



Electronic Poster Abstracts

P1. Pre-op CT Scan For Distal Radius Fracture: Is It Really Necessary?

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Introduction: Operative treatment of distal radius fractures has gained popularity due to its good outcomes. While preoperative CT scanning theoretically helps preoperative planning, routine use is not standard practice and depends on the surgeon's preference. The purpose of this study was to evaluate the value of a preoperative CT scan, as determined by postoperative radiographic outcome in patients with a fracture of the distal radius.

Materials/Methods: Between May 2013 and December 2014 62 patients with 66 AO/OTA type 23-C fractures were treated with a volar locking plate and had a postoperative CT scan. All patients were available for review. Postoperative radiographic outcome of these fractures was assessed using the postoperative CT scan, evaluating the following radiographic determinants: radial inclination, volar tilt, step-off, intra-articular gap, and assessment of sigmoid notch reduction. Of these 66 fractures, 32 had a preoperative CT scan, and 34 did not. In this way, radiographic outcome for fractures in which a preoperative CT scan had been obtained for operative planning purposes was compared to that of fractures not scanned preoperatively.

Results: There was no significant difference between the two groups for any of the radiographic outcome determinants. Those without a preoperative CT scan had acceptable radial inclination (19.7 +/- 4.7mm), volar tilt (10.3 +/- 6.4mm), step-off (0.7 +/- 1.2mm), intra-articular gap (1.7 +/- 2.4mm), and sigmoid notch malreduction (3 of 34 not reduced). In comparison, the fractures having a preoperative CT scan had a radial inclination of 17.1 +/- 6.2mm (p = 0.058), a volar tilt of 10.4 +/- 5.4mm (p = 0.913), a step-off of 1.18 +/- 1.2mm (p = 0.115), an intra-articular gap of 2.1 +/- 1.9mm (p = 0.359), and a sigmoid notch malreduction in 1 of 32 the fractures (X²= 0.286)

Conclusions: The plain radiographic appearance of fractures of the distal radius often appears complex, possibly directing the treating surgeon to obtain more advanced – and costly – studies, such as a preoperative CT scan. However, our findings indicate that for the AO/OTA type 23-C fracture treated with a volar locking plate, a preoperative CT scan provides no added value.

P2. The Scratch Collapse Test and Evaluation of Patients with Coincident Carpal and Cubital Tunnel Syndrome

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Introduction: Coincident ulnar compression at the cubital tunnel can coexist with carpal tunnel syndrome, but poses a diagnostic challenge - sensitivity of “gold standard” nerve conduction study results is limited to 60-70%. The Scratch Collapse Test is a somewhat controversial provocative diagnostic tool for cubital tunnel syndrome, but given its strong performance in the hands of experienced practitioners, it may be an excellent adjunct for diagnosing coincident ulnar neuropathy at the elbow in carpal tunnel syndrome patients.

Methods: This team has previously reported the results of a retrospective analysis of 515 patients to characterize demographics, medical history, physical exam findings, and nerve conduction study results correlated with coincident carpal and cubital tunnel syndromes. This cohort included 96 patients who were also evaluated by the scratch collapse test for ulnar neuropathy at the elbow. This partial cohort was assessed for diagnostic sensitivity of the scratch collapse test. We modified an existing clinical scoring scheme to assess the relative clinical weight of the scratch collapse test. The original scoring scheme evaluated loss of intrinsic hand strength, ulnar sensation loss, positive elbow flexion test, positive cubital tunnel Tinel's sign, and abnormal ulnar nerve conduction study to evaluate risk for coincident compression neuropathy. All modified scoring schemes were assessed by receiver operator characteristics (ROC) curves, as well as by sensitivities, specificities, positive, and negative predictive values.

Results: Compared to other physical exam findings specific for cubital tunnel syndrome, the scratch collapse test outperformed all other tests, with a sensitivity of 78.69%.

The original scoring model showed an ROC area under the curve (AUC) of 0.9295 with five equally-weighted components. Modified to include the scratch collapse test, this ROC AUC increased to 0.9618 (nearly a perfect predictor of coincident compression).

Conclusions: In addition to outperforming other diagnostic factors for evaluating cubital tunnel syndrome, the scratch collapse test significantly improved the holistic diagnostic evaluation of patients with coincident compression neuropathy. In this developmental cohort, a modified clinical score including the scratch collapse test was a robust and efficient method for diagnosing patients at risk for coincident carpal and cubital tunnel syndromes.

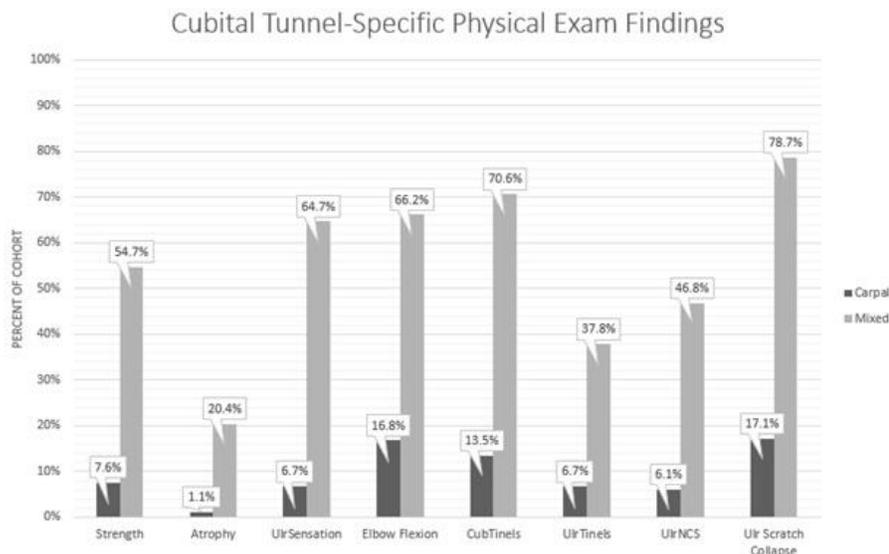


Figure 1. Comparison of Relative Sensitivities of Physical Exam Findings

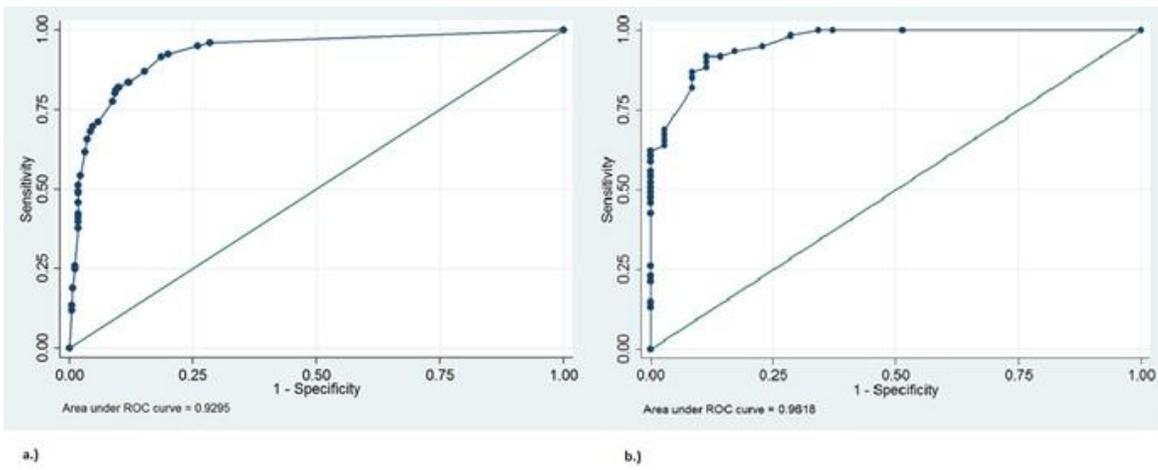


Figure 1. Comparison of ROC curves for a.) Conventional score system and b.) Scratch-Collapse modified score system

P3. Variability in Hand Surgery Experience for Graduates of Surgical Specialties

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Background: Plastic, orthopedic, and general surgery residents receive unique hand surgery training, yet often compete for similar hand surgery fellowships. The purpose of this study was to determine the baseline hand surgery experience in a national cohort of three specialties.

Methods: Procedural statistics for chief residents in 2011-2014 were obtained from the American Council of Graduate Medical Education for plastic, orthopedic, and general surgery residents. Data were grouped by specialty and compared by the number of total hand surgery procedures, including fracture repair, soft tissue reconstruction, and digital amputations. For orthopedic surgery, total number of procedures was calculated by the sum of hand and forearm cases. Statistics for interspecialty comparisons utilized a one way analysis of variance (ANOVA) with a cutoff of $p < 0.05$ for significance.

Results: Over four years, data were available for 640 plastic surgery, 2,687 orthopedic, and 4,355 general surgery residents. From 2011 to 2014, the average number of hand cases reported by plastic surgery residents increased 13.6% from 351.9 to 399.9 cases, and those reported by orthopedic residents decreased 21.7% from 270 to 211.5 cases. A significant difference was observed in the total number of hand cases with plastic surgeons performing the most at 372.3 +/- 192 followed by orthopedic and general surgery at 260.3 +/- 120 and 0.6 +/- 0.1, respectively ($p < 0.05$). Plastic surgeons performed more soft tissue reconstructions (60.7 vs 45.6) and digital amputations (14.9 vs 6.5) than their orthopedic colleagues ($p < 0.05$). Orthopedic residents reported more fracture repairs (78.2 vs 44.1, $p < 0.05$).

