunately, until now we found no relevant donor site morbidity. In summary, the free vascularised osteocartilaginous medial femoral trochlear flap is our method of choice in the reconstruction of a destroyed proximal scaphoid pole now, but patients must be informed that sometimes failures cannot be avoided. Meticulous operative technique is mandatory. At the moment, long-term results are missing, but they are necessary to evaluate this procedure definitely.

A-0701 REACH OUT: early validation results of a new ICF-based, pan-specialty, hand and upper limb function questionnaire for children

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Hand and upper limb specialists use assessment tools to determine health status, predict subsequent events, plan further treatment and evaluate change over time. The World Health Organisation’s (WHO) ICF framework provides an international standard to describe and measure health and disability. It provides a holistic approach to patient health assessment and gives equal importance to all of its four sections: Body Structures/Functions, Participation, Activities and Environment. It is generally accepted by clinicians that measuring activities and participation is important, yet there are very few hand and upper limb-specific assessment tools that incorporate them and none of these are paediatric. A recent review of assessments of upper limb function classified available hand and upper limb tests as to which areas of the ICF framework they covered. Within the setting of paediatric hand and upper limb assessment tools, those that are available are often only validated for use in disease-specific situations, and they can incur significant costs for departments. Our assessment tool was developed following consultation with user-led patient involvement groups, hand therapists and clinicians from multiple specialties. We have developed an ICF-compliant activity of daily living questionnaire that gives a well-rounded perspective of
Conclusion: The ELK procedure is easy and quick, and secures the optimal setting of IP flexion with limited flexibility, which is advantageous compared with rigid bony arthrodesis. It also avoids certain disadvantages of the commonly-used flexor pollicis longus split tenodesis, and is therefore a valuable alternative for the correction of Froment’s sign due to intrinsic or extrinsic paralysis of the thumb.

A-0705 Coexisting intra-articular lesions are unrelated to outcomes after arthroscopic management of scaphoid non-unions

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Scaphoid non-union is the most common non-union in the wrist and is a challenge to surgeons. Even though bone union is achieved, complaint of residual pain is not rare. It is unclear whether coexisting intra-articular disorders influence persistent pain and disability after arthroscopic management of scaphoid non-unions. We therefore investigated which intra-articular disorders coexist with scaphoid non-unions, and whether they influence pain and function after arthroscopic management of selective scaphoid non-unions. We retrospectively reviewed 30 patients with scaphoid non-unions, without fixed humpback non-unions nor significant arthritis, whom underwent arthroscopic guided bone graft and fixation (K-wires or headless screws). There were 5 distal one-third, 17 mid-third and 8 proximal one-third fractures. We also obtained VAS pain scores for activities of daily living, the Mayo Wrist Scores (MWS) and the Disabilities of Arm, Shoulder and Hand (DASH) scores pre-operatively and at 6 months, 1 year, and annually thereafter, post-operatively. Mean follow-up was at 32.9 months (range, 24 - 60 months). All scaphoid non-unions healed successfully. Fifteen patients had other coexisting intra-articular disorders: nine triangular fibrocartilage complex (TFCC) tears (seven traumatic tears and two degenerative tears), fourteen intrinsic ligament tears (six scapholunate interosseous ligament tears and eight lunotriquetral interosseous ligament tears), and five radioscaphoid degenerative changes. Patients with TFCC tears underwent debridement and ablation of the torn central disc or repair, and those with intrinsic ligament tears underwent simultaneous debridement and ablation of loose tissues. At 2 years after surgery, the mean VAS pain score decreased from 4.2 to 0.2, and mean grip strength increased from 33 to
Intraneural ganglions of the upper extremity are rare. They usually originate within the epineurium of the peripheral nerve as non-neoplastic mucinous cysts. Initially, most authors have supported the de novo theory of formation; however, recently a unifying articular (synovial) theory was proposed, suggesting that the intramural ganglions have connections to the adjacent joints via the articular branches of the involved nerve. In this report, we present 15 cases of intraneural ganglions of the hand and wrist.

**Materials and methods:** Between 1990 and 2012, we treated 15 patients for intraneural ganglion of the hand and wrist. The nine female and six male patients averaged 42 years of age (range, 27 - 69). Ten patients presented with mass and five presented with symptoms of entrapment neuropathy. The ganglions involved the ulnar nerve at the wrist in five patients, the dorsal branch of the ulnar nerve in two patients, superficial radial nerve in two patients, the digital nerves in four patients (1 thumb, 2 ring fingers and 1 long finger) and the dorsal branch of the digital nerve in two patients (one ring finger and one small finger). Eleven patients had magnetic resonance imaging (MRI), which showed the cystic mass, but was not diagnostic of intraneural ganglion. In all patients, the diagnosis was made during surgery. In all patients, the ganglion was excised by intraneural dissection of the nerve fascicles, with complete excision of the cyst. In eight patients, the articular branches were identified and excised.

**Results:** Post-operative follow-up averaged 57 months (range, 11 - 235 months). There were no operative nor post-operative complications. There were no recurrences. Five patients had transient paraesthesia that improved after an average of 2 months (range, 1 - 3 months). All the pre-operative symptoms improved. Patients returned to normal daily and work activities in an average of 10 days (range, 7 - 27 days). Pathological examination demonstrated findings consistent with ganglion cyst. Grip and pinch strength averaged 98% of the contralateral side.

**Conclusion:** Intraneural ganglions should be considered in the differential diagnosis of a mass in the vicinity of a nerve. Surgical excision is usually curative, with good functional outcome. Every attempt should be made to identify and excise the articular branch of the involved nerve.

**A-0709 External neuromodulation for the treatment of neuropathic pain in the upper limb**

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**Introduction:** Fortunately, few patients develop persistent, intractable nerve pain following trauma or surgery to the upper limb. Pharmacological management, including the use of opioid analgesics and membrane-stabilizing agents, is often unsatisfactory. Relocation of end neuromas and small painful nerves in continuity can be very effective, but does not work for everyone. Many patients do not wish to undergo further surgery. Transcutaneous peripheral neuro-modulation (TPNM) offers an alternative means of treating neuropathic pain that is non-invasive and inexpensive. This study evaluates the outcomes of using TPNM in 72 patients with intractable neuropathic pain in the upper limb.

**Methods:** Between October 2007 and March 2012, we treated 72 patients (43 women and 29 men) of a mean age of 54 (range, 15 - 76) years, with TPNM. Details of any precipitating surgery or trauma, the peripheral nerve involved and the nerve pathology were recorded for each case. Pain severity was determined pre- and immediately post-treatment by subjective patient self-assessment using a visual analogue pain scale (where no pain = 0; worst pain possible = 10). The outcomes were categorised depending upon the duration of symptomatic relief obtained: ‘total cure’ if relief was permanent; ‘long-term success’ if temporary relief was ≥ 1 week; ‘intermediate-term success’ if relief ≥ 3 days but < 1 week; ‘short-term success’ if
A-0710 A simple, reliable technique for the correction of swan neck deformities

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Introduction: Spiral oblique retinacular ligament (SORL) reconstruction is a recognised technique in the management of a passively correctable swan neck deformity. Several different methods have been reported. We present a variation, whereby one lateral band is passed volar to the proximal interphalangeal joint (PIPJ) and secured to the proximal phalanx with a bone anchor. Our aim was to review the outcome following SORL reconstruction with this technique in our patient population.

Methods: We identified patients whom had had a SORL reconstruction performed by the senior author, using this technique. All available patients were reviewed in the clinic. Range of motion (ROM) measurements, grip strength and pinch stress were assessed. A questionnaire was used to assess patient satisfaction with the outcome following surgery.

Results: Nine procedures were completed in five individual patients. The indication for surgery in each case was swan neck deformity, due to volar plate laxity arising either spontaneously or following trauma. All digits were improved and full correction was achieved in 8/9 fingers. The range of movement achieved at the PIPJ averaged 87° [range, 66° to 100°], with an average extensor lag of 6° [range, -4° to -24°].

Discussion: The use of a bone anchor to secure the proximal tendon, rather than a tendinous or flexor sheath insertion, gave a robust repair. The follow-up time varied, but the results were maintained in those patients reviewed beyond 5 years.

Conclusion: This technique is reliable in the correction of swan neck deformities resulting from volar PIPJ laxity; and patients were satisfied with the outcome.

A-0714 Microsurgical reconstruction of the forearm bones using epimetaphyseal autografts

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Introduction: In children with damage to one of the bones of the forearm is a clinical symptom, deviation brush and dysfunction of the wrist joint. Depending on the magnitude of the defect of one of the bones, we identified three degrees of deformation. First degree: lost no more than 50% of the length of the bone; second degree: lost more than 50% of the length of the bone; third degree: complete absence of one of the bones.

Purpose: Reconstruction of the anatomical integrity of the forearm bones, with restoration of joint function and growth opportunities.

Materials and methods: At the Department of Reconstructive Microsurgery and Hand Surgery, microsurgical reconstruction of the forearm bones epimetaphyseal perfused autografts in 15 children. The age of patients ranged from 3 - 10 years. Diseases which required restoration of the distal forearm bones
were the radius and ulna clubhand, a neoplastic process and the traumas of acute hematogenous osteomyelitis. In all cases, the complexes perfused tissues. With the defeat of at least 50% of the length performed autologous second metatarsal bone. Affecting more than 50% of transplants performed epimeta-physseal fibular autograft. All patients underwent X-ray examination. Some patients underwent computed tomography (CT) for a more detailed study of the state of osteoarticular apparatus of the forearm. In the late period, we evaluated the cosmetic condition and reduced limb function of the wrist joint. All patients studied state donor area at different times after surgery.

Results: Maximum follow-up was 7 years. After microsurgical reconstruction, eight children showed complete recovery of function of the wrist joint. Additional surgical correction was required. Clinically and radiologically, we observed restructuring of the transplanted graft. Thanks to the bone graft revascularisation containing a germ zone, we watched the last active function. Three patients had advancing bone growth in the reduced length, compared with the other. This is due to decreased function of the growing zone opposite the bone, because of this illness. Five children made subsequent corrections of total length of the forearm.

Conclusion: This use of autografts with axial type of blood supply in children is an effective method of correction of the deformity of the forearm and wrist joint function. Using perfused autografts, the growth zone ensures growth and prevents the development of limb relapse.

A-0715 Effects of repeated C botulinum toxin A injections and occupational therapy on hand function in children with cerebral palsy: a randomized controlled trial

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Introduction: The purpose of this study was to evaluate and compare the effectiveness of treatment with Clostridium botulinum toxin A (BoNT-A) combined with occupational therapy (OT), with OT alone on the hand function at an age before the indication for surgery is decided upon.

Method: We recruited 20 children from the habilitation centres and randomized them to the different treatment groups. Inclusion criteria: Unilateral spastic cerebral palsy with typical spasticity in the pronator teres muscle, the thumb muscles and the elbow flexors, interfering with bimanual activity. Age: 18 months to 10 years. Exclusion criteria: Intellectual disability interfering with the intervention program, dystonia, previous upper limb surgery and/or BoNT-A injections. Both groups received home-based intensive occupational therapy; and one group was, in addition, treated with BoNT-A twice within a 6-month interval. Follow-up assessments were carried out at 3, 6, 9 and 12 months. Outcome measurements, covering all domains in the International Classification of Functioning Disability and Health classification (ICF): Active and passive range of movement (ROM), Assisting Hand Assessment (AHA) showing the use of the impaired hand during activities that require bimanual handling, the Canadian Occupational Performance Measure (COPM) for performance and satisfaction of selected goals. Statistics: To reveal differences between the groups at baseline, the Mann-Whitney U test was conducted. Friedman’s analysis of variance (ANOVA) was employed to calculate the effects of change for the range of motion (ROM) and AHA variables, over all repeated assessments for each single group. Comparison between and within the BoNT-A+OT and OT groups were conducted according to Fischer’s exact test. A change in ROM of more than 10°, more than 5 AHA units and a change of the COPM score by 2 points were regarded as a significant change.

Preliminary results: ROM active supination within the groups: Both groups showed significant improvement at each follow-up, compared to baseline. When all assessments were considered by Friedmans’ ANOVA, a significant improvement was revealed in the BoNT-A+OT group (p < 0.01), while this was not the case in the OT group (p = 0.13). The increase of active supination in the BoNT-A+OT group was 42°, and in the OT group it was 22°. A statistically significant increase of the AHA score was found in the BoNT-A+OT group (p < 0.01), but not in the OT group (p = 0.34). The AHA score increased by a median of 10 AHA units, from baseline to 12 months, in the BoNT-A+OT group; in the OT group it increased by a median of 1 AHA unit. Regarding COPM, both groups improved in performance and satisfaction at 3 and 9 months.

Conclusion: This study demonstrated a superior effect of the combined treatment model of repeated BoNT-A and occupational therapy intervention, compared to only occupational therapy, as only the combined treatment model resulted in improvement
in all measured ICF domains. In fact, several of the children in this group improved the supination so much that surgical intervention [release of pronator teres muscle] was no longer indicated.

A-0717 Simulation-based assessment of hand trauma coordinators

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Introduction: The majority of hand injuries [unlike other trauma] can be managed semi-electively in the outpatient setting or as day-cases. The British Society for Surgery of the Hand’s Hand Surgery Report (2007) states that hand trauma coordinators (HTCs) are necessary to provide this service. The role allows a point of contact for both patients and members of staff to streamline the patient’s pathway. It is now emerging that there may be scope to extend the role of the HTCs to be involved in the initial triage of referrals. As this role evolves, the concept of simulation should be embraced. Current evidence suggests that skills acquired through training with simulators positively transfers to the clinical setting and improves outcomes. This is not exclusive to surgeons and the role for simulation should extend. Our aim was to assess the training and learning needs of HTCs, through the use of low-cost simulation and to design a competency-based curriculum.

Materials and methods: We designed three simulation scenarios based on real patient referrals that had previously been accepted to Chelsea and Westminster Hospital. Patient X-rays were available to view on the imaging system. HTCs were assessed according to a mark scheme and a senior doctor acted as the referring party. The mark scheme assessed five main domains: administration and patient details, X-rays, assessment and management of the wound, triaging, and professionalism and communication. The HTC and referring party were placed in separate rooms and the phone referral was on loudspeaker, to facilitate marking by another independent doctor, who sat in with the referring party.

Results: We assessed four HTCs in total from different backgrounds: a recovery nurse, physiotherapist, radiographer and burn care nurse. Three HTCs had a background of working in a plastic or orthopaedic surgery department. Two HTCs had a background of working in a hand unit. All HTCs scored > 83% on administration and patient details (range, 83 - 100%) in every scenario, with one HTC scoring 100% for 2/3 scenarios. Only one-half of the HTCs were able to appropriately assess X-ray images. The assessment and management of the wound had the lowest score achieved for all HTCs in every scenario (range, 33 - 54%). In addition to this, the majority of scenarios were not triaged appropriately to the correct clinic, theatre list or for admission.

Discussion: Without the appropriate training, patient safety may be compromised. In order to assess hand injuries and their management, one must have the appropriate knowledge base. Simulation enables the participant to assess their strengths and weaknesses and to tailor their learning. The HTC role requires training to acquire skills to undertake it successfully and safely. To triage patients, one must appreciate the diagnosis, management and consequences of a hand injury. Without this appreciation and knowledge, there is great scope for mistakes to occur. Low-cost simulation scenarios, in addition to structured teaching and a competency-based curriculum, can provide excellent training.

A-0719 What are the key determinants of successful flexor tendon repair? Can good outcomes and a low rupture rate still be achieved despite varied operative techniques?

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Introduction and aims: There is frequent debate regarding optimal management of Zone 2 flexor tendon injuries, differentially focusing on repair technique and therapy regimes. A retrospective analysis was performed in a tertiary hand trauma unit in the north of England.

Materials and methods: Data was collected from medical and physiotherapy records for patients whom underwent primary repair of > 50% division of the FDP tendon between January 2010 and July 2013.