Conclusions: Experience in hand surgery procedures differs widely among surgical training programs in the United States. These differences may highlight a need for optimization in training for certain areas during hand surgery fellowship. Case volume is a only a proxy for competency and greater research is needed to elucidate baseline proficiencies of incoming hand surgery fellows.

P4. Online Reviews of Hand Surgeons

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Background: The online reputation of a practicing hand surgeon is becoming increasingly important. Physician review websites (PRWs) offer patients an opportunity to search their surgeon, but many providers argue these ratings can be misused. The purpose of this study was to evaluate the landscape of online reviews in a national cohort of hand surgeons.

Methods: Names of practicing hand surgeons in the 10 most populous American cities were obtained from the search feature of the American Board of Medical Specialties. Gender, age, region, city size, pedigree, and practice type were recorded. A Google search was performed with “[first name] [last name] hand surgeon.” The number of reviews and scaled rating scores (out of 5) were recorded from the three most popular PRWs. A “very poor” rating was defined as a “1/5” review on either Vitals or RateMDs. Data were collected during December 2014 and comparisons were made via Mann-Whitney and Kruskal-Wallis tests.

Results: Of 220 hand surgeons, 92.3% had a profile on HealthGrades, 89.6% on Vitals, and 81.9% on RateMDs. The median search result position for academic website was 1, HealthGrades 2, personal website 3, and Vitals 5. Ratings were based on 12.6 +/- 9.1 reviews for HealthGrades, 10.5 +/- 12.5 for Vitals, and 4.1 +/- 5.1 for RateMDs respectively. Out of a maximal score of 5, average scores were 4.1 +/- 0.7 for HealthGrades, 4.3 +/- 0.7 for Vitals, and 4.0 +/- 1.1 for RateMDs. 44.1% of hand surgeons had at least one “very poor” rating on Vitals and 20.8% on RateMDs. No difference was seen in the median number or quality of reviews with regards to gender, age, US region, city size, pedigree (plastic vs ortho trained), or practice type ($p > 0.05$).

Conclusions: Awareness of online reviews may help hand surgeons better manage their online reputation. While mostly positive, a significant number of negative reviews exist. We suggest hand surgeons monitor these sites given their high visibility and potential influence on patients.

P5. Current Trends in Carpal Tunnel Release: A Comparison of Endoscopic and Open Surgical Rates, Outcomes, and Complications between Hand Fellowship and Non-Hand Fellowship Trained Surgeons Utilizing the American Board of Orthopaedic Surgery Certification Exam

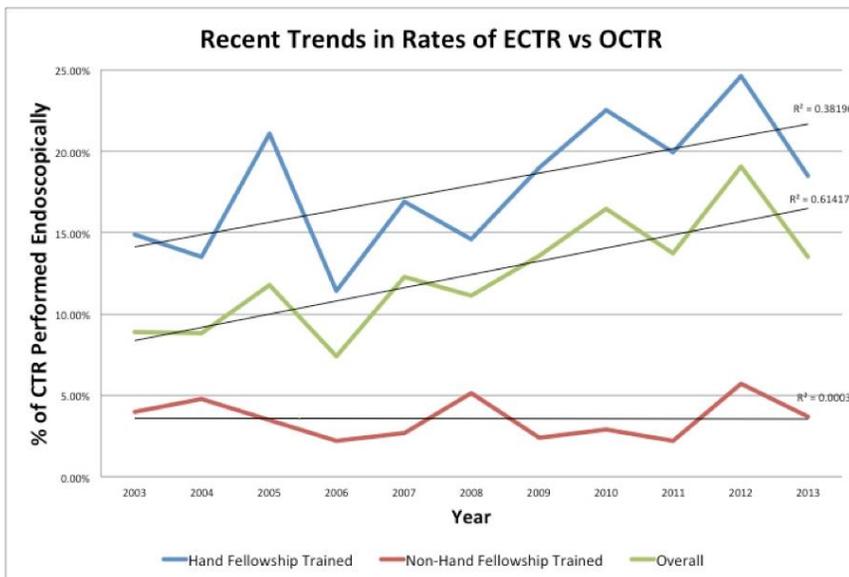
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Introduction: This study aimed to investigate the current rates, recent trends, and complications in relation to carpal tunnel surgery and type of fellowship training using the American Board of Orthopaedic Surgery (ABOS) Part II Database.

Materials and Methods: The ABOS database was searched for patients with CTS (ICD-9: 354.0) who underwent carpal tunnel release (CTR) either open (CPT: 64721) or endoscopically (CPT: 29848) from 2003-2013. Cases with multiple CPT codes were excluded. Data was gathered on geographic location, fellowship, and surgical outcomes. Data was then divided into two cohorts based on surgeon level of training: hand fellowship trained versus non-hand fellowship trained. Analysis was performed with Chi-squared tests of independence and for trend.

Results: Overall, 12.4% of all CTR cases were done endoscopically. Hand fellowship trained orthopaedists performed about 4.5 times (18% versus 4%) the number of ECTR than did non-hand fellowship trained surgeons (Figure 1). An increasing trend of ECTR was seen only among the hand fellowship cohort. The Northwest performed the highest (23.1%) and the Southwest the lowest (5.9%) percentage of ECTR (Figure 2). The complication rate associated with CTR overall was 3.56%, with ECTR was 2.83%, and with OCTR was 3.69%, although this was not statistically significant. There was no difference between complication rates with ECTR and OCTR between the two cohorts (Figure 3). However, within the hand fellowship cohort the complication rate for ECTR was significantly less than for OCTR. Wound complications were higher with OCTR and nerve palsy with ECTR, with postoperative pain equivalent between techniques.

Conclusions: The rate of ECTR is increasing, as are reported complications. However, complication rates remain low in the first few years of practice. Hand fellowship trained surgeons perform more ECTR than do non-hand fellowship trained orthopaedic surgeons however there does not seem to be a difference in complication rates between these groups.



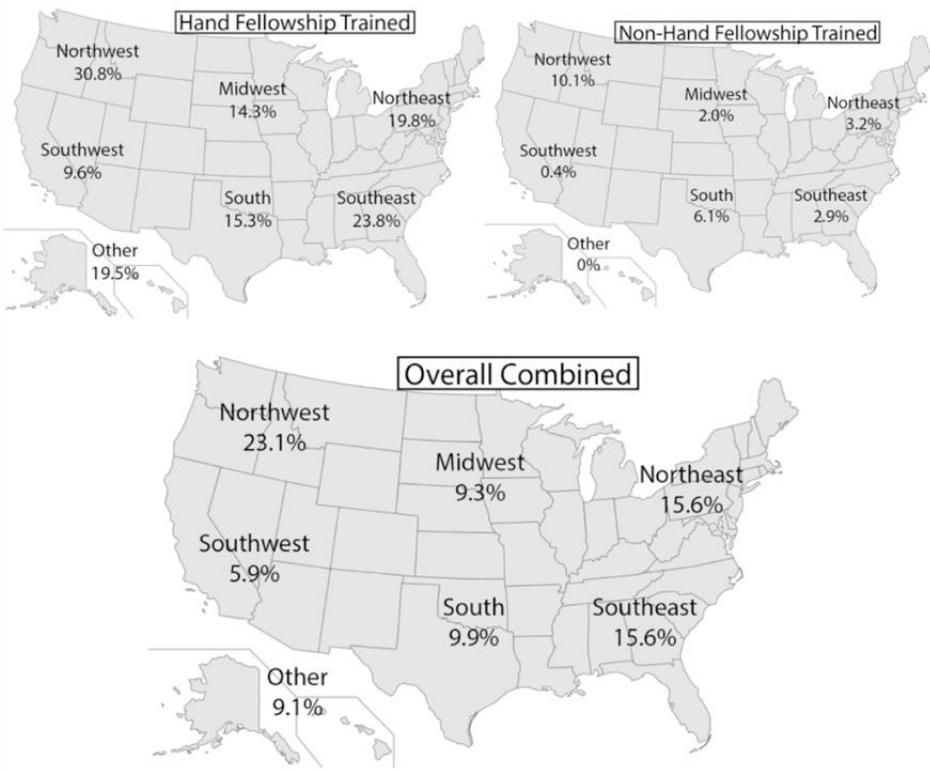
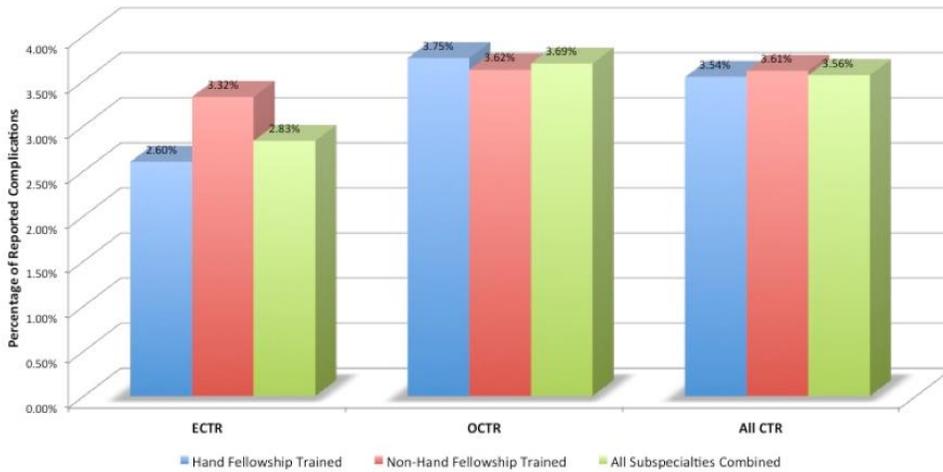


Figure 3: Total reported complications within each cohort for ECTR, OCTR, and CTR without consideration for technique.