Results: We identified 117 patients with 138 FDP repairs, of which 75 had a concurrent FDS repair: 78% were male, with a mean age of 34 (range, 15 - 89). The most commonly injured finger was the little (34%) finger with 69 (50%) having an associated digital nerve injury. A total of 101 patients (86%) had surgery within 3 days of injury. 86% of operators were non-consultant grades. Repair technique varied, with a modified Kessler being the most commonly used core suture (75%): 71% were four-stranded and 29%, two-strand techniques. A Siltverskiold epitenudous suture was used in 15%, with a non-locking running suture in the majority of the remainder. All received physiotherapy using a controlled active mobilisation...
A-0727 The use of a prospective hand fracture database for monitoring patient outcomes from ‘Max-fix’ external fixation of proximal phalanx fractures

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Background: Phalangeal fractures account for 10% of all fractures. There are several options for fixation, some of which are expensive, bulky and require specialist knowledge and training on usage. The ‘Max-fix’ is a novel external fixation method popularised in our specialist hand unit for fixation of diaphyseal and/or comminuted fractures of the proximal phalanx. This technique uses readily available theatre materials (plastic needle sheath and Kirschner wires), at a minimal cost. We conducted a prospective study using functional outcomes to monitor treatment success.

Aims: The aim of this study was to carry out a prospective analysis of patients that had Max-fix external fixation of proximal phalanx fractures, to assess objective functional outcomes.

Methods: Prospective data over a consecutive 18-month period was collected (April 2012 to November 2013) using the departmental hand fracture database. We treated 48 patients with proximal phalanx fractures using the Max fix technique. We collected data, including: patient demographics, mechanism of injury, radiographic details, operative details and post-operative care (including physiotherapy assessment data). Surgeons and physiotherapists worked in close alliance to input data prospectively, allowing for detailed monitoring of the rehabilitation. We excluded 11 patients who did not attend follow-up appointments to discharge. Objective range of motion (ROM) data was collected by the physiotherapists.

Results: We treated 37 phalangeal fractures with Max-fix fracture fixation. The most commonly-affected digit was the little finger (n = 20), then the ring (n = 12), middle (n = 3) and index fingers (n = 2). There was one documented complication of pin site infection, successfully treated with antibiotics. Fixators were removed at a mean of 3.8 weeks (range, 2 - 4). Nine patients were discharged at the time of Max-fix removal (4 weeks), as patients were happy with their outcome. At this point, they had a mean average ROM at the PIPJ of 58°, with total active movement (TAM) of 184°. The average time to discharge from physiotherapy was 9 weeks (range, 4 - 24 weeks). The mean average ROM at this time was 84° at the MCPJ, 66° at the PIPJ and 57° at the DIPJ, with a mean TAM of 207°.

Conclusions: Our Max-fix method of external fixation of proximal phalanx fractures is a cheap, effective technique, which has shown good objective functional outcomes with few associated complications in this series. The results from this prospective study compared less favourably than our previous retrospective study, where the TAM was found to be 218° at 2 months. We have highlighted some areas requiring improvement in our post-operative care. The use of a prospective, multidisciplinary database allowed us to monitor our outcomes more readily and we will use this to monitor the changes to our post-operative protocol.

A-0734 Complete ring avulsion amputations: 15 years of experience

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A total of 83 complete ring avulsion amputations were treated in our center over a period of 15 years. The average age of our patients was 23.7 years old. In nine cases, distal fragment was not available; in two cases, replantation was not attempted, once because laceration of the distal fragment was too important and once because FDS was not inserted. So 72 patients underwent a replantation procedure and 41 were microsurgical successes. Bone levels were: 40 trans DIP, 9 trans P3, 5 trans P3 complicated by P2 fracture, 2 trans PIP. The venous graft surgical technique was chosen in most of our replantations (n = 57), with a rate of success of 64.9%. In 13 cases, direct anastomosis of the dominant artery was attempted: only a 23.1% success rate was achieved. Two more patients had first a direct anastomosis, then revision for ischemia at 24 hours, using venous grafting, one with success. Transfer of adjacent finger collateral artery was never performed in our team. Using a standardised technique of vein grafting seemed to improve microsurgical success, compared to direct anastomosis. In most of the successful replantations, we
decided not to perform nerve reparation, thereby preventing distal fragment deterioration by dissection and reducing the time-length of the procedure. Proximal nerves were slipped into the distal fragment with no suture, for neurotaxis. Osteosynthesis, when required, utilized one or two Kirshner wires. Training of surgeons appeared to be a factor for better results. Only 24 patients could be reviewed among the 41 replantation successes, and follow-up took place between 6 months and 14 years. Two poor results occurred, with one patient requesting a complete ray resection; three were medium results, with PIP stiffness; five were good results, with PIP ROM superior to 70°; and two were excellent, with PIP ROM normal and no DIP arthrodesis. It must be noted that the best results involved teenagers. We achieved 23 good and very good Quick DASH results. Cold intolerance was always present, and the 2-point discrimination always bad. Cold intolerance and lack of sensibility were never the cause for ray resection amputation demand. A total of eight basi-metacarpal ray resections were performed in this series, seven of them after replantation failure and only once after microsurgical success, because of stiffness and a very bad Quick DASH result. All these patients were satisfied with the final procedure. Not one of the 24 patients reviewed had regrets about the first replantation attempt. According to our experience, almost all ring avulsions deserve an attempt at reattachment. Ray resection at first appears too narrow to us, among this young population of patients. This procedure should rather be discussed afterwards, following microsurgical failure.

A-0740 Epineural sheath jacket as a new surgical technique for neuroma prevention in the rat sciatic nerve model

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Purpose: Neuroma may form as a result of nerve transection or damage, causing pain and significantly impairing quality of life. Although many techniques have been developed so far, none have been proven to be superior in prevention of neuroma formation. The aim of this study was to test the epineurial sheath jacket (ESJ) as a new method for prevention of neuroma formation in the rat sciatic nerve model. Epineural sheath is a naturally-occurring material, easily harvestable and expresses proneurogenic and proangiogenic markers, supporting nerve regeneration.

Methods: We divided 72 rats into six experimental groups: Group 1: Control: Nerve stump without any protection; Group 2: Nerve stump buried into the muscle; Group 3: ESJ covering nerve stump; Group 4: ESJ covering nerve stump and buried into the muscle; Group 5: ESJ filled with fat graft covering nerve stump; Group 6: ESJ filled with fat graft covering nerve stump and buried into the muscle. Animals were evaluated at 12 weeks and 24 weeks for follow-up. Sciatic nerve was dissected and a 2-cm segment of the nerve was resected. Nerve fascicles were removed, using the pull out technique, creating an empty epineural sheath conduit. The distal part of the conduit was closed and the proximal part was trimmed, creating a 7 mm long tube of protective ESJ. Finally, ESJ was applied over the proximal nerve stump, using epineural sleeve technique [Groups 3 - 6]. In Groups 5 and 6, before ESJ application, autologous fat was harvested from the gluteal region and, following appropriate fat processing, it was injected into the ESJ. Animals were evaluated at 12 weeks and 24 weeks follow-up.

Results: During nerve exploration, significant adhesions were seen in Groups 1 and 2, whereas neuroma-like formation characterised by distension and disorganisation of the proximal stump was observed in Group 1. In contrast, no signs of neuroma-like formation were observed morphologically in Groups 3 - 6. The structure and integrity of the ESJ was preserved. By S-100 staining, nerve architecture was seen to be maintained in groups with ESJ protection, whereas in Groups 1 and 2 the disorganisation of the nerve fascicles was noticed. Masson trichrome staining in Groups 3 - 6 revealed a normal neural-to-connective tissue ratio, whereas in Groups 1 and 2, an abnormal correlation was observed. Using toluidine blue staining, we found dispersed axons without regular fascicular architecture, with large amounts of connective tissue, in Groups 1 and 2; whereas in Groups with ESJ protection, the axons demonstrated normal nerve architecture.

Conclusions: This study confirmed the feasibility of ESJ application as a new method for prevention of neuroma formation. The protective effect of ESJ was proved by histological analysis in the rats in Groups 3 - 6.

A-0743 Three-dimensional (3D) kinematic analysis of upper extremity function in children

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Introduction: A new evaluation method of upper extremity function, even in children, is presented. It is
Materials and methods: A 3-D optoelectronic camera system with passive markers was used to capture the possible active range of motion (ROM): 27 markers coated with a retro reflective tape were applied over anatomical landmarks on both upper limbs. These markers were recorded simultaneously by six cameras. A 3-D reconstruction of the position of the marker was done by specially-designed software. Joint centres and joint movements were calculated by using the Expert Vision and ORTHOTRAK software (Motion Analysis Corporation). Healthy probands, including children, were investigated to obtain normal values. Patients suffering from congenital forearm deformities (Madelung’s deformity and radioulnar synostosis) and from waiter’s tip posture, due to obstetrical brachial plexus lesion, were investigated before and after surgical correction.

Results: Investigation of the healthy probands allowed not only to establish normal values for ROM of the shoulder, elbow and wrist; but also to develop an easy-to-read graphical presentation of the results. Pre- and post-operative evaluation of the patients did produce static data, representing the position of the parts of the upper extremity in relation with their neighbouring parts and the healthy extremity, respectively. Dynamic data could show the influence of procedures to the kinematics of the whole upper extremity.

Discussion: Because of the more complex nature of upper limb kinematics, the transfer of the system from lower to upper extremity involves still-unsolved problems. Simplifications of the biomechanical model and limitations in accuracy are detailed and discussed; however, the method enabled analysis of upper extremity motion concerning shoulder-, upper- and forearm and wrist function. Measured angles were reliable and reproducible. The collected data allowed an objective analysis of the results of surgical procedures and will allow further follow up, which is especially important in growing children. Furthermore, the data we derived can be used to plan surgical interventions, e.g. the amount of required rotation for an osteotomy.

A-0746 A magnetic resonance imaging (MRI) study of extensor carpi ulnaris (ECU) tendon disorder associated with traumatic and degenerative triangular fibrocartilage complex (TFCC) tears

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Purpose: The purpose of this study was to investigate the incidence of ECU tenosynovitis (tendinitis) and DRUJ arthritis with the use of wrist magnetic resonance imaging (MRI) in the patients with chronic TFCC injury and ulnocarpal impaction syndrome.

Materials and methods: We conducted wrist MRI in the consecutive patients who visited our clinic complaining of chronic ulnar wrist pain, from August 2011 to January 2013. Inclusion criteria for this study were: chronic TFCC tears and ulnocarpal abutment syndrome, of which symptom duration was > 3 months. We excluded patients with acute wrist injury and rheumatoid arthritis. Thirty-four patients met our criteria: there were 14 female and 20 male subjects. Diagnosis was made based on physical examinations and MRI findings. Eight cases had ulnocarpal impaction syndrome, 24 cases had TFCC injury, and two cases had concurrence of both disorders. A 1.5-tesla MRI with microscopy coil was used, and the MRI finding of TFCC injury was a high-intensity area at the fovea or articular disc on coronal T2-weighted images. Ulnocarpal impaction syndrome had an intramedullary high-intensity area of the ulnar head, lunate and triquetrum on coronal T2-weighted images. We defined disorders of ECU tendon as the focal high-intensity area in the ECU tendon sheath (tenosynovitis) or within the ECU tendon (tendinitis) on axial T2-weighted images. We judged each finding as positive when the peri- and intra-tendinous high-intensity area of 1 mm or more was observed at the center of the ECU groove of the ulnar head. We defined DRUJ arthritis as the intra-articular high-intensity area in the DRUJ on axial T2-weighted images.

Results: There were five cases (50%) with DRUJ arthritis, three (30%) with ECU tendinitis, and six cases (60%) with ECU tenosynovitis in the 10 patients with ulnocarpal impaction syndrome. There were six cases (23%) with DRUJ arthritis, four cases (15%) with ECU tendinitis, and five cases (19%) with ECU tenosynovitis in the 26 cases with chronic TFCC injury.

Discussion: DRUJ instability associated with TFCC injury may cause ECU tenosynovitis (tendinitis), because ECU tendon friction may occur due to DRUJ instability. Injury of the ECU floor, which is a component of TFCC, may also be a cause of ECU tenosynovitis. Ulnocarpal impaction syndrome consists of Class 2 degenerative TFCC tears and may lead to DRUJ arthritis. Although ECU disorder may be associated with TFCC tears, there is a lack of information regarding frequency of ECU tenosynovitis.
A-0747 Ultrasound-guided percutaneous carpal tunnel release: a prospective study of 350 patients

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Carpal tunnel syndrome is commonly treated by a mini-open or endoscopic procedure. Theoretically, an ultrasound technique permits assessment of a precise anatomical diagnosis in the carpal tunnel, avoiding nervous compression with an endoscopic device, and controlling the complete release of the median nerve. The aim of this study is to evaluate the feasibility of the technique. In a prospective study, 350 people (55 men and 295 women, mean age 62 years old) were treated with an ultrasound-guided percutaneous procedure by the same operator. All carpal tunnel syndrome had been diagnosed by an electrophysiological examination. The procedure has been performed for all patients except one. This patient presented a palmar cyst into the carpal tunnel, diagnosed thanks to the ultrasonography and thus, an open technique was performed. The anatomical variations [not considered as a contraindication of the technique] were: two median arteries confirmed by a Doppler examination, a double ulnar artery in the Guyon tunnel, and three bifid median nerves. A picture of the knife through the retinaculum was taken as evidence of the complete release. In conclusion, the ultrasound-guided technique permitted to diagnose precisely the anatomy, and to perform a complete carpal tunnel release with a post-operative picture [legal evidence].

A-0748 Patients’ preferences for treatment for Dupuytren’s disease: Discrete Choice model

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Objective: Many treatment options are available for Dupuytren’s disease (DD) and these treatments differ significantly in attributes such as the amount of contracture correction, complication rate, convalescence and time to recurrence. Because not all treatments are equally successful in optimising all these attributes, it is important to understand patients’ preferences. For example: how much change of recurrence is a patient willing to trade for an earlier return to work. Therefore, the aim of this study is to determine patients’ preferences for different techniques to treat DD and their attributes, by using a discrete choice experiment.

Methods: We approached 973 patients whom had sustained a treatment for DD between January 2009 and August 2012, to evaluate their choice of treatment. These patients were asked to fill in a questionnaire in which they had to repeatedly choose between three different hypothetical treatments. Each hypothetical treatment was characterised by various levels [values] of seven different attributes: treatment method, major complication rate, minor complication rate, recovery period, recurrence within 5 years, extension deficit after treatment and aesthetic result. We analysed the relative importance of these attributes and the trade-offs that patients were willing to make with a latent class model.

Results: The total response rate was 73%, of whom 506 patients filled in the complete questionnaire. We found that the levels of all seven treatment attributes significantly contributed to the final treatment choice. Post-treatment extension deficit and recurrence rate most significantly contributed to treatment choice, whereas aesthetic results and recovery time seemed less important. We also calculated the trade-offs that patients were willing to make for ‘recurrence of disease’ and ‘contracture correction’. Patients accepted an increase of 10.5% recurrent disease, if they could receive needle aponeurotomy treatment instead of limited fasciectomy. Furthermore, patients accepted a 10% increment of recurrent disease for every 5% reduction of major complications. Patients accepted a decrement of 8.5% of the post-intervention contracture correction, if there was a 5% reduction in major complication rate and they accepted a 9% decrement in reduction of the post-intervention contracture correction if there was at least a 10% reduction of the recurrence rate.

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Conclusions: In this discrete choice experiment, we were able to calculate the trade-offs that patients were willing to make for ‘recurrence of disease’ and ‘contracture correction’. We showed that patients are willing to receive a treatment with a higher chance of recurrence of DD if the chance of major complications was smaller. Also, patients considered post-treatment contracture reduction more important than the recurrent disease rate. This study gives us more inside information concerning important factors for patients with DD. Hopefully, this may improve treatment selection during patient-doctor interaction.

A-0749 Post-traumatic flexor tenosynovitis (trigger digits)

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Objective: Flexor tenosynovitis develops after an initiating noxious event, such as trauma and surgery. If the optimal treatment is delayed, post-traumatic contracture of the digits follows. It is required to diagnose post-traumatic flexor tenosynovitis promptly. The aim of this paper was to clarify the clinical features of post-traumatic flexor tenosynovitis.

Materials and methods: We retrospectively checked medical records. Among 429 flexor tenosynovitis or trigger digits of 245 cases, 33 cases had a trauma or surgery on the ipsilateral upper extremity within 6 months before the diagnosis of the flexor tenosynovitis or trigger digit. One case with rheumatoid arthritis (RA) was excluded and the remaining 32 cases with post-traumatic flexor tenosynovitis were selected as this study’s subjects. The mean age of 32 cases was 62 years (range, 38 - 83 y). There were 12 men and 20 women. The affected side was right in 15 and left in 16, and both in one case. The affected digit was the thumb in 16, index in 7, middle in 18, ring in 11 and little in 4 cases. An initiating event was distal radius fracture in 14, endoscopic carpal tunnel release in 3, wrist sprain in 5, digit fracture-dislocation in 5, elbow fracture-dislocation in 3, cubital tunnel release in one, humeral neck fracture in one, and cuff repair in one case. We investigated the periods from the prior event to diagnosis, the presence or not of snapping- locking of the affected digits, the presence or not of concomitant carpal tunnel syndrome, the presence or not of trigger digit on the opposite hand, and the treatment and outcome of post-traumatic flexor tenosynovitis.

Results: The post-traumatic flexor tenosynovitis was diagnosed 13 weeks (range, 9 days to 51 weeks) after prior trauma or surgery: 21 (67%) cases had flexor tenosynovitis of multiple digits; 8 (25%) cases had snapping and locking of the digits, although 24 (75%) of the cases had no such episodes; 10 (31%) of the cases had concomitant carpal tunnel syndrome; three (9%) had trigger digits on the opposite side. Treatment was triamcinolone injection in 26 cases, surgery in two cases, and wait and see in four cases. The mean observation period from the treatment of flexor tenosynovitis was 5.4 months. Complaints such as pain and contracture of the digits were resolved in most cases, although contracture remained in four cases.

Discussion: Complex regional pain syndrome (CRPS) Type I develops after an initiating noxious event; however, the diagnosis is excluded by the existence of a condition that would otherwise account for the degree of pain and dysfunction. We have actively examined the presence or not of flexor tenosynovitis in such cases, even if there were no episodes of snapping nor locking. Because 75% of the cases had no episodes of snapping nor locking, post-traumatic flexor tenosynovitis might be diagnosed to be CRPS 1 or contracture. Care should be taken to diagnose flexor tenosynovitis after a trauma or surgery on the upper extremity. Prognosis is good if prompt treatment is applied for post-traumatic flexor tenosynovitis.

A-0755 Thumb duplication: analysis of epiphyseal morphology in grade IV duplications

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Introduction: Grade IV of Wassel classification is defined as a thumb duplication, starting at the level of the MCP joint. This classification is universally used by hand surgeons and relies on a radiological bases, but does not take into account the details of duplication of both the phalangeal and metacarpal epiphysis; however, these details might have an influence on the surgical strategy. Our goal was to investigate the details of epiphyseal duplication in a series of operated grade IV thumb duplications.

Material and methods: Among a series of 36 consecutive cases of operated grade IV duplications, 21 cases have been retrospectively reviewed by a single investigator. The series included 7 female and 15 male patients with a mean age of 7 years. Preoperative X-rays were available in all the cases. Analysis of the details of epiphyseal duplications was obtained through pre-op observations during the arthroscopy step of the procedure.
Results: Mean follow-up was 73 months. Patients were classified into three subgroups, according to the details of the morphology of the MCP joint. Sub group ‘distal’ (23%): in this subgroup, the two duplicates share a common proximal phalangeal epiphysis. Sub group ‘proximal’ (30.7%): the two duplicates have a distinct proximal epiphysis. The metacarpal head is enlarged and can exhibit two distinct facets. Sub group ‘intermediate’ (46.1%): the two duplicates have separated epiphysis united by a tight syndesmosis.

Discussion: Analysis of the details of epiphyseal duplication leads to further subdivision of Grade IV into three subgroups. Preoperative magnetic resonance imaging (MRI) might be able to allow precise grading in preop, but without any benefit for the patient; however, the surgeon should be prepared to deal with any of these subgroups, to adapt his surgical protocol.

A-0757 A prospective review of 71 children with the diagnosis of pulled elbow

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Aim: The aim of this prospective study was to assess the natural history of proximal radio-ulnar subluxation (pulled elbow, nurse maid elbow) and the preferred institutional treatment method in the pediatric age group.

Methods: We treated 71 children with ‘pulled elbow’ at our department, within a 3-year period. Clinical records and final status of the patients were analysed in detail. We included 66 children with complete follow-up in the study. There were 33 girls and 33 boys. The mean age was 27.7 months (range, 5 – 84 months) at the time of admittance to our department. The affected side was the left in 42 and the right in 24 children.

Results: The mean follow-up was 24 (range, 7 - 41) months. The most common time interval and season for the injury was between 12 pm and 5 pm (38 cases), and in Spring (28 cases), respectively. The emergency department (ED) admitted 42/66 children (64%) within 30 minutes following injury. A successful reduction by supination and flexion maneuver was obtained in all cases, and the rate of successful reduction at the first attempt was 57/66 (86%). In 64/66 cases (97%), an immediate clinical recovery was seen within 1 - 2 minutes. There was no statistically significant difference between girls and boys, right and left sides, 0 - 2 years and 3 - 7 years age groups, regarding the injury time, injury season and rate of successful reduction at the first attempt (P > 0.05). The final clinical examinations of all patients were completely normal. At the latest follow-up, 20 patients (30%) had a history of recurrent subluxation. This was higher than the usually reported literature rates. But, at these periods, mostly spontaneous or non-medical person reductions were reported by families, without being seen by any doctor or institute. As a matter of course, true recurrence is obscure, at this situation. Recurrent subluxation did not correlate with gender and site (P > 0.05).

Conclusions: Pulled elbow is usually a daylight time injury during spring. Nearly one-half of the cases are younger than 2 years of age and the left side is at more risk. Nearly 90 percent of the cases can be reduced at the first attempt, and an immediate clinical relief can be obtained following reduction in almost all cases. There is no considerable factor affecting treatment success and recurrence rate.

A-0758 Scaphoidectomy and double column midcarpal arthrodesis for SLAC, SNAC and SCAC Stage III°

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Introduction: One surgical option for the treatment for SLAC, SNAC and SCAC stage III° is the midcarpal arthrodesis with scaphoidectomy. Various methods of synthesis for arthrodesis are used, from simple K-wires to headless screws and intercarpal plates. We present our experience of this technique according with the procedure of the two columns arthrodesis (luno - capitate and triquetrum - hamate), by using the Herbert screws introduced in a proximo-distal direction.

Materials and methods: From 2001 to 2012, we treated 93 cases of SLAC and SNAC wrist Stage III°: 61 of them had midcarpal arthrodesis, according with the two columns technique. All cases were submitted to preoperative and postoperative X-rays, clinical evaluation according with a Mayo score, and DASH and PRWE questionnaires. Arthroscopy was done in all cases, in order to obtain precise information about the condition of the joint before open surgery.

Results: At a mean follow-up of 9 months, 34 cases (30 males and 4 females, with a mean age of 50 years) were controlled. No complications nor failures occurred. SLAC and SNAC had an equal distribution in this series (16 and 15 cases, respectively). Pain showed an important decrease, from 8 to 3 on the VAS scale, wrist ROM globally reduced (flexion-extension from 83° to 54°, while radio-ulnar deviation went from
24° to 20°; and grip strength slightly improved. Mayo score showed an increase from 34 to 55. All cases showed a radiographically complete consolidation and almost all the patients returned to their previous work in 3 months.

**Conclusions:** The technique of double column mid-carpal arthrodesis for SLAC, SNAC and SCAC Stage III° provides good results, in terms of clinical recovery, fusion of the arthrodesis, patient satisfaction and return to work.

**A-0765 Comparison between open and arthroscopic-assisted foveal TFCC repair for post-traumatic DRUJ instability**

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**Introduction:** The aim of this study was to assess the objective and subjective functional outcomes after foveal reattachment of proximal or complete ulnar-sided triangular fibrocartilage complex (TFCC) lesions by two surgical procedures: an open technique or an arthroscopically-assisted repair.

**Materials and methods:** The study was done prospectively on 49 wrists affected by post-traumatic distal radio-ulnar joint (DRUJ) instability. We treated 24 patients with the open technique (Group 1) and 25 patients by the arthroscopically-assisted technique (Group 2). Magnetic resonance imaging (MRI) demonstrated a clear foveal detachment of the TFCC in 67% of the cases. Arthroscopy showed a positive ulnar-sided detachment of the TFCC (positive hook test) in all cases. Distal radio-ulnar joint stability was obtained in all but five patients, at a mean follow-up of 6 months.

**Results:** Both groups had improvement of all parameters, with significant differences in wrist pain scores, Mayo wrist score, Disability of the Arm, Shoulder and Hand (DASH) questionnaire and Patient-Rated Wrist/Hand Evaluation (PRWHE) questionnaire scores. There were no significant post-operative differences between the two groups in the outcome parameters, except for the DASH questionnaire score, which was significantly better in Group 2 (p < 0.001).

**Conclusions:** Both techniques, open and arthroscopically-assisted repair of the TFCC in DRUJ instability, are safe and reliable procedures that relieve ulnar-sided wrist pain and restore DRUJ stability. The surgeon must precisely address the disruption of the radioulnar ligaments at the fovea and intervene by performing an osseous re-fixation. A diagnostic arthroscopy should be performed, to assess the structural integrity of the radio-ulnar ligaments and the condition of the DRUJ’s articular surface, since these are two main factors that determine good functional outcome.

**A-0766 The role of three-ligament tenodesis in the treatment of chronic scapholunate instability**

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Restoring ligamentous control in dissociative carpal instability is a major issue in protecting against osteoarthritis. We present clinical and radiological results for 20 patients who underwent flexor carpi radialis 3-ligament tenodesis and were prospectively reviewed at a mean follow-up of 25.1 months: 3-ligament tenodesis significantly relieved pain and increased grip strength and wrist function, at the expense of joint stiffness. This improvement was not seen in cases of dynamic instability; however, ligamentous loosening did result in rapid recurrence of radiological anomalies and frequent complications. This study challenges the long-term benefit of 3-ligament tenodesis in both dynamic and static chronic scapholunate instability.

**A-0769 Delayed surgical reconstruction of arm and hand function more than 10 years after cervical spinal cord injury: it is never too late to improve**

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**Introduction:** An important reason for the underuse of functional surgery in tetraplegic individuals may be the widespread belief that after a certain time delay following spinal cord injury, patients should settle down and accept their impairment, and that it may be ‘too late’ for surgical improvement.

**Objective:** To investigate the effect of a time delay of more than 10 years after spinal cord injury on the results of upper extremity reconstruction in tetraplegic patients. Patients: The results of 17 grip reconstructions performed at a minimum of 10 years (mean, 19 years; maximum, 38 years) after cervical spinal cord injury (SCI) in 17 patients (3 women and 14 men) aged 43.5 ± 7.85 (mean ± SD) were reviewed.
Methods: Key grip strength, grasp and first web space opening were recorded prospectively in some patients and retrospectively in some. Functional improvement was evaluated prospectively, using the Canadian Occupational Performance Measure (COPM). All tests were conducted pre-operatively and 12 months post-operatively.

Results: All parameters were significantly improved. Strength of key pinch increased from 0.5 kg in one case and zero in 16 cases, to an average of 2.6 ± 1.35 (mean ± SD) kg. Grip strength increased from almost 0 to 4.9 ± 3.41 (mean ± SD) kg. Maximal distance between the thumb and index increased from 1.9 to 6.2 ± 2.64 (mean ± SD) cm. The COPM increased with more than 2 points, which is clinically relevant (performance 2.5 and satisfaction 2.6 points).

Conclusion: According to this study, tetraplegic patients significantly benefit from a surgical rehabilitation of their upper extremities, even decades after their original spinal cord injury. A long-time delay should therefore not be regarded as a contraindication to these highly beneficial procedures in motivated patients with realistic expectations.

**A-0783 Axial-patterned flap raised from the radial duplicate in Grade IV thumb duplications**

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Introduction: Conservation of the ulnar duplicate and resection of the radial duplicate are among the common strategies when dealing with grade IV thumb duplication. In these situations, the ulnar duplicate is too small to achieve the reconstruction of a good looking thumb. Many different options have been proposed in the literature, to increase the volume of the ulnar duplicate. We investigate the results of an axial patterned flap, raised on the collateral artery of the radial duplicate, used for this purpose.

Material and methods: We operated on 16 children presenting with a grade IV thumb duplication, with a protocol that incorporates the use of such an axial-patterned flap, representing 76% of all the cases of grade IV thumb operated during the same period. All the patients were retrospectively evaluated by a single investigator, whom was not involved in the surgery. Mean age at surgery was 3.34 years. The ulnar duplicate was preserved in all cases, the flap being raised from the resected radial duplicate. Associated steps included a proximal phalanx osteotomy and reinsertion of the collateral MCP ligament and thenar muscles. The flap was raised with an ‘en bloc’ dissection of the neurovascular pedicle. The length of the flap was planned to allow the tip of the flap to reach the midline of the pulp of the ulnar duplicate. Evaluation of the morphology of the reconstructed thumb included clinical measurement of the circumference, compared to the healthy opposite thumb. These data were correlated to measurements made on X-rays, including comparison of the width of the bony structures and of the thickness of the soft tissues.

Results: All flaps fully survived, confirming the existence of an axial pedicle. X-ray evaluation confirmed that the bony structures of the reconstructed thumb were thinner than those of the opposite thumb, whereas the soft tissues were thicker. The resulting thumb had acceptable contour and volume.

Conclusion: Extra padding offered by this axial patterned flap, raised on the ulnar duplicate, allows to mimic the size and shape of the opposite thumb in Grade IV duplication.

**A-0784 Does partial or complete wrist fusion change the load distribution of the hand during gripping?**

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Introduction: How does wrist fusion change muscle load distribution during gripping? Many studies attested to reduced grip force after partial or complete wrist fusion. The loss of carpal height and a suboptimal wrist position might be the most important reasons for limited flexor muscle force. Measuring cylinder grip forces is proven to represent better all muscle efforts during gripping than the Jamar dynamometer. Using electronic pressure sensor mats, additionally load distribution of all areas with contact to the cylinder can be assessed. The aim of this study was to analyse the influence of wrist fusion on the total grip force and the load distribution of the hand. Furthermore, this study investigated if there was a difference between partial and complete wrist fusion. We followed 12 patient after complete wrist arthrodesis (CWA) and 12 patients after partial wrist fusion (midcarpal arthrodesis, MCA) for 64 months post-operatively (range, 19 - 100 months). In both groups, 10/12 patients had the dominant hand fused. Radiographs confirmed that wrist fusion healed and ruled out further pathologies. Total grip force, as well as load distribution of seven areas of the hand (thumb, four fingers, thenar, hypothenar) were assessed using the manugraphy system. For this,
three cylinders with a 100 mm, 150 mm and 200 mm circumference, wrapped with pressure sensor mats (spatial resolution of two sensors per cm²), were used. Results after the wrist fusion were compared to the uninjured opposite hand, using the Wilcoxon-test. Complete and partial wrist fusion were compared to each other, using the Mann-Whitney-test. For the 100 mm and 150 mm cylinder, the uninjured hand showed a significantly higher grip force than the injured hand, after both kinds of fusion. For the 200 mm cylinder, there was no difference between both hands after complete wrist fusion, but a significant difference after midcarpal fusion. For the affected hand, grip force was higher after partial wrist fusion than after complete wrist fusion, with 435 N versus 330 N for the 100 mm cylinder, 397 N versus 364 N for the 150 mm cylinder, and 354 N versus 317 N for the 200 mm cylinder. The force of the uninjured opposite hand was also higher in the MCF group, than in the TWF group (583/523 N, 531/480 N and 450/400 N). Those differences were without statistical significance. With regard to the load distribution of the hand, no difference between the healthy and the affected side was found, both for the MCF and CWF. Neither was there a difference between the two types of wrist fusions.

**Conclusion:** Midcarpal and complete wrist fusion result in reduced grip force, which was found to be slightly higher after midcarpal arthrodesis. Both procedures do not influence the load distribution of the hand during cylinder grip.

**A-0788 Is the UK ready for hand transplantation?**

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**Aim:** Is the UK ready for hand transplantation? With the advent of hand transplantation in the UK, what was once a lab-based theory is now a clinical reality. The aim of this paper is to examine attitudes towards hand transplantation in the general public, as well as tomorrow’s clinicians, medical students.