P6. Arthroscopic All-Inside Suture Fixation and Bone Grafting of Osteochondritis Dissecans Lesions of the Capitellum

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Hypothesis: We hypothesize that a novel technique for all-arthroscopic fixation of capitellum osteochondritis dissecans (OCD) lesions using suture fixation and autogenous iliac crest bone grafting offers a successful alternative to open, internal fixation techniques as measured by validated, patient reported outcomes scores.

Methods: Our technique utilizes arthroscopic all-inside suture fixation with iliac crest autogenous bone grafting. The procedure was performed on four adolescents presenting with five unstable capitellum OCD lesions. The patients were all elite-level athletes: two gymnasts, one baseball pitcher, and one lacrosse player. All patients presented with elbow pain, limited range-of-motion (ROM), and decreased ability to play. MRI provided the diagnosis of an unstable OCD lesion, which was correlated with arthroscopy at the time of surgery. Postoperatively, all patients were immobilized in a long arm cast for 2 months. ROM exercises were then initiated with return to activity as tolerated over a period of 8 weeks. Patients were evaluated prospectively with DASH, Oxford Elbow and Mayo Elbow scores, VAS scores, postoperative ROM and return to play.

Results: Three females and one male aged 13 to 15 years old underwent the procedure. Three patients demonstrated a loss of preoperative terminal extension (average 28 degrees). Two patients underwent failed prior procedures at outside institutions (one retrograde drilling and one internal fixation). Average final follow-up was 2.8 years. All patients went on to union as seen on MRI at an average of 3 months. At follow-up, the average loss of extension was 2 degrees. The average flexion was 153 degrees. There was no loss of supination or pronation. The average DASH score was 11. The average Mayo Elbow score was 88. The average Oxford Elbow score was 42. The average VAS was 2. Average return-to-play was 4 months. All patients continued to compete at an elite level. There were no infections, failure of fixation, need for conversion to open surgery, or revision surgeries.

Summary points:

- Arthroscopic all-inside fixation of unstable OCD lesions is a successful technique, facilitating athletes to return to elite level of play
- Our technique results in outcomes comparable to those reported in the literature for open fixation and arthroscopic-assisted fixation (1-3).
- Drilling from posterior to anterior through the humerus avoids the need for articular surface violation and limits the manipulation of tenuous fragments.
- Absorbable suture is used, precluding the need for hardware removal should collapse or progression of the lesion occur.



P7. Outcomes of Concomitant Fractures Of The Radial Head And Capitellum: The Kissing Lesion

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Background: Radial head compression against the capitellum in this position may cause concomitant fracture of the capitellum.

Hypothesis: We hypothesized that radial head fracture type was not predictive of the presence of a kissing lesion, and capitellar fracture type was also not predictive of the presence of a kissing lesion.

Methods: Data were identified from 5 area hospitals. The first 2 hospitals are level 1 trauma centers, the third is a community hospital tied to a level 1 trauma center, and the latter 2 hospitals are community hospitals. We retrieved records of patients over 18 years of age who underwent treatment for capitellum fracture and radial head fracture between January 1993 and 2014. Patients with olecranon fractures or trochlea fractures were excluded. Patients without surgical notes were also excluded.

Results: A total of 10 patients with a radial head fracture and a concomitant capitellum fracture were included. Based on the operative reports, 9 radial head fractures were classified as Hotchkiss Modification of the Mason Classification type II, and 1 was classified as type I. Based on the available radiographs and computed tomography, 3 capitellum fractures were type I, and 7 were type II according to the Grantham classification.

Conclusions: Surgeons have to be alert to capitellar damage in case of a Hotchkiss type II radial head fracture. An additional computerized tomography of the elbow should be performed, and during operative treatment of the radial head, a careful inspection of the capitellum is recommended to avoid a missed diagnosis and subsequent complications.

P8. Comparison of 2D and 3D Metacarpal Fracture Plating Constructs Under Cyclic Loading

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Purpose: To determine if any differences in fixation construct stability exists under cyclic loading and subsequent load-to-failure between locking double-row (3D) plates and single-row (2D) plates in a metacarpal sawbone fracture gap model simulating mid-diaphyseal comminution.

Hypothesis: 1.5-mm locking 3D plates will demonstrate equal or greater stability under cyclic loading in comparison to 2.0-mm locking 2D plates in a sawbone model simulating an aggressive range of motion post-operative protocol. Furthermore, we predict the 3D plates will demonstrate a higher tensile strength when loaded to failure.

Methods: Thirty metacarpal saw bones were cut with a 1.75mm gap in between the two pieces simulating a comminuted fracture pattern. Half of the bones were plated with 2D plates and half with 3D plates. The plated bones were then mounted into a Materials Testing System (MTS) Mini Bionix testing apparatus where they were cyclically loaded under cantilever bending for 2,000 cycles at 70N, 2,000 cycles at 120N, and then monotonically loaded to failure. Throughout the testing sequence, fracture gap sizes were measured, failure modes were recorded, and construct strengths and stiffnesses were calculated for comparison.

Results: All double-row constructs survived both cyclic loading conditions. Ten of the fifteen (67%) single-row constructs survived both cyclic loading conditions, while five constructs failed during the 120N loading at 1377 +/- 363 cycles. When loaded to failure, the double-row constructs failed at 265 N +/- 21 N, whereas the single-row constructs surviving cyclic loading failed at 190 N +/- 17 N ($p < 0.001$). The double-row plates exhibited significantly lower stiffness ($p < 0.001$), however, the construct stiffness was not significantly different.

Conclusion: Double-row metacarpal plates offer a lower profile metacarpal fixation option that provides the stability necessary for an early post-operative range of motion protocol. Double-row plates demonstrated increased resistance to failure in a cyclic loading model and increased load to failure compared to higher profile single-row metacarpal plates.

P9. 3D Printing for Preoperative Assessment and Simulation in Elective Wrist Surgery: Our Experience

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Introduction: There has been great advances in 3D printing technology and its possible medical applications. The use of this expertise in surgery may significantly advance all aspects of the operative process. We present our initial experiences using 3D modelling for preoperative templating in revision wrist surgery.

Materials and Methods: Data from three patients was included in the study: a revision scaphoid malunion (with broken screw in situ), a distal ulna nonunion with limited bone stock, and a failed wrist fusion. High resolution CT scans were taken at 1 mm per slice; images were exported to a 3D printer. Using CAD/CAM technology a virtual design of the model was generated. Selective laser sintering was used to create a 3D 1:1 scale polyethylene model. Defects were defined, implant type and size determined and necessary bony resection and fixation aided. Models were created at an average cost of £34 each.

Results: In each clinical case 3 D printing enabled us to accurately recreate the anatomical problem and allow templating as well as actual fixation using our implants. This accurately predicted the likelihood of intraoperative success, or otherwise.

Conclusions: With the push towards “personalised medicine”, 3D scanning and printing is an economical and accurate method of aiding planning for complex surgical procedures. It is especially useful in revision situations or where there are anatomical variations.

P10. The Brachialis Syndrome: A Rare Consequence of Patient Positioning Causing Postoperative Median Neuropathy

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Introduction: The purpose of this study is to report a previously unreported condition, that we call “brachialis syndrome”, caused by patient positioning that can result in permanent median nerve damage.

Methods: This is a retrospective series from 2008 to 2014 of five patients. Average age was 33 years (17-49). Each patient was an ASA1. All patients underwent surgical decompression of the median nerve. Two-point discrimination and manual muscle testing assessed neurological function.

Results: Five patients (all men) with six median nerves presented with a brachialis syndrome. Every patient presented with mixed sensory and motor deficit: numbness and paresthesias in the median nerve distribution (including the palmar cutaneous branch) as determined by loss of two point discrimination, pain in the forearm and volar wrist, pain with elbow extension, and motor dysfunction of the AIN innervated muscles. The patients underwent various index surgeries averaging 8.2 hours (3-13 hours). All patients were positioned with their elbows in full extension. The average time to symptoms postoperatively was 1 hour (0-2 hours). Two patients (1 and 2), initially presenting in 2008, had an average time to decompression of 58.5 days (25-92 days). In these patients, CT demonstrated brachialis necrosis adjacent to the trochlea. In the subsequent patients (3-5), the average time to decompression was 19.7 hours (16-22 hours). In these patients, CT demonstrated focal brachialis swelling and neural compression, but no necrosis. During decompression, the median nerve was found to be markedly compressed beneath the fascia and the edge of the lacertus fibrosis extending distally to include the takeoff of the AIN. In all cases the lacertus was abnormally thickened. The brachialis was found to have varying degrees of muscle necrosis. In the patients who presented in 2008, there was only partial neurological recovery up to 1 year. Both continued to have sensory deficits and FPL and FDP weakness, although improved. In patients expediently decompressed (patients 3-5), full neurological recovery occurred in 1 day to 2 weeks.

Discussion and Conclusion: This is the first description of the brachialis syndrome, a postoperative median neuropathy associated with patient positioning. The patients’ arms were placed into full extension, compressing the brachialis against the trochlea during lengthy surgical cases in anesthetized patients and resulting in necrosis, swelling and median nerve compression. The importance of patient positioning can not be overemphasized. Our experience includes patients with delayed presentation, delayed decompression and poor neurological outcomes. Thus, we advocate aggressive surgical management.

P11. Vascularized Bone Grafting in Scaphoid Nonunion: A Review of Patient-Centered Outcomes

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Introduction: Scaphoid fractures are among the most common upper extremity fractures, and 10% can result in nonunion. Vascularized bone grafting (VBG) has become an increasingly popular option to restore hand function, reporting significant improvement in objective clinical and radiographic outcomes. Equally important, however, are patient-centered outcomes such as functionality and overall satisfaction. The purpose of this study was to determine the effect of VBG for scaphoid nonunion on patient-centered outcomes.