**Methods:** A survey regarding organ transplantation and hand transplantation was distributed through the University of Birmingham medical school in the UK and the general public, which identified their demographic data and opinion on solid organ transplantation. Respondents’ knowledge of hand transplantation, their perceptions of its benefits, the level of risk they would be willing to take (in life-years sacrificed) to have the operation, and indications for hand transplantation.

**Results:** A total of 200 medical students and 200 members of the public were interviewed. Among the general public, opinions were divided as follows: 63% in favour, 21% against and 17% undecided; whilst medical students were 80% in favour, 5% against and 15% undecided. In exchange for a hand transplant, 19% of medical students were willing to forgo 11 or more years of their life, compared to only 3% of the general public.

**Conclusion:** This survey suggests that there is support for hand transplantation, both among the general public and medical students; however, knowledge on the subject is limited and this is a barrier to potential donation, if hand transplantation becomes a clinical reality, rather than an experimental exercise.

**A-0794 Ulnar nerve transposition: should local anesthesia be preferred to general anesthesia?**

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**Introduction:** Surgical management of ulnar nerve compression at the elbow traditionally requires regional or general anesthesia. In the past few years, there has been a trend toward performing hand surgical procedures under local anesthesia. We wished to assess the feasibility of performing ulnar nerve decompression and transposition at the elbow under local anesthesia.

**Methods:** This retrospective study examined the charts of 50 consecutive patients having undergone ulnar nerve entrapment surgery in our clinic by a single senior surgeon. The diagnosis was made on clinical examination findings and electroneuromyography. Surgery was performed either under general or local anesthesia. The latter required 15 ml of 2% lidocaine with epinephrine 20µg/ml, and 1ml of 8.4% sodium bicarbonate. At the end of the procedure, 3 ml of 0.25% bupivacain were injected at the surgical site. No tourniquet was used with the local anesthesia. The decompression was performed through a longitudinal incision and nerve stability was assessed by flexing the elbow. If subluxation was present, the nerve was transposed anteriorly in a subcutaneous plane. Patients were classified into four groups: general anesthesia and simple decompression (GASD) or transposition (GAT), local anesthesia and simple decompression (LASD) or transposition (LAT). Patients were asked to estimate pain on post-operative days 1 and 7, on a visual analogue scale.
A-0796 Percutaneous treatment of carpal tunnel syndrome using ultrasound guidance: results of a pilot study outside the operating room

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Purpose: To study the feasibility of percutaneous treatment of carpal tunnel syndrome (CTS) using ultrasound guidance in the interventional radiology room.

Method: This study included 39 patients whom had a CTS confirmed by EMG, with failure of medical treatment. Patients were recruited through orthopedic surgery and rheumatology consultations. Then the surgery was performed in the interventional radiology room under local anesthesia. The surgical incision was located into the fold of flexion of the wrist. The follow-up was 90 days.

Results: We included 39 patients whom had a CTS confirmed by EMG, with failure of medical treatment of carpal tunnel syndrome (CTS) using ultrasound, performed outside the operating room under local anesthesia. The surgical incision was located into the fold of flexion of the wrist. The follow-up was 90 days.

Discussion: Our results indicate that local anesthesia not only presents comparable results to general anesthesia in terms of resolution of pre-operative symptoms and post-operative complications, but is associated with superior pain control in the first week after surgery, especially when nerve transposition was performed.

A-0803 Long head of biceps (LHB) tenodesis during arthroscopic rotator cuff tear repair: we need 2 simple technical options

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There is evidence to support LHB tenotomy during arthroscopic treatment of most cuff tears. There is still debate between tenotomy and tenotomy-tenodesis (biomechanically more sound). We hypothesized that one arthroscopic technique cannot face all situations, because LHB may not always be amenable to arthroscopic tenodesis (inflammatory/frayed within the groove). During our last 59 arthroscopic procedures performed for cuff tears, depending on the status of LHB as arthroscopically examined in the groove, we (1 surgeon) used two LHB tenodesis techniques as options (39 were all arthroscopic, 20 were mini-open axillary). After tenotomy, the LHB was found in the sub-deltoid space at the level of the bicipital groove, in its relaxed position. It was examined and tested by traction through the antero-superior portal. Option 1: If traction revealed that LHB was not weakened, one
anchor was placed within the middle one-half of the groove; the sutures were driven around the tendon at its maximally-relaxed tension and tied while viewing from a postero-lateral portal. The remaining cranial LHB was removed. No LHB extraction through the skin was necessary. Option 2: If traction revealed an inflammatory or frayed LHB, a mini-invasive sub-pectoral tenodesis was done at the end of the procedure. A 3 cm long, totally hidden axillary incision was enough to find the LHB directly by palpation under the pectoralis major insertion and retrieve it. A fixation of LHB in the relaxed position was done with one anchor. At a minimum of 1 year follow-up, no complications nor residual pain specifically related to LHB tenodesis were observed, whether Option 1 or 2 was chosen. Not all LHB should sustain all-arthroscopic tenodesis during arthroscopic rotator cuff repair, because they may display significant fraying into the groove. These two simple/quick options help the surgeon to optimise time-management/efficiency of LHB tenodesis during arthroscopic treatment of cuff tears.

**A-0804 Perilunate injuries, non-dislocated**

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**Purpose:** To review a series of equivalents of perilunate dislocations and fracture-dislocations (PLDs-PLFDs) where there was no dislocation of the capitae from the lunate on the initial radiographs. To propose to include these injuries as a PLIND Group of perilunate injuries in a modified perilunate injuries classification.

**Methods:** A review of possible PLIND injuries was done in a single centre wrist surgery unit over a 5-year period. All cases presenting at the acute stage with displaced fractures of the scaphoid, lunate, triquetrum or capitae, along with perilunate gaps but no true dislocation of the capitae from the lunate in the sagittal or coronal planes, were analysed.

**Results:** We identified 11 patients with PLIND injuries within a 5-year period. Three cases with clinical and radiological follow-up are presented.

**Discussion:** Equivalents of PLDs-PLFDs presenting without dislocation of the capitae from the lunate do exist. There is currently no specific denomination for these injuries, which may be overlooked despite their severity. Indeed, they may need complex osseous and ligamentous injuries management. Including them into an existing perilunate injuries classification highlights their recognition and allows for a better understanding and treatment of both acute and chronic non-dislocated perilunate injuries.

**A-0809 The ECU test to diagnose radial tunnel syndrome**

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**Background:** Radial tunnel syndrome (RTS) is frequently found in conjunction with, or misdiagnosed as, lateral epicondylitis. Since nerve conduction studies in the instance of radial nerve entrapment in the proximal forearm are generally inconclusive, and even considered unreliable, we propose a clinical test to aid diagnosis. In RTS, the radial nerve is entrapped under the superficial edge of the supinator, in the arcade of Frohse. Since the radial nerve branch to the extensor carpi ulnaris (ECU) is found in the most radial and narrow space under the arcade, patients with RTS will have a weakness of ECU, as found when manually testing the strength in the ECU.

**Methods:** With the patient seated, shoulder at 90° elevation and extended elbow, the patient ulnarily deviates the wrist. The examiner places one hand over the radial aspect of the distal radius, the other on the ulnar side of the hand and then asks the patient to resist as the examiner radially deviates the wrist. The strength is compared to the contralateral side. If the ECU is weak, the diagnosis of RTS is further verified using the scratch-collapse test according to McKinnon, and pain upon compression over the arcade of Frohse.

**Results:** Between 2008-2013, 74 patients (27 women and 47 men; mean age 45, range 23–56 y) had been diagnosed using the ECU-test and surgically released using a dorsal approach: 64% were manual workers, and the dominant hand was affected in 75% of the cases. We followed 45 patients retrospectively, using the Ritts score, and of these, 88% reported good results at the 6-month follow-up. We followed 29 patients prospectively using the quick- and work-DASH. The average pre-operative quick-/work-DASH scores were 40.6 and 48.9, respectively. At the 6-month follow-up, the DASH scores were significantly (p < 0.00001) reduced, to 13.9 and 10.7, respectively. The average subjective satisfaction with surgical outcome was 85%.

**Conclusion:** The ECU-test is an easy and reliable clinical test to diagnose RTS. We propose that all patients with suspected lateral epicondylitis be examined using the ECU-test, as RTS is an entity commonly found in patients with proximal forearm and lateral elbow pain.
A-0812 Treatment of delayed unions and non-union of scaphoid

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Despite a great amount of diverse methods of operational treatment of delayed unions and non-union of the scaphoid, positive outcomes according to the data in the literature make up 65 - 80%. We have the experience of treatment of 477 patients with delayed unions and non-union of the scaphoid. Among them, 149 (31.2%) patients displayed non-union, and 328 (68.8%) patients had delayed unions of the scaphoid. The majority of the patients (75.2%) were admitted for treatment 1 year or more after the injury. Before applying to the clinic, 211 (44.2%) of patients did not receive any treatment, 193 (40.5%) patients received conservative treatment, and 73 patients (15.3%), different kinds of osteosynthesis of the scaphoid. It was found that the main reason for the delayed unions and non-union of the scaphoid were mistakes made in diagnostics (42.7%). The mistakes made in the treatment of fractures of the scaphoid were visualised in 33.9% of patients. Late application of patients for treatment was registered in 44.2% of cases. Union and non-union of the scaphoid were treated by external fixation, with the application of a device created in our clinic. The device was applied onto the Kirschner wires put through both bones of the lower third of the forearm and the base of II-V ossa metacarpalia. In the cases of delayed unions, the distraction made 1 mm per day (0.5 x 2 times per day). After achieving the necessary level of distraction, the period of fixation in the device started for 4 - 6 weeks. After that, the external device was removed and a plaster splint was applied for 4 weeks. In cases of non-union of the scaphoid, the distraction was carried out with 1 mm per day [0.3 x 3 times]. After that, the time of fixation in the device continued for 6 - 8 weeks. After that, the external device was removed and a plaster splint was applied for 4 - 6 weeks. Long-term results were investigated in 438 (91.8%) cases, within the period from 1 - 18 years. The union was achieved in 404 patients (92.2%). Poor results were discovered in 34 (7.8%) cases and were caused by a repeated injury of the wrist, early mobility of the injured joint, an insufficient level of distraction, insufficient period of fixation in the device and immobilisation in the plaster, long-term periods from the time of the injury to the beginning of treatment and non-fulfillment of medical recommendations.

A-0813 Distraction technique for treatment of injuries and diseases of carpal bones

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We have the experience of treatment of more than 1000 patients with injuries and diseases of carpal bones using the distraction technique. Based on our considerable clinical trials, we proved the advisability and practical possibility of the distraction method application for treatment: luxations and fractures-luxations of carpal bones; delayed unions and non-union of the scaphoid bone; distal radial fractures; aseptic necrosis of carpal bones (Preiser’s disease; Kienbock’s disease; deforming arthrosis wrist joints). In delayed cases of dislocations and fracture-dislocations of carpal bones, open single-step reduction leads to a poor result. Therefore, it is an expedient action when 2-step treatment is used. We performed preliminary distraction of radiocarpal articulation using a device at the first stage of the distraction method. The device was applied onto the Kirschner wires put through both bones of the lower third of the forearm and the base of II-V ossa metacarpalia. The distraction was 2 - 3 mm per day. After 2 - 4 weeks, the second stage was performed: the operation – an open elimination of the luxation, reposition of carpal fractures and osteosynthesis with K-wires. The distraction technique was performed for treatment of non-unions and pseudoarthrosis of the scaphoid bone. We varied distraction speed and time of fixation, depending on X-ray signs of injury. During the process of treatment for the purpose of definition, the dinamics of the scaphoid bone union were carried out by X-ray study of radiocarpal articulation in three projections. When signs of union appeared, we removed the device and put a plaster slab. In cases of aseptic necrosis of carpal bones (Preiser’s disease, Kienbock’s disease), a deforming arthrosis wrist joints distraction technique was performed in slow mode, which allowed for decreasing or eliminating the pain syndrome, preventing further carpal deformations and reaching the union of lunate bone fragments as a result of pathologic fracture. In no cases did we fulfill an operation of arthrodesis of carpal bones. Analysing of the long-term results of our treatment showed that good results were received by more than 90% of patients. This indicates a high efficacy of the distraction technique application in cases of injuries and diseases of carpal bones.
A-0814 The use of a resurfacing capitate pyrocarbon implant in chronic wrist disorders
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Proximal row carpectomy (PRC) is a widely accepted treatment for degenerative diseases of the wrist such as scaphoid non-union advanced collapse (SNAC), scapholunate advanced collapse (SLAC), scaphoid chondrocalcinosis advanced collapse (SCAC), and the advanced stages of Kienböck’s disease; however, when arthritis affects the head of the capitate, PCR is contraindicated. In these situations, partial or total wrist fusions are preferred. The replacement of the head of the capitate with the RCPI pyrocarbon resurfacing prosthesis, combined with PRC, may present a treatment option for degenerative wrist diseases when the articular surfaces of capitate and radius are damaged, while preserving wrist motion. The purpose of this article is to describe the surgical technique and to report the authors’ experience in the use of RCPI with PRC, and to discuss the results in comparison with other surgical procedures, such as partial arthrodesis, total arthrodesis and total wrist prosthesis. From March 2004 to November 2011, we treated 41 patients with wrist arthritis who also had involved the head of capitate, by proximal row carpectomy, radial styloectomy and replacement of the head of the capitate with the RCPI implant. Six patients were lost to follow-up. Of the remaining 35 patients, 18 were affected by SNAC, 11 were affected by SLAC, two were affected by SCAC, and four patients were affected by Kienböck’s disease. The mean age of the patients at the time of the intervention was 54 years of age. Patient assessments were performed using active and passive range of motion (ROM), Jamar grip strength test, and the Disabilities of the Arm, Shoulder and Hand (DASH) score and visual analogue scale. Radiographs were taken at 40 days, 3 months, 6 months and at the end of the first year, to check for implant stability, implant failure, subchondral osteolysis and implant sinking. The median follow-up period was 34 months. The mean pre-operative values of wrist flexion, extension, radial deviation and ulnar deviation, grip strength, VAS and DASH scores were 25°, 25°, 4.7°, 12°, 10.1 N, 8.4 and 56.9, respectively. The mean pre-operative values of the same variables were 33°, 34°, 5.3°, 19°, 16.5 N, 1.4 and 11.4, respectively. The increases in the mean values of wrist flexion, extension, ulnar deviation, grip strength and the decreases in the mean values of VAS and DASH scores were found to be statistically significant. Thirty-two patients were satisfied with the intervention. The radiological controls demonstrated that the implant was found to be well-situated on the lunate fossa of the radius in 22 patients. In 13 patients, a slight medial translation of the implant was observed. In one patient, mild sinking of the implant into the capitate was observed at the 1-year follow-up control. In conclusion, we believe that, in advanced wrist degeneration, PRC and prosthetic replacement is a relatively safer procedure and offers pain relief, while preserving wrist mobility and improvement of grip strength.

A-0819 Joint reconstruction with free vascularized osteochondral transplantation in the upper extremity
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The purpose of this study is to introduce a reconstructive method in major joint defect of the upper extremity, with free vascularised bone and joint transplantation. We underwent 16 cases of joint reconstruction with free vascularised fibular head or metatarsal joints. Affected joints were: twelve wrists, three shoulders and one elbow joint. Average age of the patient was 12.3 years (range, 3 - 34). Average follow-up period was 6.3 years (range, 1 - 16 years). The etiologies of the joint defect were: 7 traumatic, 3 infection sequel, 3 congenital and 3 tumorous conditions. Donor bone and cartilage of this transplantation surgery were 15 fibular heads with the metaphysis and one case of double metatarsal joints transplanted to the elbow joint. We evaluated the joint conditions and fate of the transplanted osteochondral parts during the follow-up period, with serial radiographic study and functional evaluation of the joints. The transplanted bony portion united to the recipient’s bone within 5 months, in all cases (average 4.8 months, range 3.2 - 8.3 months). The articular cartilage of the donor bone survived, with expectable outcome in 13 cases, maintained continuous growth potential was observed in child patients, in both volume and length of the bone and cartilage. Adoptive changes of the transplanted osteochondral parts were observed in 13 cases. In the case of elbow reconstruction with double metatarsal joints, transplantation had persistent lateral instability and weakness of joint power was revealed. In conclusion, free vascularised osteochondral transplantation to the defective joint portion in major joints in the upper extremity can be utilised as one of the most challenging methods...
in profound joint lesions that have no effective solutions with conventional modalities. The proximal osteochondral part of the fibula can serve as a very effective donor in this procedure.