Methods: The MEDLINE and PubMed databases were queried for the use of VBG in scaphoid nonunion. We included studies which reported on patient-centered outcomes. We excluded studies with less than 10 patients or six months follow-up. The primary outcomes assessed included functionality, percent and time to return to preinjury activity, postoperative pain, and patient satisfaction. Data analysis was completed with weighted means based on sample size. Statistical significance was defined as $P < 0.05$.

Results: Twenty-six articles described the outcomes of 520 subjects with an average of 19.3 subjects per study. 91.1% of subjects were male with an average age of 29.3 years. The mean follow-up was 35.1 months. The average duration of nonunion before VBG was 31.4 months. Functionality was most commonly assessed by the MMWS and DASH scores which increased 53.8% and 81.7% postoperatively, respectively ($P < 0.05$). 90.3% of patients returned to their previous occupation or sporting activity within 16 weeks. Pain was most commonly reported using a 0-10 scale. Preoperative pain was 5.20 while postoperative pain was 0.99, a fourfold improvement ($P < 0.05$). Complete satisfaction was reported by 92% of patients postoperatively. The most common complications were superficial infections (1.56%), nerve irritation (1.56%), and complex regional pain syndrome (1.25%).

Conclusions: VBG for scaphoid nonunion results in significant improvement of patient-centered outcomes. The available literature suggests that VBG can markedly improve functionality and pain, resulting in excellent rates of return to preinjury activity level and patient satisfaction. Multiple metrics of patient-centered outcomes were utilized by the studies in our review without a clear consensus as to which metric is most responsive and accurate.

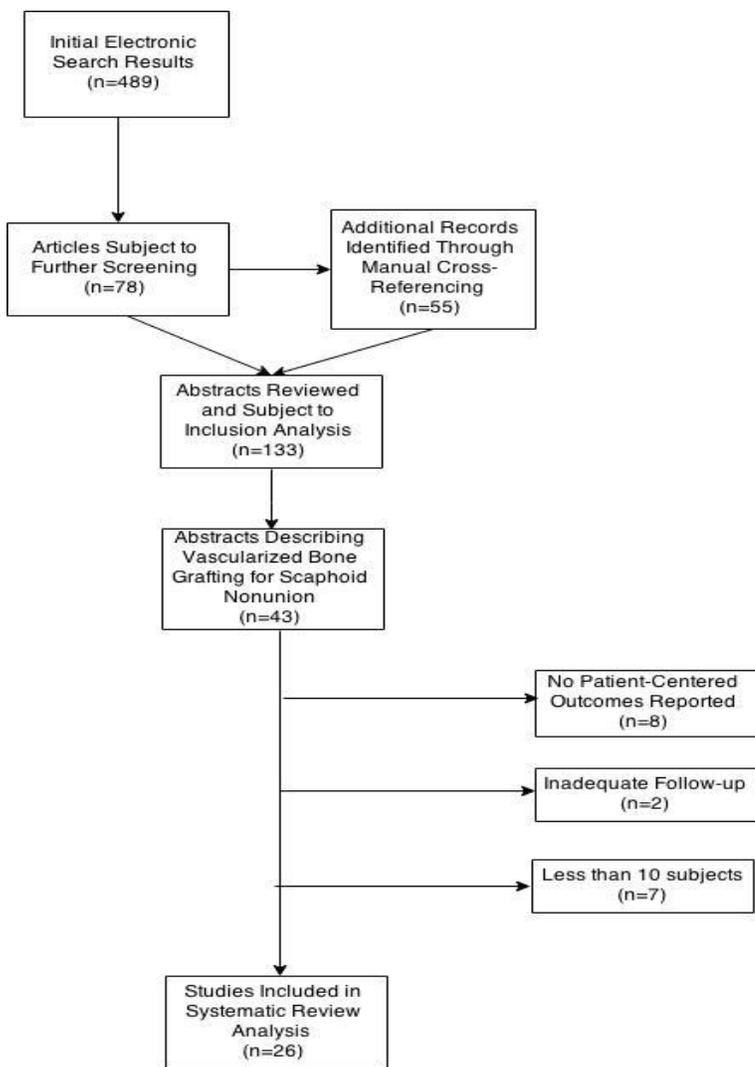


Figure 1: Flow Chart of Article Selection

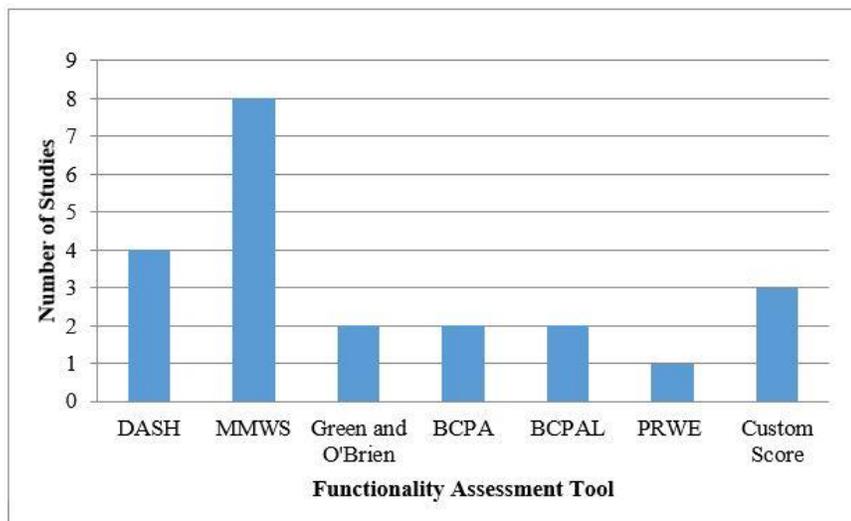


Figure 2: Assessment tools utilized to assess postoperative functionality in this systematic review.

P12. Treatment of Traumatic Bone Loss of the Hand Using the Masquelet Technique

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This study proposes a prospective evaluation of eighteen patients treated for traumatic bone loss affecting the fingers, hand and wrist using the induced-membrane technique.

Sixteen men and two women, mean age 54 years (27-74) presented an injury including bone loss. Sixteen patients were treated in emergency and two had pseudarthroses following the fractures. There were 13 cases of open fractures of the phalanx and 5 cases of metacarpal fractures. These patients were treated with debridement and covered when necessary. As for the bone loss, the first step of the induced-membrane technique was performed placing the cement spacer (polymethyl methacrylate [PMMA]) without antibiotics, to replace the lost bone tissue.

During the second step the cement spacer was removed and replaced by an autologous cancellous bone graft. The graft was placed with the biological tube left empty after removal of the cement. For each patient, consolidation was assessed by radiography and/or CT-scan. Failure was defined as non-consolidation at one year.

In 16 patients the fractures were consolidated after a mean 4 months (1.5 - 12 months). Two failures were noted (a pseudarthrosis treated using an IPP D3 prosthesis and one case of delayed consolidation). Mobility, evaluated using the TAM (Total Active Motion) was 145° (75¼ - 270¼) for the fingers. The Kapandji score reached 8 for the thumb. The grip strength measured using the Jamar reached 21 Kg/F and the pinch strength 5 Kg/F, both were half those in the healthy hand.

The induced-membrane technique is simple and can be used to treat traumatic bone loss in emergency, thus avoiding amputations and limb shortening, while preserving limb function. It provides immediate stability and thus allows early mobilization.

P13. Limited Carpal Fusion Using a Novel, Memory Wire, Staple

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Purpose: While multiple techniques have been used to salvage degenerative wrists, partial wrist fusions maintain carpal height, preserve functional motion and reliably improve pain. Partial wrist fusions have been achieved using a variety of techniques, with more recent techniques offering less violation of articulating surfaces. We retrospectively reviewed our early experience and learning curve with a dorsally impacted memory wire staple.

Methods: A retrospective review of a single surgeon series was conducted for patients with SLAC or SNAC degenerative wrist arthritis. Patients who underwent partial wrist fusions with a nitinol wire memory staple between 2011 and 2014 were eligible for inclusion. Review of medical records and radiographs for VAS, ROM, radiographic outcomes, and revision operations were assessed.

Results: 25 patients with an average age of 55 years \pm 8.9 years were included with an average follow up of one year \pm 7 months. All patients (5) with less than one year follow up had radiographic evidence of fusion at final follow up. Overall 10/25 (40 %) of staples backed up from the original insertion. 7/25 (28 %) underwent repeat intervention with staple removal. 3 patients returned to operating room prior to 6 weeks. 4 patients returned to the operating room on average one year after the index operation. 3/25 (12 %) patients failed to maintain radiographic reduction.

Conclusion: Although nitinol provides a unique memory characteristic which offers continuous compression across partial wrist fusions, there is a learning curve and back up rate to be considered when using the implant. Avoiding staple back up requires careful attention by the surgeon and a modification of the insertion technique. All patients within the study cohort achieved a painless wrist at final follow up. One patient was converted to cannulated screws after early back up of the staple. One patient went on to a painless nonunion.

P14. Interposing Auto/isografts to Promote Axonal Regeneration Across Long Acellular Nerve Grafts

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Introduction: Nerve grafting is often necessary to repair large nerve gaps. Alternatives to autografts are desirable; however, the leading alternative, acellular nerve allografts (ANAs), fail to facilitate axonal regeneration across long gaps (>3cm), where the need is greatest. In an effort to extend the graft length limit of ANAs beyond 3cm, we evaluated the effect of interposing a short auto/isograft between short ANAs, used to generate a long hybrid graft, on axonal regeneration.

Materials & Methods: Rat sciatic nerve was transected and repaired with 6cm nerve grafts. Nerve grafts consisted of either isograft interposition (coaptation of 1cm isograft between two 2.5cm ANAs: Hybrid group) or ANA interposition control (coaptation of 1cm ANA between two 2.5cm ANAs: ANA group). At an endpoint of 20 weeks post surgery, EDL muscle force and mass was measured, and nerve was harvested for histomorphometry or staining for cellular senescence. Cellular senescence accumulation was quantified using senescence associated markers (SA- β -galactosidase, p16^{INK4A}, p53).

Results: In our initial studies, a limited number of axons regenerated across the hybrid (ANA-isograft-ANA) group reaching the distal nerve. Additionally, the hybrid group contained an ~36% increase in myelinated axon numbers when axons reached the mid-graft (isograft) compared to the proximal graft (ANA; 11,200 vs 8,230, respectively). In contrast, the ANA (ANA-ANA-ANA) group failed to facilitate axonal regeneration across the long graft, and axons arrested within the first ANA graft region. Neither experimental group achieved measurable muscle force production. Additional animal studies are underway to further power the study and assess cellular senescence accumulation.

Conclusions: The interposition of auto/isografts enhanced axonal regeneration across a long nerve gap reconstructed with primarily ANA. Additionally, the isograft portion promoted increased myelinated axon numbers suggesting axonal sprouting due to native Schwann cells. While axonal regeneration across the long hybrid graft was achieved, the outcome was still considerably worse compared to a sole, long auto/isograft based on our historic data.

P15. Assessment of Internet Information Available to Patients for Total Wrist Arthroplasty

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Introduction: Hand surgeons are performing an increased number of total wrist arthroplasty procedures. Despite the informed consent process between the patient and surgeon, patients will turn to the Internet for education regarding this procedure, and hand surgeons need to understand the information available. No studies have assessed the Internet information available to patients regarding total wrist arthroplasty. We hypothesize that information found on the Internet during a simulated patient search does not adequately address the core components necessary for an informed decision and is presented at too advanced of a reading grade level.

Methods: The search terms "total wrist arthroplasty" and "wrist joint replacement" were search-using Google, Bing, and Yahoo search engines. The top 25 websites for each search term were recorded for each search engine. This search was modeled to represent the patient experience. We used this to compile a list of unique websites for analysis (Figure 1). The websites were reviewed for authorship and a discussion of indications, contraindications, risks, benefits and alternatives. We noted this and additional information on a web-site review worksheet. The readability of the information was calculated using the Flesch-Kincaid score. A paired t-test was used for statistical analysis with $p < 0.05$ as significant.

Results: A total of 60 websites were analyzed. Authorship of the websites were 51.7% academic, 21.7% private, 13.3% industry sponsored and 13.3% other sources. The mean number of indications, contraindications, benefits, risks and alternatives are reported by website authorship (Table 1). There was no difference in the number of indications, benefits, risks and alternatives when academic websites were compared with the other website types. Academic websites provided more detailed discussion of contraindication ($P < 0.05$) compared with the other authorships. Of the academic websites, 28/31 provided indications, 9/31 discussed contraindications, 21/31 reported benefits, 17/31 identified risks, and 27/31 provided alternatives. Peer reviewed literature was only referenced on 54.8% of academic websites vs. 10.3% private, industry and other websites. Flesch-Kincaid score was 10.8 (range 6.8-12) with only 6.7% of websites written under an 8th grade reading level.

Discussion: Internet information available for total wrist arthroplasty does not adequately report the necessary information to help a patient make an informed decision. Academic websites do not provide better information than other website types. Peer reviewed references were scarce and information provided was above the understanding of the average patient. Hand surgeons should properly counsel patients and supplement poor information available on the Internet.

Figure 1 – Internet Search Methodology

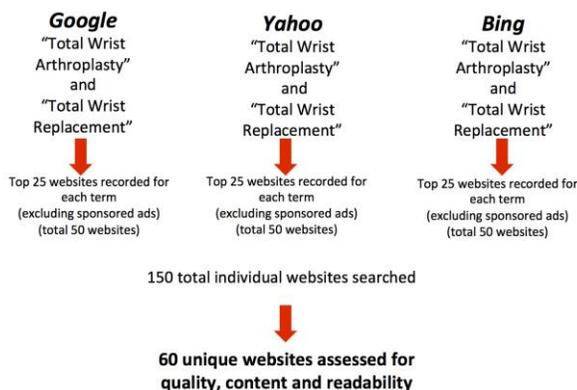


Table #1 – Breakdown of Authorship and Elements of Informed Consent

	# of Websites	Mean # Indications	Any Indications?	Mean # Contraindications	Any Contraindications?	Mean # of Benefits	Any Benefits?	Mean # of Risks	Any risks?	Mean # of Alternatives	Any Alternatives?
Academic	31 (51.7%)	1.9	28/31	1.1	9/31	1.7	21/31	2.1	17/31	1.4	27/31
Private	13 (21.7%)	2.2	11/13	0.1	1/13	2.1	10/13	1.6	5/13	2.5	10/13
Industry	8 (13.3%)	0.5	2/8	0.0	0/8	0.8	2/8	1.0	3/8	1.0	3/8
Other	8 (13.3%)	2.1	6/8	0.3	1/8	0.8	3/8	1.0	2/8	2.3	7/8

P16. One-Stage Treatment of Osteomyelitis for Digital Salvage using an Antibiotic Eluting Methylmethacrylate Joint-Stabilizing Spacer

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Introduction: Osteomyelitis of the digit is a challenging problem that can result in amputation particularly when the osteomyelitis involves the joint. The purpose of this retrospective study is to review 11 cases of osteomyelitis of the digit managed with a novel technique. Materials &

Methods: With IRB approval, we performed a retrospective review of 11 patients treated with placement of a joint-stabilizing, antibiotic eluting, methylmethacrylate spacer as a definitive one-stage treatment for digital osteomyelitis. The primary outcome was eradication of the infection[0] as defined by no recurrent infection at three months. Secondary outcomes included stabilization of the joint, functional status of the operated hand relative to individual goals, visual analog pain scale, wound characteristics, and radiographic outcomes. The patients were followed until resolution of infection and plateau in hand function.

Results: At a mean follow up of seven and a half months, all digits were successfully salvaged with the one-stage operation. Our data included patient ages ranging from 39 to 87 years old and involved either the distal interphalangeal, proximal interphalangeal or metacarpal phalangeal joints. Following intraoperative cultures, each patient was treated with broad spectrum intravenous antibiotic coverage. Antibiotic spacers eluted either tobramycin or vancomycin into the local area. No patient required removal of the spacer due to recurrent infection or joint instability and all patients regained a functional active range of motion. There were two minor complications: One patient experienced dysesthesia at the tip of the right middle finger that resolved with desensitization therapy. A second patient experienced a fracture of the spacer, but retained normal function and no further surgeries were required. In all subjects, the patients' goals of function were achieved.

Conclusion: We present an innovative treatment plan for osteomyelitis of the digit using an antibiotic eluting methylmethacrylate spacer. In eleven consecutive cases we were able to salvage the digit with preservation of functional outcomes.

P17. Midcarpal and STT arthritis in patients with CMC arthritis

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Background: CMC (carpometacarpal) arthroplasty provides well-documented pain relief with preservation of thenar function for the treatment of basal joint arthritis. Nevertheless, a segment of the population undergoing this procedure will continue to have pain following surgery. In addition to documented basal joint arthritis, the authors of this study hypothesize that some of these patients also suffer from unrecognized midcarpal arthritis. The prevalence of midcarpal arthritis in patients with basal joint arthritis is unknown. The goal of this study is to establish the prevalence of midcarpal arthritis in patients with CMC arthritis and/or STT arthritis. This data will allow hand surgeons to better prepare patients for the possibility of incomplete pain relief following CMC arthroplasty.

Methods: Patients with basal joint arthritis were identified using CPT code 716.94. Hand and wrist x-rays were retrospectively reviewed and graded using the Eaton, and Sodha classification for CMC arthritis. STT (scaphotrapezotrapezoidal) arthritis and midcarpal arthritis were graded using the Sodha classification for arthritis as follows, grade 1: no or nearly no arthrosis, grade 2: definite arthrosis but not severe, grade 3: severe arthrosis.

Results: 896 x-rays were reviewed. At the CMC joint, the average Eaton score was 3.14 ± 0.03 (mean \pm SEM) and the average Sodha score was 2.51 ± 0.02 . The mean Sodha score at the STT joint was 1.90 ± 0.03 for a 64% prevalence of STT arthritis in this population. The mean Sodha score at the midcarpal joint was 1.30 ± 0.02 for a 23.5% prevalence of midcarpal arthritis in this population.

For patients with an Eaton CMC grade of 1, the mean midcarpal Sodha score was 1.06 ± 0.03 ; for patients with an Eaton CMC grade of 2, the mean midcarpal Sodha score was 1.08 ± 0.02 ; for patients with an Eaton CMC grade of 3, the mean midcarpal Sodha score was 1.11 ± 0.03 ; and for patients with an Eaton CMC grade of 4, the mean midcarpal Sodha score was 1.47 ± 0.03 (Pearson Chi square value: 95.3, $p < 0.001$).

Conclusions: The prevalence of midcarpal arthritis in patients with basal joint arthritis is 23.5%. The presence of two types of pathology may explain persistent hand and wrist pain in this population despite CMC arthroplasty. Clinically, this data will allow hand surgeons to better educate patients with basal joint and midcarpal arthritis regarding the possibility of incomplete pain relief following CMC arthroplasty.