A-0822 Pronator quadratus muscle pedicled bone graft in Kienböck’s disease

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Purpose: Treatments of Kienböck’s disease range from conservative measures to various surgical procedures, according to the progression of diseases. In this report, the author reviewed and analysed the patients treated with pronator quadratus muscle pedicled (PQMP) bone graft for Kienböck’s disease, and reported the results of this procedure.

Materials and methods: 12 cases were treated with PQMP bone graft. The mean follow up period were 4 (range, 1.2 - 11.3) years. Of the 12 patients, 9 were men and 3 women, with a mean age of 39.5 (19 - 55) years. Two patients had history of trauma, and nine involvements occurred in the dominant hand. The author assessed subjective pain, radiographic findings such as Lichtman’s stage and the carpal height ratio on the pre-operative, post-operative, and last follow up, and analysed the range of motion (ROM) of the wrist, grip and pinch power, as measured by Jamar Dynamometer, compared to the opposite side. In the pre-operative radiologic stages by Lichtman, five patients had Stage II and seven patients had Stage IIIA. Average carpal height ratio was 0.53 (range, 0.51 - 0.55) pre-operatively.

Results: All patients had painless wrist and expressed satisfaction with the outcome of this procedure. All patients returned to their original jobs or avocations; 10/12 patients used their wrists without difficulty. The remaining two patients had a difficulty in daily work, but not in the activities of daily living. At the last follow up, the radiologic stages were as follows: Stage II, 4 cases; Stage IIIA, 7 cases; Stage IIIB, 1 case. In the radiologic stages, two cases were deteriorated at last follow up. The mean carpal height ratio was 0.53 pre-operatively and 0.52 (range, 0.45 - 0.55) post-operatively. The average range of wrist motion, compared with that before operation, increased slightly in all planes. The average palmar flexion was 52°, an average increase of 9° compared with the average pre-operative palmar flexion; average dorsiflexion, 51°, an average increase of 8°; average ulnar deviation, 31°, an average increase of 9°; and radial deviation, 15°, an average increase of 4°. The average grip and pinch strength on the affected side were 79% and 85% of that on the opposite side, an average improvement of 32% and 33%.

Conclusions: PQMP bone graft is an effective treatment for Kienböck’s disease with Stage II or IIIA in wrists, because pain relief, preserving ROM of the wrist with a short period of immobilisation, and preventing the progression of this disease can be expected.

A-0824 Sonographically-assisted percutaneous release of the transverse carpal ligament: a new surgical technique for treating carpal tunnel syndrome

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We propose a new percutaneous release technique for carpal tunnel syndrome (CTS), under the guidance of ultrasonographical monitoring. This technique provides direct visualisation of the target structures, guides the division of the transverse carpal ligament by a simple hook knife, and avoids the risks of incomplete release and injury to adjacent neurovascular structures. The transverse and longitudinal ‘safe zone’ localisation, estimated size, and extent of the transverse carpal ligament were determined using a cadaver study. We will describe this new operative technique, performed under local anesthesia without tourniquet and the clinical outcome. First, we will report on our first prospective clinical study of 91 consecutive cases of carpal tunnel release, treated with this technique after 22.5 months. The sensory disturbances disappeared in 76.8%, 93.4%, 100%, and 100% of the patients in post-operative week 1 and month 2, 6, and 12; and 24.2% experienced moderate pain within 1 week, 6.6% within 2 months, and 1.1% within 12 months after the operation. Second, the author’s experience with a total of 4841 procedures in 3247 patients performed during a 9-year period will be presented. Follow-up evaluation was performed in 4794 (99.0%) hands or 3205 (98.7%) patients. A total of 92 hands (1.9%) were considered to have unsatisfactory results, including 42 hands of patients who complained of moderate wrist pain that persisted over 6 months and 50 hands of patients who complained of persistent/recurrent numbness. There were no permanent nerve injuries. Ultrasonographical guidance can be used to avoid injury to neurovascular structures and release the carpal tunnel effectively, in the management of CTS, with meticulous surgical technique. In summary, this technique might be a useful...
alternative to open carpal tunnel release or endoscopic carpal tunnel release, because of its simplicity, effectiveness and lower cost.

A-0825 The comparison of ultrasonographical changes of carpal tunnel syndrome in very elderly patients and the outcome after a new sonographically-assisted percutaneous release (SAPR): a prospective study with matched controls

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There is no study investigating the ultrasonographical changes in elderly patients with carpal tunnel syndrome (CTS) and also no agreement about the outcomes of the surgical release of these elderly patients. The study aimed to investigate the influence of age on the disease progression and ultrasonographical changes and to evaluate the outcomes of a newly-developed sonographically-assisted percutaneous release (SAPR) for CTS. We evaluated a prospective, consecutive series of 50 hands of 40 very elderly patients (mean age, 83.0 ± 2.30 years; range, 80 - 88) with CTS, and compared them with 50 gender-matched patients (mean age, 54.0 ± 0.80 years; range, 53 - 55) having idiopathic CTS. The ultrasonographical changes were evaluated before operation, and the outcomes after the SAPR were assessed with the functional severity score (FSS), symptom severity score (SSS) and the grip force. The pre-operative evaluations, Phalen test and Tinel test showed no significant difference, but muscle dystrophy was more severe in the very elderly group (P = 0.002). The ultrasonographic diagnosis, cross-section area (CSA) in the inlet, mid, and outlet area were significantly narrower in the very elderly group (P = 0.009, 0.020 and 0.029). The pre-operative FSS and SSS were both significantly more severe in the very elderly group (P = 0.00 for both) than the control group. The majority of the patient’s symptoms improved following SAPR in both groups: the very elderly group also showed significant improvement in FSS and SSS for at least the 12-month follow-up. The grip force dropped after the surgery, but recovered to pre-operative grip force in 3 months, and kept improving after the 12-month follow up. Our study suggested very elderly patients with CTS have similar beneficial outcomes after this sonographically-assisted percutaneous carpal tunnel release as the common idiopathic CTS patients. This technique was performed under local infiltration anesthesia, without tourniquet, within 5 minutes, and required no need for wound care, removal of stitches, or any physical therapy. We therefore believe this technique is an effective, safe and minimally invasive procedure suitable for all age groups with idiopathic CTS, even for the very elderly population.

A-0828 A prospective study of clinical diagnostic triad and wide-awake surgical treatment of proximal median nerve entrapment at the elbow

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Background: Proximal median nerve entrapment (PMNE) or pronator syndrome at the elbow has traditionally been considered an elusive and rare diagnosis, as it is seldom detectable using electrophysiological techniques. We propose the use of a clinical triad to safely diagnose these patients. The clinical triad consists of:

1. Manual muscle testing of the flexor carpi radialis (FCR), flexor pollicis longus (FPL) and flexor digitorum profundus II (FDP II);
2. Scratch-collapse test at the level of the lacertus fibrosus;
3. Pain upon compression over the median nerve at the level of the lacertus fibrosus.

Patients/methods: During 2011 - 2013, we diagnosed 156 patients with PMNE using the clinical triad, and then released using a wide-awake, minimally-invasive surgical treatment with lidocaine-epinephrine anesthesia and no tourniquet. Of these 156 patients, 119 filled out pre-operative quick-/work-DASH questionnaires. Then 70 patients (59%) completed the 6-month follow-up questionnaires (42 women/28 men; mean age 50.3 and range, 24 – 72 years). There was a slight predominance of office-workers (59%) and the dominant hand was treated in 58% of cases. All patients had gone through a conservative treatment regime with a local cortisone injection and nerve gliding exercises for 4 weeks, before the decision was made to proceed to surgical treatment.

Results: The average pre-operative quick-DASH was 37.4 and the work-DASH was 40.8. At the 6-month follow-up, the average post-operative quick-/work-DASH was 13.3 and 10.4, respectively, which is a
patients were fixated with semitubular plates and ate with Kirschner wires (11/36), and the bones of 25–7 y). In our study, the bones of 11 patients were fixated, in order to overcome the supination deformity. The proximal and distal fragments of the bone are suspended by a GoreTex ligament and five failed supination contractures caused by obstetric brachial plexus paralysis: our experiences with the pronation rotation osteotomies

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The supination contracture is one of the most challenging conditions in the management of the patients with obstetric brachial plexus paralysis. In the literature, various techniques are described, such as tendon transfers, interosseous membrane releases and radius rotation osteotomies, in order to overcome this problem. In the conventional technique of radius rotation osteotomy, the distal part of the radius is osteotomised distal to the insertion area of the pronator teres tendon, and the distal radius fragment is pronated, in order to overcome the supination deformity. The proximal and distal fragments of the bone are united either by appropriate Kirschner wires or by semitubular fixation plates; however, there are several complications of these procedures such as fractures, mal-union, non-union, osteomyelitis, and the lack of achieving adequate post-operative pronation degrees. In this study, we evaluated 36 patients with supination contractures caused by obstetric brachial plexus paralysis, between November 2003 and December 2013, in the Istanbul University Department of Plastic Reconstructive and Aesthetic Surgery, by the same operative team. The mean age of the patients was 9.2 years (range, 2 – 28 y). The mean follow-up period of the patients was 4 years (range, 1 – 7 y). In our study, the bones of 11 patients were fixated with Kirschner wires (11/36), and the bones of 25 patients were fixated with semitubular plates and screws (25/36). We rotated and fixated the radius between 30 and 90° intraoperatively. We performed tendon transfers in 19 patients for the restoration of shoulder, and thumb abduction and wrist extension simultaneously with the pronation osteotomy (19/36). The pre-operative and post-operative active and passive pronation degrees and supination degrees of the patients were recorded, and they were compared with each other. The mean pre-operative active pronation of the patients was -35.9° (range, - 90° - 75°), and the passive one was 47.7° (range, - 50° - 90°). The mean post-operative active pronation of the patients was -7° (range, - 90° - 70°), and the passive one was 70° (range, 25° - 90°). The mean pre-operative active supination of the patients was 55.3° (range, - 75° - 90°), and the passive one was 76° (range, 40° - 90°). The mean post-operative active supination of the patients was 40° (range, - 35° - 70°), and the passive one was 37° (range, - 100° - 90°). In the aspects of complications, one patient was diagnosed with mal-union of radius at the post-operative year 2 (1/36). On the other hand, inadequate post-operative pronation degrees were achieved in three of the patients (3/36). As is seen, all of the parameters decreased after the operation, and both the patients’ and family satisfaction increased after the appropriate intervention. In conclusion, we believe that the radius rotation osteotomy is an ideal method for patients with severe supination contractures of obstetric brachial plexus paralysis.

A-0830 Prospective study of revision of failed trapeziectomy with pyrocarbon implant: more than 4-year follow up on 13 cases

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Introduction: Revisions of failed trapeziectomy for rhizarthrosis are seldomly reported and poorly detailed in the medical literature. The aim of this study was to evaluate results with > 4 years [range, from 5 months to 93 months] follow-up, after a revision of a failed trapeziectomy using pyrocarbon implants.

Materials and procedure: We operated on 12 patients with an average age of 66 [range, 55 – 77 years old] after a failed trapeziectomy for rhizarthrosis, one of them being bilateral. Revisions concerned eight simple failed trapeziectomy linked to a stabilization-suspension by a GoreTex ligament and five failed trapeziectomy with interposition of a silicon implant.
The average wait between the trapezeictomy and the revision surgery was 9 years (between 1 and 23 years). The cause of these failures were nagging residual pains with a shortening of the thumb column in three cases, an impingement with scaphotrapezial arthritis in five cases and a worn out silicon implant in five cases. The surgery was an interposition of a free implant made of PI2® [Tornier] pyrocarbon in nine cases and of a resurfacing implant made of PYROCARDAN® [Tornier] pyrocarbon in four cases.

**Results:** Every patient’s mobility and strength improved [from 2.4 kg to 4.3 kg on the pinch]. A revision surgery was needed for an ablation of the implant, because of some unexplained nagging residual pain which did not get any better after the ablation of the implant. Patients resumed their professional and personal activities < 3 months after surgery. As for functional scores, the average Quick-DASH and PRWE, respectively, went from 77 and 71 to 20 and 28, post-surgery. We found that 91% of patients were very satisfied with the revision procedure. Radiographically, implants were all in place. No secondary lesion was found, neither on the bone nor on any neighboring soft tissues.

**Conclusions:** Treatment of trapezeictomy failures using a pyrocarbon implant is a new solution for these difficult therapeutical problems. These interposition implants make it possible to treat either painful impingement caused by the inevitable shortening of the first metacarpal following a trapezeictomy, a secondary decompen sation of a scaphotrapezial arthritis following a trapezeictomy, or an intolerance caused by the wearing out of a silicon implant. The clinical and radiological tolerance of these implants seems to have been demonstrated in the short run, in this type of indication. This solution brings the patient some functional improvement and is therefore an interesting therapeutical perspective.

**A-0837 Distal radius and distal metaphyseal ulna fracture in patients older than 65 years old: comparative study between internal fixation of the ulna and Darrach’s procedure**

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**Introduction:** Acute management of fractures involving the distal head and neck of the ulna associated with unstable fractures of the distal radius in patients older than 65 years old remains difficult and controversial. Internal fixation of a fracture of the distal ulnar head or neck can be challenging, and limited data is published regarding the management of these lesions. The present study was performed in order to test the hypothesis that open reduction and internal fixation of the distal ulna in patients older than 65 years with distal radius and ulna fractures is associated with a higher rate of complication than resection of the distal ulna.

**Methods:** Twenty-one consecutive patients with distal radius and ulna fractures that were treated with either ORIF of the distal ulna or distal ulna resection, and volar locking plating of the distal radius, were included in this study. Ten cases had ORIF of the distal ulna (Group 1) and eleven had distal ulna resection (Group 2). All patients were women. There were no differences between groups, according to follow-up (Group 1, 24 months versus Group 2, 19 months), dominant side injured (Group 1, 60% versus Group 2, 54%), rate of open fractures (Group 1, 40% versus Group 2, 45%), and days between fracture and surgery (Group 1, 6 days versus Group 2, 7 days). At an average follow-up of 21 months, patients were retrospectively assessed for range of motion (ROM), grip strength, pain and radiographic appearance. The functional outcome was evaluated by the DASH questionnaire. Fisher’s exact test was used to compare the rate of complications; and Wilcoxon signed-rank test to compare pain, motion, grip strength, and the DASH questionnaire outcomes between groups. The level of significance was set at p < 0.05.

**Results:** All distal radius fractures healed radiologically. Patients with ORIF of the distal ulna and those with distal ulna resection did not differ significantly with respect to motion, except for supination [Flexo-extension: Group 1, 116° vs Group 2, 116°] (Pronation: Group 1, 76° vs Group 2, 83°) (Supination: Group 1, 80° vs Group 2, 86°), pain (VAS: Group 1: 0.2 vs Group 2: 1.3), grip strength (Group 1: 14 vs Group 2: 16) or DASH score (Group 1: 9 vs Group 2: 25). However, there was a significant difference in the number of complications (Group 1: 6 vs Group 2: 1 [p = 0.02]). Patients in the ORIF group suffered tendon irritation, non-union of the ulna, low ulnar palsy, hardware loosening, superficial infection and complex regional pain syndrome. The patient who had a complication in the Darrach group suffered a loss of reduction of the distal radius.

**Discussion:** Our study shows that, in women older than 65 years old with fracture of the distal radius and distal ulna, there is a higher rate of complication if ORIF of the distal ulna is performed. Since there is no difference in objective and subjective results, patients should be aware of this possibility, in case of ORIF of the distal ulna.
A-0840 Anodisation of titanium does not prevent and in fact may promote adhesion of tendons to the implants: an experimental study

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Background: Open reduction and internal fixation with titanium-based implants is being increasingly used for the treatment of unstable fractures of the upper extremity, particularly hand and wrist. Good mechanical strength, excellent corrosion resistance and bio-compatibility are favorable features of titanium implants; however, when these implants are in close proximity to tendons, adhesion formation, tenosynovitis, and tendon ruptures can occur, leading to unsatisfactory results. These adverse effects may be related to the surface physical and chemical characteristics of these implants that are currently being used. Typically, titanium implants are anodized by the manufacturers, in order to improve their function and aesthetics. It is the purpose of this work to study the interaction of tenocytes exposed to anodized versus non-anodized titanium surfaces.