P18. A Biomechanical Comparison of Suture-Button Suspensionplasty and LRTI for Basilar Thumb Arthritis

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Introduction: The use of a suture-button (SB) suspensionplasty with trapeziectomy has been described in the treatment of basilar thumb arthritis as an alternative to the ligament reconstruction and tendon interposition (LRTI). Advocates of the suture button technique cite safety, ease of use, early mobilization, and good early results. However, it is not known how effectively the SB suspensionplasty withstands metacarpal subsidence under loaded conditions. The purpose of this study was to compare the initial strength of the LRTI procedure to SB suspensionplasty in preventing first metacarpal subsidence in a cadaveric model.

Methods: We used eight matched pairs of below-elbow cadaveric arms for this study. Each specimen was randomly assigned to either receive a trapeziectomy and LRTI (LRTI Group) or trapeziectomy and SB suspensionplasty (SB Group). Using previously described and validated testing protocols; physiological key pinch was simulated in each specimen. We then incrementally loaded only the thumb metacarpal from 5 to 20 pounds, using 5-pound increments. Metacarpal subsidence during physiological key pinch and incremental loading was determined using radiographic measurements of trapezoidal space height.

Results: The pre-loading trapezoidal space height did not differ significantly between the SB (11.9 mm) and LRTI group (13.7 mm, $p=0.4$). Metacarpal subsidence was evident at all testing loads in each group. After simulated physiological key pinch, the SB group had significantly greater trapezoidal space height compared to the LRTI group (8.0 mm vs. 5.5 mm, $p<0.05$). For each incremental metacarpal load from 5 to 20 pounds, the SB group had significantly greater trapezoidal space height than the LRTI group. Figure 1 demonstrates the decrease in trapezoidal height as a percent of the initial post-operative value for the SB and LRTI groups.

Conclusion: SB suspensionplasty is biomechanically superior in resisting metacarpal subsidence compared to LRTI in a cadaveric model following trapeziectomy.

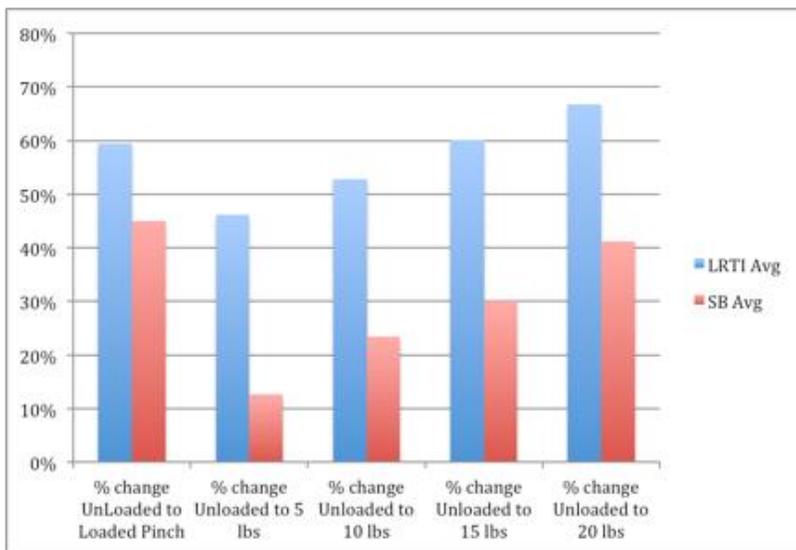


Figure 1: Comparison of average change in trapezoidal space height between the LRTI and SB group after simulated pinch and incrementally increasing axial loads to the first metacarpal. (Higher percentage indicates a greater loss of trapezoidal space height and collapse of the first ray).

P19. Venous Flaps for Revascularization and Soft-tissue Coverage in Traumatic Hand Injuries: A Comprehensive Review of the Literature

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Background: The use of venous flaps for simultaneous revascularization and coverage of soft tissue defects has been documented in the literature for over 30 years. The aim of this study was to conduct a comprehensive review of the literature and to perform meta-analysis of the outcomes of venous flaps in traumatic hand injuries.

Methods: A literature search of PubMed was performed with emphasis on venous flap use in traumatic hand injuries. The following search terms were combined as appropriate: vein graft, revascularization, venous flow through flap, arterialized venous flap, bypass, replantation, amputation, avulsion, trauma, injury, amputate, finger, hand and thumb. The initial search returned 1777 articles of which 43 met inclusion criteria. Articles were included if they demonstrated primary data and the use of a venous flap for revascularization in traumatic injuries distal to the wrist.

Results: The included articles described 563 venous flaps. The average age of subjects was 36.5 years, and the likelihood of partial loss of the flap increased with increasing age ($p=0.018$). The average number of anastomoses per flap was 2.34 with a range of 1 to 8. The anastomosis types were comprised of 452 arterio-venous flaps (AFV) with arterial inflow and venous outflow, 63 arterio-arterial flaps (AFA), 37 veno-venous flaps (VFV), and 7 retrograde venous flaps (FV). Concurrent analysis of all anastomosis types revealed no significant difference with respect to the following: complete flap survival (81.9% AFV, 77.8% AFA, 67.6% VFV, 88.8% FV; $p=0.26$), partial flap loss (13.0% AFV, 19.0% AFA, 21.6% VFV, 11.1% FV; $p=0.46$), and total flap failure (2.9% AFV, 3.2% AFA, 10.8% VFV, 0% FV; $p=0.139$). A flap covering multiple fingers had a higher rate of partial loss than a flap covering a single finger (46% vs. 14%, $p=0.016$). Flap size of 0-10 cm² resulted in a higher rate of complete failure (6.5%; $p=0.02$) compared to a flap size of 10-25 cm² (1.1%) and those greater than 25 cm² (2.5%); however, flap size had no significant effect on partial loss ($p=0.256$).

Conclusions: Older patients have a higher likelihood of partial venous flap loss, but the type of anastomosis has no effect on flap survival. If multiple digits require coverage, a single flap per digit should be considered. Flaps smaller than 10 cm² had the highest incidence of total flap failure; however, medium to large venous flaps had few total flap failures and can be used reliably for traumatic defects of the hand.

P20. Epidemiology of Medial Ulnar Collateral Ligament Reconstruction: A 10-Year Study of New York State

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Background: Despite an increase in the prevalence of medial ulnar collateral ligament (UCL) reconstruction of the elbow in professional baseball and popularity within the media, there are no population-based studies examining the incidence of UCL reconstruction.

Purpose: To examine the epidemiological trends of UCL reconstruction on a statewide level over a 10-year period. The primary endpoint was the yearly rate of UCL reconstruction over time and secondary endpoints included patient demographics, institution volumes and concomitant procedures on the ulnar nerve.

Methods: The New York Statewide Planning and Research Cooperative System (SPARCS) database contains records for each ambulatory discharge in New York State. This database was used to identify all UCL reconstructions in New York State from 2002 to 2011 using the outpatient CPT-4 (*Current Procedural Terminology, Fourth Revision*) code. Patient age, sex, ethnicity, insurance status, associated procedures and hospital volume were assessed.

Results: There was a significant yearly increase in the number of UCL reconstructions ($p < 0.001$) performed in New York State from 2002 to 2011. The volume of UCL reconstructions increased by 193% and the rate per 100,000 population tripled from 0.15 to 0.45. The mean age was 21.6 years ($SD \pm 8.89$) and there was a significant trend for an increased frequency in UCL reconstruction in 17-18 and 19-20 year-olds ($p < 0.001$). Males were 11.8 times more likely to have a UCL reconstruction than women ($p < 0.001$) and individuals with private insurance were 25 times more likely to have a UCL reconstruction than those with Medicaid ($p = 0.0014$). There was a 400% increase in concomitant ulnar nerve release/transposition performed over time in the study period, representing a significant increase in the frequency of ulnar nerve procedures at the time of UCL reconstruction ($p < 0.001$).

Conclusion: The frequency of UCL reconstruction is steadily rising in New York State and becoming more common in adolescent athletes. Emphasis on public education on the risks of overuse throwing injuries and the importance of adhering to preventative guidelines is essential in youth baseball today.

P21. Locked Plating for Phalangeal "Pilon" Fractures: Volar, Lateral, Dorsal

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Introduction: Phalangeal “pilon” fractures have historically been treated with dynamic traction external fixation, yielding suboptimal and unpredictable clinical outcomes characterized by stiffness, malunion, and a higher rate of complications compared to other fracture patterns in the hand. Advances in plate technology and a unique volar surgical approach have allowed the application of small-sized, customizable, locking plates to these difficult fractures.

Materials & Methods: The study is a retrospective consecutive case series of forty patients (29 male, 11 female) with an average age of 39 years treated with locked titanium plates (0.6 mm thickness) and 1.5 mm diameter screws for phalangeal “pilon” complete articular fractures involving 5 index, 9 long, 14 ring, and 12 small fingers. The fracture was approached and the plate applied from the position of greatest comminution and axial collapse: 24 volar, 11 lateral, 5 dorsal. The volar approach uses a hemi-Bruner incision and partially reflects one slip of the FDS tendon to allow application of the longitudinal limb of the plate. Early active motion supervised by a hand therapist was initiated within a week of surgery; assisted motion was added after 3 weeks. Cases were followed until the point of measurable plateau in range of motion, mean 13 weeks. Objective measurements and final DASH scores were statistically compared between the 4 digits and between the 3 approaches using ANOVA, with a p-value of < 0.05.

Results: All fractures healed clinically and radiographically by 6 weeks. There were no cases of hardware failure, infection, tendon rupture, or wound dehiscence. Two patients required subsequent tenolysis. The mean DASH score at final evaluation was 12. Mean active range of motion values at final evaluation were: PIP flexion 93 degrees, PIP extension -5 degrees, DIP flexion 53 degrees, DIP extension -1 degree. The mean articular step-off was 0.1 mm. The mean articular gap was 0.02 mm. Mean coronal mal-alignment of the shaft to the articular surface was 1.2 degrees. There were no statistically significant differences between the 4 fingers or the 3 different approaches.

Conclusion: Locked plating of phalangeal “pilon” fractures produces favorable range of motion results compared to the historical literature using dynamic traction external fixation. Unlike dynamic traction, locked plating demonstrates a high level of consistency in maintaining the fracture reduction, a low average DASH score, and no strategy specific complications.

P22. The Congruency of Radius of Curvature in Type 1. and 2. Lunates in Cadaver specimens

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Introduction: Proximal row carpectomy (PRC) is a treatment option for various wrist arthritides. It has been suggested that when the lunate is excised, there is a mismatch with respect to the radius of curvature between the capitate and the lunate fossa of the distal radius. This mismatch is proposed to lead to failure of a PRC with subsequent progressive disease. The purpose of this study is to compare the articular morphology (radius of curvature) of the capitate in cadaveric wrists with type 1 and type 2 lunates.

Methods: Twelve specimens were used for a total of twenty wrists. Two groups were created based on type of lunate, group 1 wrists had type 1 lunates, and group 2 wrists had type 2 lunates. A NextEngine 3D scanner was used to create three-dimensional images (Figure 1) of each lunate and corresponding capitate bone. The scanned images were analyzed using the Rapidform XO V program in order to calculate radius of curvature.

Results: The specimens were 70% male and the average age was 50 +/- 10 years. A priori power analysis was performed using an effect size determined from a prior study. This analysis showed that we needed 9 total wrists to achieve a minimum power of 0.80. There were no statistical differences in age, gender and BMI between the two groups, p=0.06, 0.107, and 0.16 respectively. When the mean radii of curvature of capitates to lunates was compared, using paired t-test, there was a statistically significant difference, p=0.015. Likewise, the mean ROC of lunates in group 1, 0.113 +/- 0.01 was statistically different from lunates in group 2 which was 0.088 +/- 0.01, p=0.024. In group 2 (type 2 lunates) the mean radius of curvature between capitates and lunates showed a statistical difference in size, p=0.021. The lunate: capitate ratio in group 1 compared to group 2 showed no significance, p=0.531.

Conclusion: This cadaveric anatomical study has shown that in wrists with a type 2 lunate, the mean ROC is statistically different between capitates and lunates. This implies that more translational force could be applied to capitates, due to smaller radii of curvature, compared to lunates. Based on the data proximal row carpectomy may prove to be a better treatment option for patients with type 1 lunates, as the articular surface in these wrists are more comparable between capitates and lunates.

P23. Office-Based "Wide-Awake" Postaxial Polydactyly Excision in Infants and Children

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Introduction: In adult hand surgery literature, there are multiple publications highlighting the successful use of "wide-awake" hand surgery in the treatment of hand conditions. There are few instances of wide-awake hand surgery in the pediatric population present in the literature. Polydactyly of the hand is one of the most common congenital hand malformations. We present a case series of successfully performed in-office surgical excision of the Type B post-axial polydactylous digit in infants and children. The added healthcare utilization improvements by performing this in the office, as well as lack of exposure to general anesthesia and decreased parental anxiety are reviewed.

Methods: A retrospective review of the patients treated was completed and the technique of in-office excision documented.

Results: Over a 15 month period, a total of twenty-six children were treated in the office for post-axial polydactyly. The average age of the child at the time of excision was 3.3 months old, with a median of 1.4 months with a range of 9 days to 4.2 years. There were no post-procedure complications in function or sensation.

Conclusion: We report a case series of successful surgical excision of Type B post-axial polydactyly in newborns, infants, and children in a wide-awake manner in the office setting with the use of lidocaine with epinephrine. This technique is a cost-conscious approach to the condition without the need for general anesthesia. Further, this results in decreased parental anxiety. This demonstrates excellent results with improved safety without sacrificing quality.

P24. Cost and Efficiency Analysis of Percutaneous Fixation of Hand Fractures in the Main Operating Room Versus the Ambulatory Setting in Canada

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Background: Hand fractures are the second most common fractures and are a significant cause of morbidity. Definitive treatment of reducible but unstable fractures may involve closed reduction internal fixation (CRIF). To date, there have been no studies identifying the cost differential for performing CRIF of hand fractures in the operating room (OR) versus an outpatient clinic setting under field sterility. Our goal was to analyze the cost and efficiency of performing CRIF in these two settings and to document current practice trends in Canada.

Methods: A detailed cost analysis of the salaries of personnel involved both directly and indirectly in the CRIF of a hand fracture, including the material and hospital fees, was conducted using available fee codes and wages. Hospital statistical records were used to calculate efficiency, including average operative and turnover time. A survey was distributed to practicing plastic surgeons across Canada regarding their current practice of managing hand fractures.

Results: The average wait time at our institution for hand fracture CRIF in the OR is 3 days versus 0 days in an ambulatory care setting. According to institutional averages, it takes 90 minutes to perform a hand fracture CRIF in the OR, including set-up and cleanup. There is an average 25-minute turnover time between cases. Thus, in an 8-hour surgical block, we are able to perform approximately five K-wire fixations in the OR. In an outpatient setting, we are able to perform approximately eight cases in the same 8-hour block. The costs of performing a K-wire fixation of a hand fracture in the main OR under local anaesthetic is \$449.77 CDN compared to \$86.42 CDN in the ambulatory setting. The use of a regional block increases the cost to \$653.24 CDN.

The final results of the online survey are pending.

Conclusion: The use of the main OR for K-wire fixation of hand fractures under a regional block or general anesthetic leads to a significant increase in cost and hospital resources compared to the use of an outpatient ambulatory setting under local anaesthetic. This doesn't take into account patient travel costs, or costs for anaesthetic drugs. There is decreased efficiency when performing CRIF in the OR, with longer turn around time, and many more health professionals involved in the peri-operative care. We conclude that for appropriately selected hand fractures, CRIF in a clinic setting is more cost effective and efficient compared to the main OR.

P25. The Treatment Of Ruptures Of Multiple Extensor Tendons At Wrist Level By Using Each Reversed Extensor Digitorum Communis (Edc) Half-Slip Tendons Of Proximal Stump In The Rheumatoid Hand

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Introduction: In rheumatoid arthritis (RA), rupture of extensor tendons often occurs in multiple fingers. Direct repair was usually impossible because of retraction, shortening of the muscle. However, we tried to reduce the tendon gap and repair directly by using each reversed EDC half-slip tendons of proximal stump. In this study, we evaluated our surgical repair outcome.

Material and Methods: Of 4 RA patients (3 females, 1 male) who underwent surgery for total EDC tendon ruptures between 2012 and 2015. The mean age at surgery was 67 years (range, 59 to 71). The mean period from symptom of total drop fingers to surgery was 58days (range, 29 to 97).The mean follow-up period after the surgery was 2.0 years (range, 1 to 3). Our treatment consisted of synovectomy, wrist arthroplasty by Sauve-Kapandi's procedure, tendon end-to-end interlacing suture using each reversed 5cm EDC half-slip tendons of proximal stump, and repaired tendon was sutured side-to-side each other. Active exercise of the fingers was started immediately after the surgery. Surgical outcomes were evaluated on the basis of patient's satisfaction and the range of motion (ROM) of the MP joint and wrist.

Results: Three patients (75%) were highly satisfied and one (25%) was satisfied with surgical outcomes. The mean MP joint active extension was 1.7°(range , 0 to 5). The mean MP joint active flexion 78.3°(range, 65 to 83). In all cases, wrist flexion ROM was limited more than 15°compare to non-surgical wrist, but no one complained of activity of daily living(ADL) disturbance.

Conclusions: For multiple extensor tendon ruptures of rheumatoid hand, our tendon reconstruction procedure led to almost full finger extension function without damage of other intact tendon and active finger ROM exercise could start soon after surgery.Full finger flexion also obtained in all cases. Although limitation of wrist flexion ROM were observed, no one complained of ADL disturbance.

P26. Use of Integra Dermal Matrix in the Treatment of Combat Related Upper Extremity Soft Tissue Injuries

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¹Walter Reed National Military Medical Center, Bethesda, MD; ²Uniformed Service University of the Health Sciences, Bethesda, MD; ³The Ohio State University, Wexner Medical Center, Columbus, OH

Introduction: This is a retrospective review of patients with severe upper extremity combat wounds treated with Integra placement and autologous skin grafting.

Methods: Active duty patients treated with Integra Dermal Matrix for traumatic injuries of the upper extremity were identified in our local surgical scheduling system. All wounds were treated with a standard protocol of serial debridements until clean, continuous negative pressure wound therapy after application of Integra, and placement of splitthickness or fullthickness skin grafting after Integra incorporation. The primary outcome was wound healing. Percentage take of skin grafts was assessed as a secondary outcome. Univariate analysis (MannWhitney U test for continuous variables and Fischer Exact test for categorical variables) was used to examine the effects of demographic and injury factors on healing rates.