Materials and methods: Circular titanium discs with 11mm diameter were custom manufactured for the purpose of this study (Medartis, Basel, Switzerland). The discs were made of grade 4 titanium. The surface treatment consisted of mass finishing (6 discs) and mass finish followed by blue anodization (6 discs). Both mass finish and anodization were done exactly similar to what is done for clinical implants. The implants were cleaned using Millipore water in an ultrasonicator and sterilized by autoclaving to 126° for 27 minutes. The surface topography was studied using scanning electron microscopy (SEM). They were laid in sterile 12 well culture plate and ovine tenocytes suspended in DMEM and 10% FBS were seeded on to the surface of the discs and incubated at 37°, in 5% CO₂ for 7 days. The cells were then lysed and mRNA extracted. Real time polymerase chain reaction (PCR) was carried out for the following genes in triplicates: alpha actinin1 and 4, collagen Type 1, talin, vinculin and zyxin.

Results: SEM showed that the surface of the mass finished titanium was uniform and flat, whereas the anodized surface was rougher and wavy. RT-PCR showed increased activity of all the genes tested from the cells that were exposed to anodized discs, compared to the non-anodized surfaces. The results will be discussed.

Discussion: The biological reactivity at the implant tissue interface is dependent upon the physico-chemical properties of the implant surface. Surface roughness, even at sub-micron levels, is known to promote cell adhesion. Anodization, by increasing the surface roughness, could increase the tissue reactivity and lead to tendon adhesions. Furthermore, titanium is known to attract cells. A coating that would increase the smoothness of the surface, as well as insulate the cell adhesion property of titanium such as a polymer coating, would be an ideal coating for titanium implants in the hand and wrist.

Conclusion: Anodization does not prevent and in fact enhances tendon adhesions to titanium implants, as evidenced by a rougher surface and increased activity of genes promoting adhesion of tenocytes. There is a need for developing surface treatments that prevent tendon adhesions in hand and wrist implants.

A-0845 How to screw and not get stuck: using self-tapping screws without pre-tapping predisposes to increased surface roughness of the screw tip

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Background: Self-tapping screws are being used increasingly in orthopaedic surgery. These screws are often made of titanium. Most of these screws have a cutting flute at the tip that cuts the threads as the screw is being inserted into the bone. This avoids an additional step of pre-tapping the screw hole and decreases the surgical time; however, we believe that in the process of cutting a thread, the tip of the screw gets scratched and the surface becomes rough. This may promote Osseo integration, as it is well known that surface roughness even at the sub-micron level facilitates Osseo integration. This might increase the difficulty in screw removal, should it become necessary.

Hypothesis: Self-tapping screws inserted without pre-tapping develop roughness at the tip (flute area) compared to self-tapping screws that are inserted after pre-tapping.

Materials and methods: Ten 3.5 mm self-tapping titanium screws 24 mm in length were purchased (Acumed, Hillsboro, USA). The screws were cleaned using Millipore water and ethyl alcohol, in a ultrasonicator, and autoclaved at 126° centigrade for 27 minutes. Sheep humerus from a freshly slaughtered sheep was obtained. The sheep was disease free when slaughtered. The bone was X-rayed to ensure that the cortical thickness was uniform in the regions where the screws were being placed. As recommended by the screw manufacturer, a 2.8 mm drill was used to create the screw hole. In case of 5 holes (selected randomly), a 3.5 mm tap was used and in...
the other 5 holes, no pre-tapping was done. The screws were inserted using the screw driver supplied by the manufacturer. The diameter of the humerus was 20 mm for all the locations drilled and 24 mm screws were used. The projecting 4 mm screw end, including the tip, was cut using a Harrington rod cutter and the screw tips were cleaned in an ultrasonicator with ethyl alcohol. Scanning electron microscopy (SEM) was carried out to examine the surface of the implants. The area of surface roughness was measured at a magnification of 100X, using Image J basics version 1.38 (National Institute of Health, Bethesda, MD, USA). Atomic force microscopy was used to measure the depths of the asperities created as a result of the screw insertion.

**Results:** The screws that were inserted without pre-tapping showed areas of roughness significantly more than the screws inserted after pre-tapping. The difference was statistically significant ($P > 0.05$) for the area, as well as the depth.

**Conclusion:** Using self-tapping screws without pre-tapping leads to an increased surface roughness. This may predispose to Osseo integration and make screw removal more difficult at a later time.

**A-0848 Treatment of hyperextension deformity of the thumb metacarpophalangeal joint**

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Thumb osteoarthritis treatment has been studied in many articles in the literature, with various therapeutic choices. The attitude of the different authors concerning the hyperextension of the metacarpophalangeal joint associated with thumb osteoarthritis does not seem consensual. With this study, we wanted to assess the effectiveness of our technique for correcting this distortion taking place during the treatment of thumb osteoarthritis. This study analyses the results of a prospective consecutive cohort of patients operated between 2008 and 2011 by a single surgeon: 32 patients, with a hyperextension over 40°, benefited of the treatment. This involved an anterior capsulodesis of the metacarpophalangeal joint and a tenodesis of the extensor pollicis brevis to the neck of the first metacarpal. All the patients were evaluated at a mean of 2.4 years (range, 11 months to 4.2 years) by an independent auditor. The assessment results included analysis of residual hyperextension or flexion induced, mobility and strength of the thumb, functional improvement as assessed by the Quick-DASH score, as well as the aesthetic aspect, evaluated by the patient. X-rays allowed both to control the treatment of the thumb osteoarthritis, which was for the majority of cases a trapzietectomy with interposition, and to control a direct evaluation of the metacarpophalangeal angle. The average residual hyperextension of the metacarpophalangeal joint was estimated at 3.52° for all patients. No post-operative flexion by overcorrection was found. Kapandji score assessing mobility of the thumb column was 9.08 and the Quick-DASH score stood at 16.89. The strength values in full grasp (19.6 KgF) and thumb index grasp (5.41 KgF) were improved by the treatment of thumb osteoarthritis. We found that 96% of patients were satisfied or very satisfied with the aesthetics aspect. This technique associated with treatment of thumb osteoarthritis allows for an efficient correction of the deformity, improving the function the thumb as well as its appearance. The results of this study seemed to confirm medium-term stability of this correction over time.

**A-0849 The arrangement of Sharpey’s fibers in the metacarpals and proximal phalanges is unique and helps explain the structural and functional uniqueness**

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**Background:** Periosteum of the phalanges and metacarpals is structurally and functionally different from periosteum elsewhere. It is possible to separate it from the underlying bone, even in adults, and indeed it is a described surgical technique to raise the periosteum off the bone when plating these bones, so that the periosteum could then be closed over the implant, thereby avoiding contact between the implant and the overlying tendon. Thereby, tendon-implant adhesions are minimised. Histologically, we reported earlier that the periosteum in metacarpals and phalanges shows the presence of elastin fibers which are not seen in other locations. It was the purpose of this study to further elucidate the ultrastructure of periosteum in hand bones and understand the structure-function relationship. Specifically, we wanted to study the arrangement of Sharpey’s fibers in these bones and compare them with their arrangement elsewhere. Sharpey’s fibers are predominantly composed of collagen Type 3 and play a role in anchoring the periosteum to the underlying bone.

**Materials and methods:** After obtaining ethical committee approval, fresh frozen segments 0.5 cm X 0.5 cm were cut from mid-diaphysis of 10 proximal phalanges and 10 metacarpals, as well as 10 segments from the mid-diaphyseal area of two humeri. The bone was prepared for specific collagen 3...
immunofluorescence stain, as previously described by Al-Qtaitat et al. We prepared 10 - 12 micron thick cryosections, using a heavy duty cryomicrotome. Sections were incubated in anti-collagen Type III primary antibody [mouse monoclonal; Bio Genex, UK]. The secondary antibody was FITC-conjugated anti-mouse IgG [Sigma, UK]. Stained sections were mounted in a water-based mounting medium. The sections were examined under a Nikon Eclipse E400 epifluorescence microscope (Nikon, Japan), using ultraviolet (UV) light and FV1000 Confocal Scanning Microscope (Olympus, USA). Positive regions were identified as apple green in colour. Three dimensional (3D) reconstructions of the architecture of Sharpey’s fibers were created, using the dedicated software.

Results: The arrangement of the Sharpey’s fibers was predominantly superficial and horizontal in the phalanges and metacarpals, compared with the samples from the humerus. A greater proportion of deep and trans-cortical fibers were seen in the humerus samples.

Conclusion: The arrangement of the Sharpey’s fibers is unique in proximal phalanges and metacarpals and helps explain the ease with which the periosteum can be separated from the underlying bone.

A-0851 Composite tendon-bone grafts enable stronger healing when compared to conventional pullout repairs in reconstruction of the tendon-bone insertion in rats

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Hypothesis: Flexor tendon injuries involving the tendon-bone insertion [TBI] are difficult to address. Standard techniques typically lead to diminished strength of the healed insertion site. We hypothesized that these injuries would benefit from being reconstructed with decellularized composite grafts. To test this hypothesis, decellularized composite grafts [TBI grafts] were compared to conventional pullout repairs in an in vivo animal model.

Methods: 48 Wistar composite TBI grafts (Achilles-calcaneus tendon insertion) were harvested. Grafts were physicochemically decellularized according to a previously-described protocol. TBI graft and pullout reconstructions of Achilles tendon detachment from the calcaneal insertion were compared using a pair matched design. The ultimate failure load [UFL], ultimate tensile stress [UTS] and stiffness [STF] were evaluated using a materials testing system at 2, 4, 8 and 12 weeks. Histological analysis of insertion morphology and cellular infiltration was evaluated after sacrifice. Statistical analysis of biomechanical data was performed using a paired Student’s t-test.

Results: There was a significant increase in UFL (35 ± 11 versus 24 ± 7 N, p = 0.03) and UTS (1.5 ± 0.3 versus 1.0 ± 0.4 N/mm², p = 0.03) of the TBI grafts, compared to pullout repairs at 2 weeks. These differences remained at 4 weeks; UFL [54 ± 17 versus 43 ± 19 N, p = 0.046], UTS [2.9 ± 1.0 versus 2.0 ± 0.7 N/mm², p = 0.03]. At 12 weeks, both TBI grafts and pullout repairs were as strong as native tissue UFL (75 ± 16 and 65 ± 19, p = 0.25, versus 76N native), although with a decreased relative strength, UTS (4 ± 1.6 and 2.8 ± 0.7, p = 0.04 versus10N/mm² native). At 12 weeks, both TBI grafts and pullout repairs had regained stiffness equal to native tissue (18.5 ± 5.1 and 16.6 ± 3.9, p = 0.38 versus 18N/mm native). Histology showed a more organized extracellular matrix in the TBI graft group at the early time points. Repopulation of the decellularized grafts increased over time. The insertion point was at 12 weeks richly populated with a morphology similar to that in the native tissue.

Summary points: Decellularized TBI grafts are stronger [UFL] compared to conventional pullout repairs at 2 and 4 weeks. Decellularized TBI grafts and pullout repairs are as strong and have equal stiffness as native tissue after 12 weeks. A more organized extracellular matrix and different collagen composition in the early time points may explain the differences in strength at early time points. In the future, tissue engineered TBI grafts may be used to repair complex tendon-bone insertion tears in the flexor tendon, as well as other tendon and ligament injuries in the hand. This project was funded by an ASSH/AFSH grant and a PSF grant.

A-0853 A prospective, synchronous, 3-region audit of distal inter-phalangeal joint arthrodesis in the UK

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Introduction: Arthrodesis of the distal interphalangeal joint is most commonly performed for painful osteoarthritis. There are several techniques: these most commonly employed are either a combination of Kirschner and dental wire, or a compression screw. There is no consensus on which is better. Complication
rates are reported to be as high as 10%, some patients need further surgery. A prospective, multi-centre audit could determine the relative success for this procedure and the most reliable technique.

**Methods:** An audit was carried out synchronously in three areas of the UK. Data was collected using a proforma at the time of surgery and at 12 weeks. Patient-related outcome measures were assessed using PEM and DASH questionnaires. Pain was assessed using a visual analogue scale. Data collected included the patient demographics, indications for surgery, operating time, cosmesis, angle of fusion, complications, additional procedures, angle of fusion and union.

**Results:** Thirty-nine patients participated: 69% female, the mean age was 58, and 45 joints were fused. The indication was osteoarthritis in 50%. The most commonly fused DIPJ was the index finger (44%), then the middle (27%), thumb (16%) and ring finger (13%). A general anaesthetic was used in 17 patients, regional in 11 patients and local in 10 patients. The mean duration was 38 minutes, with no difference for each procedure. The mean preoperative DASH score was 36, this reduced (p = 0.049) to 23 at 12 weeks after surgery [32/39 patients completed the 12-week questionnaires]. The mean pain score was 6.34, reducing (p = <0.0001) to 1.71. The cosmetic appearance was described as better in 46%. A combination of Kirschner wire and dental wire was used for 40% of fusions, a compression screw in 60%. There was a regional bias. A perceived worse cosmetic result was associated more commonly with the use of wires. Radiological union was achieved in 88% of fusions. Kirschner wire alone was associated with a higher likelihood of non-union. Additional procedures were required in 13% of cases, two patients had removal of screws, five had removal of wires.

**Conclusions:** DIPJ fusion effectively reduced pain and improved function. A compression screw did not prolong surgical time and was associated with a better-perceived cosmetic result, reliable union, and less need for further surgery.

**Objective:** Surgical stabilisation for hypalaxity of the carpometacarpal joint of the thumb was introduced by Eaton in 1987, using the flexor carpi radialis (FCR) tendon to reconstruct the beak ligament; however, little evidence is available on the outcome of this treatment for this patient group. In this study, we present the overall outcome of surgical stabilisation in 92 thumbs. Within this group, we compare a volar approach with a dorsal approach in a small pilot randomized controlled trial (RCT).

**Methods:** We treated 88 patients with chronic, non-degenerative hypalaxity of the thumb (92 thumbs) complaining of pain and impaired function due to pinch instability. Sixteen of these patients were randomly assigned to either a variation of the volar technique by Eaton, using the FCR to reconstruct the beak ligament [n = 8] or a dorsal technique, using the ECRL for stabilisation of the intermetacarpal ligament [n = 8]. From the remaining patients in the cohort of 92 thumbs, 37 thumbs were also treated with the volar FCR technique and 39 thumbs with a volar technique of reconstructing the beak ligament with the palmaris longus tendon. All patients received standard post-operative therapy. At baseline and at 3 and 12 months after surgery, we measured pain, strength and ADL function, using the Michigan Hand Questionnaire (MHQ) and the DASH. Generalized estimating equations statistics were used to compare repeated measurements over time in two groups.

**Results:** For the overall group of 92 thumbs, we found that stabilisation of the thumb significantly reduced the visual analogue score for pain (mean ± SD from 52 ± 3 to 27 ± 3, after 3 months, and 16 ± 6 after 1 year, p < 0.001) and improves function in MHQ (52 ± 2 to 71 ± 3 to 82 ± 5, p < 0.001) and after 1 year grip strength (21 ± 1 kg to 25 ± 2 kg, p < 0.014) and pinch strength (0.5 - 1.1 kg, p from 0.011 - 0.028). The pilot randomized trial comparing the volar to the dorsal technique showed a trend in favor of the volar approach, but no significance was reached; only pain had significantly worsened in the dorsal group after 3 months [30 ± 2 to 43 ± 8, compared with the volar group 59 ± 11 to 26 ± 6, p < 0.003]. After 1 year a better function [DASH] (35 ± 11 to 46 ± 8 in the dorsal approach, compared with 38 ± 6 to 24 ± 7 in the volar group, p < 0.124), a higher grip strength [17 ± 2 to 22 ± 3 kg compared with 18 ± 3 to 29 ± 2, p < 0.199] and a higher key pinch strength was seen in the volar group [4.6 ± 0.4 to 5.2 ± 0.6, compared with 4.0 ± 0.7 to 6.0 ± 0.4, p 0.084].

**Conclusion:** Surgical stabilisation of the thumb base is an effective method for patients suffering from thumb hyperlaxity and results in pain relief, improved strength and improved function. Although no significance was reached, a trend was found towards better
strength and function using the volar technique, compared to the dorsal approach.

A-0856 Lunate Pyrocarbon® implant arthroplasty: analysis of physical function and patient satisfaction

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Background: Kienbock’s disease is frequently discussed by different authors; however, the precise aetiology is still uncertain and the treatment remains controversial. Depending on the stage of lunatomalacia, various surgical treatments have been described. A relatively new treatment for a symptomatic patient with a Lichtman Stage IIIB or Stage IV is lunate implant arthroplasty, using a pyrocarbon prosthesis. A literature study could not identify any outcome studies regarding this implant, despite the implant being on the market since 2009. No outcome data have been published since the operative technique was first described in 2011. This study will document the first clinical outcomes.

Methods: Between 2010 and 2013, 16 patients with Kienbock’s disease Stage III were treated by lunate pyrocarbon implant arthroplasty, using a single tendon graft to stabilize the implant. Average age of patients was 38 years (range, 16 - 53). Eight male and eight female subjects were included. Pre-surgical and post-surgical assessment was performed, with a mean follow-up of 14 months (range, 3 - 34). Assessment included an interview, questionnaire (VAS-score and PRHWE-score), examination, X-ray and measurements (active range of wrist motion and grip strength).

Results: After surgery, the levels of pain and function were improved in the majority of patients, with a minimum follow-up of 1 year. Average VAS-score improved from 4.7 to 2.1, average PRHWE-score from 59 to 19. One patient had undergone a proximal row carpectomy 11 months after lunate implant arthroplasty, because of persistent pain, although no reasonable technical issue could be identified during X-ray or explantation. The average flexion-extension arc and wrist deviation arc were decreased, with a decline in flexion/extension of 16/12° and a decline in ulnar/radial deviation of 12/3°. Grip strength was not considerably changed after surgery, with improvement of average Jamar-score from 23 to 29. Most patients were very satisfied about the operation. Eight patients rated the procedure as ‘excellent’, one patient as ‘good’, three scored ‘moderate and three no responses. Two patients would not undergo the same procedure again, eight patients would undergo the same procedure and there were five no responses.

Conclusion: Lunate implant arthroplasty may be a solution in symptomatic patients with a Lichtman Stage IIIB or Stage IV. Our study suggests that a majority of patients benefit from this procedure; however, this study reports the first clinical outcomes of a small population, with a limited maximum follow-up period of 3 years. Future prospective studies with larger patient samples have to be awaited. A clear advantage of this technique is that no bridges are burnt by using this technique. The usual surgical plan for end-stage Kienbock’s disease is a salvage procedure such as PRC (Proximal Row Carpectomy). In case of failure of this particular implant, the same salvage options remain possible. This fact and these first outcomes warrant continuing the lunate implant arthroplasty procedure.

A-0860 An anatomical study of the neurovascular anatomy of the web spaces between the fingers

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Introduction: The web spaces of the hand can present a dissection challenge to the hand surgeon, e.g. in recurrent Dupuytren’s disease (DD). The neurovascular supply to the first web space is recognised to be variable, but the supply to the second, third and fourth web spaces is more consistent. Although the vascular anatomy of the palmar arches giving origin to the common digital arteries (CDAs) is well described in anatomy texts and the medical literature, there is little written about the anatomy of bifurcation of these arteries into the digital arteries. Similarly, the patterns of origin of the common digital nerves (CDNs) from the median and ulnar sensory divisions are well documented, but there is a paucity of commentary about their bifurcation into the digital nerves. Our study aims to address this deficit.

Materials and methods: Dissection was performed on 10 (five right, five left) fresh-frozen cadaveric hands. The flexor retinaculum and Guyon’s canal were incised, and dissection of the neurovascular structures was performed in a proximal to distal direction, under 3.0 loupe magnification. In the second, third and fourth web-spaces, the adventitial tissue was carefully removed, and the anatomical relationships between the CDN bifurcation and CDA bifurcation were documented and photographed.
The distance between the two bifurcation points was measured.

**Results:** In all 30 web spaces, the CDA lay volar to the CDN in the palm and bifurcated distal to the CDN bifurcation. Mean distance between bifurcation points was $16 \pm 4.3$ mm (range, 7.0 - 27.3). In 27 of the web spaces, the CDA coursed distally between the digital nerves prior to undergoing bifurcation; however, in three web spaces (10%), the CDA looped laterally dorsal to one or other of the radial or ulnar digital nerves, before bifurcating distally. In two hands a neural loop (connecting ulnar and radial digital nerves) was identified in the third web space.

**Conclusion:** Our study details the usual neurovascular anatomy of the web spaces of the hand, and highlights variations. Such knowledge guides safe operative dissection.

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**A-0865 Scapholunate instability: definitions, classifications**

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**Introduction:** Pathogenesis and treatment of scapholunate (SL) injuries are still under definition in the literature, especially in chronic cases. A multiple-staged mechanism able to damage the scapholunate ligament complex is described by several authors. It is unknown when exactly the instability starts, but presumably any damage to this ligament complex is potentially able to produce an instability. This will also depend on the age of the patient and the use or overuse of the wrist. A partial initially asymptomatic injury to SL ligament can later become symptomatic. Lack of early diagnosis of this injury can develop a chronic instability, leading to degenerative arthritis and SLAC wrist. The treatment of these injuries is not always satisfactory. Arthroscopic classifications in use (Dautel, Geissler), do not fulfill all arthroscopic findings and have been described in acute injuries only. A development of arthroscopic classification is proposed, which aims to allow a better definition of acute and chronic injuries, especially in partial tears of the scapholunate and scapholunate complex injuries.

**Materials and methods:** Eighty symptomatic patients underwent arthroscopy of the wrist. Intraoperative findings were described by the surgeons. The lesions of SL ligament were identified and classified according to the proposed classification. The simple sprain with haemorrhage is classified as Stage I. A sprain with damage to the membranous portion of SL ligament is classified as Stage II. A lesion of the anterior portion of SL injury is classified as Stage IIIA. An injury to the dorsal part of SL injury is classified as Stage IIIB, a complete damage to SL interosseous ligament is classified as Stage IIIC. A more complex damage of SL ligament complex with SL gap is classified as Stage IV. The mean age of patients was 44 years old (range, 16 - 72 years). There were 51 male and 29 female subjects. There were 24 sports injuries, 4 road traffic injuries, 26 accidental injuries, 21 working injury and 5 unknown. The dominant hand was involved in 56 cases.

**Results:** The acute injuries were 12, while the chronic were 68. The arthroscopic findings showed one lesion Stage I, 10 Stage II, 13 lesions Stage IIIA, 16 lesions Stage IIIB, 27 lesions were Stage IIIC, 13 lesions Stage IV. Associated lesions were six fractures of the radius/ulna, 15 TFCC lesions, three nerve compression syndromes, four ganglions, 12 lunotriquetral ligament injuries and three other. No lesions lacked classification.

**Discussion:** The classification proposed (EWAS Classification) can be used to classify a variety of acute and chronic scapho-lunate injuries. Classify means a better understanding of the complexity of the lesions and possibly define or improve the treatment in the different stages. Evolution of arthroscopic classification of scapho-lunate tears (EWAS Classification).

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**A-0866 Primary flexor tendon grafting in the acute settings as a possible Zone 2 injury treatment option**

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**Introduction:** The problems of primary flexor tendon grafting, the efficiency of this procedure, its advantages and possible risks have not often been discussed in the literature.

**Purpose:** To compare the functional results of primary and conventional 1-stage secondary digital flexor tendon grafting.

**Materials and methods:** We treated 428 patients with Zone 2 flexor tendon injury (by a single hand surgeon): 187 patients underwent primary flexor tendon...
Scapholunate instability: Arthroscopic Grading

G Dautel

Arthroscopy remains a valuable tool when it comes to grading the severity of a scapholunate instability, allowing to record informations that will be directly used when planning the appropriate surgical treatment.

- Inter osseous ligament: Radiocarpal arthroscopy permits visualisation and palpation of the interosseous ligament, showing complete or partial disruption and precising the site of the rupture (Scaphoid avulsion, midportion disruption or lunate avulsion). During this step, the quality of the ligament remnants will be precised, ligaments that can still be repaired being separated from those quoted as “non repairable” (leading to selection of a ligamentoplasty or another palliative procedure).

- Extrinsic ligaments: All the palmar extrinsic ligaments can easily be viewed and palpated during radiocarpal arthroscopy, retrieving tears and disruptions when present; However, if these data on extrinsic ligaments are priceless in our quest of a better understanding of the physiopathology of SL instability, in our practice, they do not influence our surgical indications so far.

- Chondral surfaces: In our routine examination of the wrist in patients presenting with a Scapholunate Inter osseous ligament disruption, we carefully check the chondral surfaces both in the radiocarpal and midcarpal joints. Special attention is paid to the proximal pole of the scaphoid, looking for early chondral consequences of a dissociative instability. Chondritis of this area can be a valuable proof of a long-standing instability, even though the patient refers to a very recent trauma.

- Midcarpal dynamic testing: Dynamic testing of the interosseous space between the scaphoid and lunate remains the key feature of our arthroscopic screening of any case of dissociative instability. Static examination will sometimes reveals a gap between the scaphoid and lunate, but this situation corresponds to static SL dissociations that are easily retrieved on plain X-rays. Similarly, dynamic SL dissociations are commonly retrieved on dynamic X-rays (clenched fist supinated AP view) without the need of arthroscopy to reach a diagnosis. However in many situations diagnosis can remains difficult even after completion of a full set of dynamic X-rays. In such circumstances, arthroscopy will permit to confirm or rule out the hypothesis of dissociative instability, while allowing a precise grading of its severity. Inspection and palpation of the triquetro-lunate space will always be the first step of this arthroscopic screening establishing what is the normal situation [providing that the patient is not presenting with som form of perilunate dissociation...]

- Stage 0: the tip of the hook cannot be pushed in the interval between the scaphoid and lunate
- Stage 1: The tip of the hook can be introduced in the interosseous space, but this interval cannot be enlarged even when using the hook with a twisting motion.
Stage 2: Twisting motion of the hook will reveal the Scapholunate gap.
Stage 3: Using the hook as a lever will permit the scope to go from the midcarpal joint to the radio-carpal joint, retrieving the remnants of the SL10 ligament.

Many other dynamic testing has been described including tests that try to demonstrate the hypermobility of the scaphoid. Although these tests can be added to our armamentarium, their results are difficult to quantify.

In summary, wrist arthroscopy offers a unique opportunity to demonstrate if needed the existence of a dissociative instability while precising the quality of the ligament remnants, helping to differentiate recent from chronic lesions and to assess the severity of the instability.

Arthroscopic volar capsuloligamentous suture for treatment of midcarpal instability stage 1

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Introduction: Midcarpal instability is a rare disease, occurring in young patients most often after sports injury, whose origin is in stage 1 a lesion of the palmar capsular ligamentous complex (arcuate ligament and long radio lunate ligament). Conservative treatment by ligamentoplasty did not lead to the results expected. Secondary therapeutic alternatives by partial wrist arthrodesis or proximal rowcarpectomy remain palliative, with all the well-known functional problems.

We report on a new arthroscopic treatment for 2 cases of midcarpal instability by arthroscopic volar capsuloligamentous suture.

Observation: We report two cases (33 year-old man and 35 year-old man), who made several months ago (9 months and 1 year) trauma to the wrist (left and right).

Both patients had chronic wrist pain poorly systematized with preserved mobility and major loss of strength. Testing of the midcarpal joint highlighted an important painful clunk. Imaging showed a VISI tilt of the proximal row. The radiocarpal arthroscopic exploration showed a distension of extrinsic palmar ligament system (Radio-scapho capitale ligament et long radio lunate ligament). In midcarpal jointwe found avulsion of the volar capsular ligament complex with a lesion of the arcuate ligament concerning his ulnar part (ligament triquetro - capital [TC]) and radial part (radio-scapholunate ligament capital [RSC]) and distension of the long radiolunate ligament [LRL]. A volar capsuloligamentous suture by arthroscopic technique was performed by a triple suture with a PDS 3/0 between the RSC, TC, and LRL.

Immiscination of 6 weeks was performed post operatively. The last follow-up was 9 and 12 months. Both patients had their pain and clunking disappeared. The recovery of range-of-motion as well as muscle strength was excellent. The X-rays showed a complete reduction of the VISI in one case and, a partial reduction in the other.

Discussion: The treatment of midcarpal instability remains difficult and no particular treatment has proved effective. Conservative treatmentas ligamentoplasty or open capsulodesis sometimes makes stabilization possible but classically with severe stiffness. Palliative treatment, usually performed as final treatment, have a heavy functional ransom. The advent of arthroscopy has enabled surgeons to understand and visualize better the lesions and allows in stage 1 a volar capsuloligamentous repair, which would appear to stabilize the lesions and suppress the painful clunking. An arthroscopic procedure using volar capsuloligamentous shrinkage has also been reported but remains limited to partial lesions.

A long follow-up with a larger series would enable us to validate this technique, which appears to be promising.

Radial side TFCC tears and DRUJ Instability

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The Triangular Fibro-Cartilage Complex (TFCC) is the main stabilizer of the distal radio-ulnar (DRUJ), it contributes also to the suspension of the ulnar aspect of the carpus and cushions the load-bearing forces transmitted through the ulno-carpal axis. This ligamentous structure adheres intimately to the radial sigmoid notch and converges to the ulnar fovea. This close relationship with the radius explains the high frequency of pathologic association between distal radius fractures and lesions of the radial aspect of TFCC (Palmer Class 1D). This tear can also be observed during load injuries combining a twisting torque and ulnar deviation of an outstretched wrist.

Histologically, le central portion of the TFCC is less vascularized and weaker than the dorsal and palmar ligament connections. Nevertheless, some radial-sided vascularity has been documented, suggesting healing possibilities even in its central portion.

Classical Palmer 1D Classification of radial side TFCC tears has been recently updated by Toshiyasu.
Nakamura depending on the extend of the contingent lesion of palmar and/or dorsal DRUJ ligaments:

- **1D type (a)**: the radial slit or flapped tear is limited to the central fibrocartilage (most frequently observed)
- **1D type (b)**: dorsal rim tear +/- dorsal margin fracture of the sigmoid notch
- **1D type (c)**: palmar-radial avulsion tear of TFCC +/- fracture
- **1D type (d)**: total radius avulsion of TFCC +/- sigmoid notch fracture

As the DRUJ stability is assumed by the strong connection of the TFCC on the very dorsal and palmar edges of the sigmoid notch, only Class 1D type (b), (c) or (d) can induce DRUJ instability. On the other hand, Class 1D type (a) lesions is responsible of ulnar-sided wrist pain and clicking while the provocative tests of DRUJ instability remain negative. An association with another type of TFCC lesion can be observed and needs to be documented for an accurate management.

Clinical diagnosis of TFCC tear can be confirmed by high-resolution MRI or triple injection arthro-CT scan but arthroscopy is the most sensitive tool for diagnosing the radial-sided TFCC tear, its exact classification and assessing its elasticity (trampoline test) closely related to DRUJ stability.

**Technique**: The portal was made 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 into the joint. The ulnar head, sigmoid notch of the radius, proximal surface of the TFCC, radioulnar ligament (RUL) origin at the fovea, 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 performed DRUJ arthroscopy in 196 wrists of 194 cases. There were 108 male and 86 female, with an average age of 32 (range, 15 to 63). Right wrists were 109, left 85, and one bilateral. All cases indicated moderate to severe DRUJ instability.

**Results**: DRUJ surface including ulnar head and sigmoid notch of the radius could be observed in all cases. We could observe RUL origin at the fovea in 170 wrists, while no visualization at the fovea was obtained in 26 wrists due to severe proliferation of the synovial at the fovea. Conditions of the RUL were the absence of the RUL with/without scaring in 58, the partial avulsion of dorsal portion of the RUL in 35, the partial avulsion of the palmar portion of the RUL in 9, relaxed RUL in 32, fibrillation on the RUL surface in 20, normal RUL in 16 (may be related to the horizontal type tear of the TFCC). We performed synovectomy on synovial proliferation and fibrillation case, open repair/ reconstruction of the TFCC in scar, empty RUL and complete disruption cases, and ulnar shortening in relaxed RUL cases.

**Conclusion**: DRUJ arthroscopy is useful especially for evaluation of the RUL condition and selection of treatment.

**SCAPHOID FRACTURES: WRIST ARTHROSCOPY ASSISTANCE, Technique and results**

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**Introduction**: Scaphoid fracture is the most frequent fracture of carpal bones. The high risk of nonunion or mal union justifies treating some of these injuries by reduction and osteosyntheses. Percutaneous fixation has been showing a real interest for many years. The authors present a technique of a wrist arthroscopic procedure for treating scaphoid fracture.
assistance for the surgical management of scaphoid fresh fractures. 

**Technique:** The technique is different in case of proximal or middle fracture because of the necessity of an anterograde or retrograde screw fixation and the position of the dorsal distal radius margin. It uses both fluoroscopy and arthroscopy. The interest of arthroscopy is a perfect control of the reduction, the compression and the size of the screw also the diagnosis of articular soft tissue associated injuries.

**Material and method:** Between 2010 and 2013, 20 scaphoid fractures were managed under arthroscopy with this method in our department. 18 male, mean age 35yo (14 to 45), 38 months of follow up, 90% middle, 10% proximal pole fractures. 2 cases were associated with a capitate fracture. Arthroscopy allowed a diagnosis of scapho-lunate stage IV in two cases. The associated injuries were managed under arthroscopy during the same procedure.

**Results:** All cases healed with a bone fusion controlled by X-ray. Mean time of healing was 5 weeks (4 to 9w). Fluoroscopic reduction was unsatisfying in 2 cases; one oversized screw was removed and changed during arthroscopy. Range of Motion (ROM) and strength were controlled. After healing ROM was 13% less in flexion-extension and 15% in radial and cubital inclination with the contra-lateral wrist. All the patients were able to recover the same work as before the scaphoid fracture.

**Conclusion:** Percutaneous screw fixation of scaphoid fracture is an interesting method of management in certain cases. Wrist arthroscopy assistance improves the quality of the reduction, increases the control of the compression, the size of the screw and allows the surgical management of associated ligament injuries.

**Arthroscopically-assisted treatment of Distal Radius Fractures. Do we achieve the anatomical goal?**

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**Purpose:** The use of arthroscopy as a means of better reducing the distal radius joint surface after acute distal radius fracture (DRF) in adults has been suggested in the literature a long time ago but has not been proven by any comparative study. We designed a prospective non-randomized single-centre study to compare the quality of reduction of the intra-articular displacement of DRF treated with volar plating with or without the adjunct of arthroscopic techniques.

**Methods:** Pre and post-operative CT scans were done in 26 AO type “C” DRF treated with volar plating under fluoroscopic control (Fluoroscopy group) and 23 AO type “C” DRF treated with volar plating plus arthroscopically-assisted internal fixation and fluoroscopic control (ARIF group). Patients of both groups were matched in terms of general health, functional needs and pre-operative intra- and extra-articular displacements. Gap and step deformities were assessed by pre- and post-operative CT scans both at the distal radius articular surface and at the sigmoid notch.

**Results:** The reduction of the intra-articular gaps and steps was better in the ARIF group at the distal radius articular facets (p<0.05). There was no difference between the two groups for reduction of gaps and step-offs at the sigmoid notch level. The extra-articular component of the fracture was satisfactory reduced in both groups with no statistical difference.

**Conclusions:** Our results suggest that the use of ARIF in combination with volar plating improves the anatomic reduction of the distal articular surface of the distal radius after acute DRF in adults. The clinical influence of this better anatomical reduction remains to be proven.

**Distal radius fractures and soft tissue lesions**

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**Introduction:** Distal radius fractures may in high-energy trauma be part of the Mayfield greater arc mechanism for perilunate injuries except that there is no dislocation of the lunate. This has recently been further described as PLIND (Peri-Lunate-Injury Non-dislocated; Herzberg, J Wrist Surg 2013) It is therefore not surprising that distal radius fractures frequently are associated with more or less obvious associated ligament injuries (Lindau et al JHS 1997)

**Methods:** Since 1995 there have been prospective longitudinal studies looking into the impact of distal radius fractures and its associated soft-tissue injuries, such as TFCC tears, luno-triquetral (LT) tears and scapho-lunate (SL) tears. In addition there has been quite a few chondral lesions diagnosed.

**Results:** It was early noted that peripheral TFCC tears caused laxity and a worse outcome (Lindau et al, JHS 2000). Some of the not so well understood findings were later elaborated on by changing the arthroscopic classification of the peripheral TFCC IB lesions (Atzei JHS 2009).

15 years later, only 1 patient had been operated on due to instability suggesting that peripheral tears do not need immediate treatment (Mrkonjic et al JHS...
2012). Furthermore, there was no secondary DRU-joint OA!

Intercarpal ligament tears, such as SL-tears were found to have increased radiological SL dissociation 1y after injury (Forward et al JHS 2007), which 15 years later were found not to have given any late SL reconstructions nor late SLAC-OA type of presentations (Mrkonjic et al submitted to JHS 2014).

Discussions: There is weak or no evidence for the need for immediate repair of associated injuries in distal radius fractures. Long-term longitudinal studies suggest that peripheral TFCC tears (Mrkonjic et al 2012) and SL tears Grade 1-3 (Mrkonjic et al 2014) do not need acute repair. However, despite support of evidence, the management should be guided by the surgeon’s experience and philosophy, as the weak evidence do not always reflect reality! It is important to remember that with Grade 4 SL tears, the secondary stabilizers may still be present and unharmed supporting the intercarpal injury to a stage where some patients may be clinically ok, while others will develop secondary instability. The take home message is therefore to diagnose and assess all associated soft-tissue injuries, to decide whether to treat them surgically or at least to change the post-op rehabilitation from early mobilization to immobilization perhaps in an above elbow sugar tong plaster if a peripheral TFCC tear is known.

Management of intraarticular malunion of the distal radius.

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Intraarticular malunion is common and is a source of pain and limitation after distal radius fractures. Depending on the personality, 3 different approaches are proposed to dealt with it:

- Arthroscopic guided osteotomy (Piñal et al. JHSAm 2006 and 2010). This option is valid when the cartilage of the radius and carpal are intact. The technique and results are discussed.
- Arthroscopic Resection Arthroplasty (Piñal JHSAm 2012). The technique of arthroscopic leveling of the joint is an option when the carpals are damaged or mirror type injuries exist. The technique and results are discussed.
- Vascularized osteochondral graft from the base of the third metatarsal (Piñal et al JHSAm 2005 and 2013). When a localized osteochondral defect exists on the radius it is possible to restore the joint anatomy by transferring a free vascularized segment of the base of the metatarsal. The indications and results are discussed.

Arthroscopic Wrist Arthrolysis

R Luchetti

Introduction: Wrist stiffness is a debilitating condition that may complicate a traumatic injury to the wrist or follow immobilisation of the wrist in a brace or plaster cast. This stiffness may be due to intra- and extra-articular causes. Arthrofibrosis is the predominant intra-articular pathology encountered and may involve the radiocarpal, radioulnar and ulnocarpal joints. Treatment initially consists of a prolonged course of conservative treatment involving therapists. Following failure of conservative treatment, arthroscopic arthrolysis is an effective treatment for re-establishing range of motion and improving patient’s pain. At the same time other intra-articular pathologies may be identified and treated. The post-operative rehabilitation protocol needs to be considered when treating other co-existent pathologies, as early post-operative mobilization is mandatory following arthrolysis. The surgical procedure involves resection of intra-articular adhesions, capsulotomy and possible release of the radiocarpal ligaments. Due to the complex nature of this condition certain parts of the procedure may need to be performed as an open procedure. Satisfactory results may be obtained following surgery with improvement in range of motion.

Purpose of the study: To evaluate the results of this surgical procedure in patients affected by wrist stiffness after wrist fracture. Criteria for patient inclusion in our preoperative and postoperative study were wrist stiffness with or without pain, decreased grip strength, and unsuccessful results 3 to 6 months after following a rehabilitation program.

Methods: From 1988 to 2003, surgery was performed in 22 patients (16 men and 6 women) with a mean age of 37 years. Radiocarpal, midcarpal, and distal radioulnar joint portals were used in relation to the site of rigidity. Statistical evaluation was performed in all cases.

Results: At a mean follow-up of 28 months (range, 9 to 144 months), no complications were documented. One case that was operated on bilaterally successively required an additional right wrist arthroscopic arthrolysis to reach the same level of improvement as that of the contralateral side. Pain was almost absent in all cases (P > .0001), and mean flexion/extension range of motion increased from 84° preoperatively to
Does Arthroscopic Debridment With or Without Ligament Reconstruction Address Carpometacarpal Osteoarthritis?

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Thumb carpometacarpal (CMC) joint osteoarthritis is a common problem in clinical practice with a variety of treatment options. Arthroscopic procedures can preserve all or part of the trapezium in the setting of treatment of basilar joint arthritis. Such procedures (even without stabilisation or ligament reconstruction) have high reported success rates. However, little is documented concerning the limitations of the procedures in term of patients selection. A retrospective review was performed to determine the influence of patient related factors (including metacarpophalangeal joint hyperextension, dorsal or radial subluxation, severity of osteoarthritis, scaphotrapeziotrapezoid [STT] changes, carpal tunnel syndrome, depression) on pain, functional scores and post operative complication.

Method: 127 patients were included and underwent a partial arthroscopic trapeziectomy, first without ligament reconstruction and then with ligament reconstruction using the abductor pollicis longus. Thirty-four patients treated without ligament reconstruction and 93 patients with concomitant ligament reconstruction were evaluated after a minimum follow up of 12 months. The outcomes were assessed with the quick DASH and the Nelson Hospital scores. Mobility and strength were noted at the last follow up. Radiographs were evaluated to determine the recentering of the metacarpal at rest and under stress.

Results: Partial trapeziectomy with or without ligament reconstruction were both associated with satisfactory improvement and low rates complications. Eaton – Glickel stages 1 to 3 were treated successfully with this technique. The effect of STT changes was variably described. The metacarpal hyperextension did not seem to have an adverse effect.

Conclusion: Partial trapeziectomy with ligament reconstruction can be use for treatment of Eaton Stage 1 to 3 CMC osteoarthritis with satisfactory outcomes.

H.A.L.T. syndrome

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Introduction: The chondritis or osteoarthritis of the hamate tip is a condition which has not a clear etiology. The Ulna-Impaction-Syndrome is a condition in which the ulna is hitting against the lunate-triquetrum complex which can then secondarily hit the hamate tip by painful longitudinal force transmission. Alternatively rotational instabilities like in midcarpal instability can result in shearing forces which act on the hamate tip. In these conditions two different shapes of the lunate have been described and are found in reality. Viegas has described these two conditions. In some cases we have seen this chondritis on the hamate tip in isolated form. In other conditions this seems clearly associated to a form of ulna impaction syndrome where the axial forces which act on the ulnocarpal column seem to be transmitted distally to the midcarpal joint. This leads to lesions of the lunotriquetral ligament and also to arthritic conditions in this joint (H.A.L.T. = Hamate Arthritis Lunotriquetral Instability).

Methods: As the hamate tip is not a load bearing part of the wrist, resection of a few mm of the conflicted chondral and subchondral bone is easily performed with a 3.5mm burr. The operation is performed after diagnostics of all carpal components and indicated in isolated form only in cases where no other concomitant problem is seen. We have reviewed 24 Patients which were operated in the period 2008 – 2010. There were 50% workers, and the period of pain pre OP: was 4.56 Years

Results: The mean resection length was 2.5 [0-4]mm, the postoperative DASH was 13.4 points. The Impingement Test was negative in 95% of our patients postoperatively, while positive in all patients preop.

Pain persistence was in average: 3.8 [0-10] months. In 3 Pat. moderate pain persisted until today. VAS in rest is 1.16 [0-3] points VAS under load: 4.54 [1.5-10] points. Power improved by 2.71 Kg [Baseline]. Patient’s satisfaction rate was extremely high with 23 highly satisfied Patients.
Conclusion: The differential diagnostics in ulnocarpal pain is not easy and many factors can lead to that pain.

Arthroscopy is a very effective tool in diagnosis of these pathologies. Once there, the problem can be resolved effectively by arthroscopy in many cases. This operations gives pain free patients with a fast and relatively simple method.

Scaphoid nonunions

D J Slutsky

Trail and Stanley analysed the predictive factors of a scaphoid non-union. They calculated the fragment ratio by dividing the proximal fragment size by the sum of the sizes of the proximal and distal fragments. The more proximal the fracture, the lower the probability of union, and the longer the delay before surgery the lower the probability of union. The age of the fracture has a large effect in proximal but only a weak effect in distal fractures. For example, if the fragment ratio is 0.6 then the probabilities of a successful outcome are 98% and 81% for surgery carried out at one year and ten years, respectively. If surgery is carried out at one year a fracture with a fragment ratio of 0.4 has a probability of union of 83%, but this falls to 27% if there is a delay of ten years.

The indications for percutaneous scaphoid screw insertion include nondisplaced fibrous scaphoid nonunions without evidence of avascular necrosis. The nonunionsite is first assessed with an anteroposterior, lateral and oblique x-rays, although a CT scan is helpful in difficult cases. Dorsal screw insertion is recommended for scaphoid nonunions of the proximal pole and waist as this permits maximum compression whereas distal pole nonunions are best approached through a volar percutaneous approach. Volar implantation often requires eccentric screw placement through the distal pole since one has to ream through the trapezium in order to gain access to the central scaphoid axis, but the screw can still be placed centrally through the waist and proximal pole. Screws that are placed along the central axis are stronger and have faster union rates than eccentrically placed screws. Insertion down the central axis also permits insertion of a longer screw, which is desirable since biomechanical data has shown that a longer screw distributes and reduces the bending forces more efficiently. Stable fixation however is the key to healing since eccentric screw fixation can still result in union.

Scaphoid nonunions with a humpback deformity and secondary dorsal intercalated segmental instability (DISI) deformity require an open volar wedge graft. A small proximal pole fragment does not allow adequate screw purchase and may fragment and may be best treated with multiple k-wires. The presence of significant radiocarpal and/or midcarpal degenerative changes mandates some type of salvage procedure.

Partial or complete avascular necrosis of the scaphoid is a relative contraindication to percutaneous techniques and may require a vascularized graft. The emergence of vascularized bone grafts (VBG) have changed the treatment of scaphoid nonunion. They can be inlay or onlay grafts. Their use can lead to a faster rate of union, and improve the viability of the proximal pole. They can also provide an alternative to a salvage procedure with previously failed conventional bone grafting. A variety of pedicled grafts from the dorsal and volar aspects of the distal radius have been described, as well as a pedicled graft from the thumb metacarpal and free vascularized medial femoral condyle grafts.

Augmented reality-based navigation system for wrist arthroscopy: feasibility study

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Introduction: In video surgery, and more specifically in arthroscopy, one of the major problems is positioning the camera and instruments within the anatomic environment. The concept of computer-guided video surgery has already been used in ENT, gynecology and even for hip arthroscopy. These systems however rely on optic or mechanic sensors, which turn out to be restricting and cumbersome.

Objective: The aim of our study was to develop and evaluate the accuracy of a navigation system in video surgery, based on electromagnetic sensors.

Material and methods: We have used an electromagnetic localization device (Aurora®, Northern Digital Inc™, Ontario, Canada) in order to track the
movements in space of both the camera and instruments. We have developed a dedicated application in Python language, using the VTK library for the graphic display, and the OpenCV library for camera calibration.

**Results:** A prototype has been designed and evaluated for wrist arthroscopy. It allows to display the theoretical position of instruments onto the arthroscopic view with useful accuracy.

**Conclusion:** The augmented reality view represents a valuable assistance when surgeons want to position the arthroscope or locate their instruments. It makes the maneuver more intuitive, increases comfort, saves time and enhance ---