Results: A total of 61 patients (69 wounds) met inclusion criteria. Mean age was 24.6 years, all were male, and 48% reported a preinjury history of tobacco use. Most patients sustained blast injuries. Six wounds were clinically infected with positive cultures all were treated with targeted antibiotic therapy and underwent successful skin grafting without recurrence of infection or graft failure. Median wound size was 56 square centimeters. 74% of wounds required a single application of Integra, 24% required a second and one wound required a third. Sixteen wounds were treated with full-thickness skin grafting. No wounds became infected during treatment and all healed successfully with primary skin grafting. A total of 53 wounds were treated with splitthickness skin grafting. Among those, 49 of the 53 wounds had initial take assessed as greater than 95%: all went on to heal without incidence. Two wounds had graft take between 70% and 90%; they were treated with local wound care and went on to heal. Two skin grafts failed. On univariate analysis no association was found between failure to heal and wound size, wound location, presence of an open fracture, infection, number of operative debridements, time from injury to definitive closure, or any demographic factor.

Conclusion: Within our cohort, 97% of combat-related upper extremity wounds healed after treatment with serial debridement, Integra placement, and autologous skin grafting. We believe that this study validates the use of Integra in the treatment of upper extremity soft tissue wounds. Further study is needed to assess the longterm functional outcomes of Integra treatment relative to traditional reconstructive procedures.

P27. Current Trends in Operative Techniques for Scaphoid Non-union: A Survey of Hand Surgeons

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Purpose: With the number of procedures available for the surgeon, surgical treatment of scaphoid non-union remains varied and controversial. The purpose of this study was to collate current trends in operative techniques used by hand surgeons for the treatment of scaphoid nonunion.

Methods: Members of the ASSH were surveyed via email. We created a set of 6 multiple choice questions regarding their treatment preferences in scaphoid nonunion procedures. We asked how long surgeons have been practicing, surgical approach, assessment scaphoid vascularity, bone graft preferences, fixation methods, and additional modalities used. Statistical analysis of surgical preferences was presented as frequency- adjusted mean \pm standard error with differences between groups calculated using t-test and chi-square test. The level of significance was $\alpha = 0.05$ for all tests.

Results: Of the 1681 active members of ASSH, 315 responses were received (18.7% response rate). Regarding surgical approach, open palmar was most common at 58% followed by open dorsal at 34%. 7% used percutaneous and less than 1% arthroscopic. For vascularity assessment, 78% use MRI, 67% intraoperative bleeding, 47% radiographs, 16% CT, 2% histology. For bone graft, 50% use distal radius non-vascularized, 23% use iliac crest non-vascularized, 18% 1,2 SRA, <1% medial femoral condyle, 8% other (volar carpal artery, capsular based, olecranon). Headless compression screws were the most common bone fixation method at 78%, followed by K wires in scaphoid only at 10%, screw plus K wires 9%, plate 1.3%. Additional modalities used to augment healing were electrical stimulation 40%, ultrasound 35%.

Conclusions: As expected, there is a wide range of treatment preferences for scaphoid nonunion. Progression in novel techniques reported in the literature as well as evolution in surgical training may in part help explain the varying preferences for scaphoid non-union techniques. Future studies will aim to assess the effect on outcome based on the differing preferences for treating scaphoid non-union.

P28. Assessment of Postoperative Pain and Narcotic Usage by Automated Mobile Phone Software: A Pilot Study

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Introduction: Patient-reported outcome (PRO) instruments are integral in evaluating orthopaedic treatments and outcomes. Mobile phone use is high in the United States at 85% of the adult population and we recognize that mobile phones and software algorithms enable health care systems to communicate with and evaluate patients outside of traditional hospital settings. This investigation is the first attempt to validate text message or software driven delivery of orthopaedic PRO instruments (12-Item Short Form Health Survey (SF-12) and short form of the Disabilities of the Arm, Shoulder and Hand (QuickDASH)) on mobile phones. We hypothesized there would be a high correlation between PROs collected by automated delivery of text messages on mobile phones compared to paper delivery.

Materials & Methods: Written versions of the SF-12 and the QuickDASH were completed by patients in orthopaedic hand and upper extremity clinic. Over the next 48 hours, the same patients also completed the mobile phone portion of the study outside of the clinic which included software driven, automated text message delivery of the SF-12 and QuickDASH, assigned in a random order. Correlations between written and text message delivery of the two PROs were assessed. Based on a power analysis (80% power, alpha 0.05), 39 patients were required to detect an intraclass correlation coefficient (ICC) value of 0.8 (excellent reproducibility) distinguishable from 0.6 (fair reproducibility).

Results: Seventy-two patients were enrolled in the investigation. Completion rates for mobile phone delivery of QuickDASH and SF-12 were 75% and 77% respectively. There were no significant differences in patient demographics between completers and non-completers of SF-12 or QuickDASH delivered by mobile phone. The ICC between the written and mobile phone delivery of QuickDASH was 0.91 (95% CI: 0.85-0.95). The ICC between the written and mobile phone delivery of the SF-12 physical health component summary was 0.88 (95% CI: 0.79-0.93) and 0.86 (95% CI: 0.75-0.92) for the SF-12 mental health component summary.

Conclusion: Text message delivery using mobile phones permits valid assessment of SF-12 and QuickDASH scores. The findings suggest software driven automated delivery of text communication to patients via mobile phones may be a valid method to obtain other PRO scores in orthopaedic patients. The results also suggest that appropriately designed software and mobile phone technology platforms may be utilized to communicate with patients outside of the hospital setting, and we emphasize the need for further inquiry in this area.

P29. Modification of Sauvé-Kapandji Procedure for the Treatment of DRUJ Arthritis

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Purpose: The authors modified the original Sauvé-Kapandji (S-K) procedure of 1 cm leaving and 1 cm resection of distal ulna to 2 cm leaving and 2 cm resection, and experienced good results without the distal ulna-radius impingement or distal ulna instability.

Materials and Method: The clinical results of 28 patients with modified S-K procedure for the treatment of DRUJ arthritis or instability, were reviewed (9 male and 19 female). Modified S-K technique is defined as 2 cm ulna head arthrodesed to the distal radial sigmoid notch, and 2 cm gap is created with the resection of ulna proximal to the remained ulnar head. So, the distal tip of proximal ulna is leveled approximately 4 cm proximal to the level of distal radius articular surface. The arthrodesis of distal radio-ulnar joint was done using a cancellous screw with an additional Kirschner wire, occasionally. At last follow-up, radiological evaluations and the range of motion were checked.

Results: The average remained ulna head was 21 mm and the gap was also 21 mm in length. The postoperative distance between the distal tip of ulna and radius was 9 mm in average, and the final distance was 7.8 mm. The preoperative pronosupination ranges of motion of wrist were pronation 28° and supination 33°, and at last follow-up, pronation 70° and supination 65°. There were no ulno-radial impingement symptoms in these patients at last follow-up, clinically and radiologically.

Conclusion: We think the above good result of the modified S-K procedure as because of the widened initial distance between the tip of distal ulna and radius, which is interposed with the radioulnar membrane and other soft tissues, such as muscles. The interposed soft tissues prevent the impingement between ulna and radius, even though allowing the instability of the distal tip of ulna.

P30. Dupuytren's Management Trends: A Survey of Members of the American Society for Surgery of the Hand

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Introduction: Indication for intervention in Dupuytren's disease is influenced by many factors including location and extent of disease, surgeon preference and comfort level with different techniques. The aim of this study was to determine current Dupuytren's disease management trends.

Materials and Methods: A questionnaire was sent to members of the American Society for Surgery of the Hand in which participants were queried on their current Dupuytren's management practices. The survey requested respondent demographic data, practice type and resident and/or fellow involvement. Questions focused on indications for different procedural interventions based on location of disease, age and activity level of the patient. We also aimed to determine whether cost or available evidence affected practice patterns.

Results: 638 of 2676 (23.8%) active ASSH members completed the survey. Respondents were most commonly part of a group private practice (58.1%) followed by academic (18.5%) and solo practice (11.1%). The majority of respondents did not work with residents or hand surgery fellows (54.4%). Orthopedic surgeons comprised the majority of the cohort (81.6%) followed by plastic surgeons (14.1%) and general surgeons (5.9%). Seventy-six percent of respondents reported seeing 10 or less Dupuytren's patients per month. Thirty-nine percent of respondents performed needle aponeurotomy for Dupuytren's disease and 65.5 % reported using collagenase. Respondents preferred collagenase (48.3%) over needle aponeurotomy (24.6%) and limited fasciectomy (20.9%) for primary Dupuytren's disease involving only the MP joint. Limited fasciectomy (39.4%) was the preferred treatment for primary Dupuytren's disease involving the MP and PIP joints. Eighty-one percent of the respondents felt that there is sufficient evidence for the use of collagenase though 51.3% of the cohort felt that the cost of collagenase was not worth the benefit. For a patient amenable to any treatment option, the majority (42.9%) would use collagenase though 87.1% felt that fasciectomy offered the longest disease-free survival. When analyzed by board certification, 60.6 % of plastic hand surgeons use collagenase compared to 63.3 % percent of orthopedic hand surgeons. For a patient amenable to any surgical option, orthopedic hand surgeons prefer collagenase injection (38.8%) whereas plastic hand surgeons prefer a limited fasciectomy (33.7%).

Conclusions: There are several options available for the treatment of Dupuytren's contractures. This survey study details current practice patterns among members of the American Society for Surgery of the Hand and supports the need for further comparative studies with respect to location and severity of disease, time to contracture recurrence, and cost of treatment.

P31. Improved Surgical Outcomes with Endoscopic Carpal Tunnel Release in Patients with Severe Median Neuropathy

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Introduction: Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment. CTS symptoms range from mild to severe, and are managed by either endoscopic (ECTR) or open (OCTR) carpal tunnel release. Currently, severe CTS is more commonly treated with OCTR. However, little is known regarding the efficacy and safety of ECTR for severe CTS. In this study, we evaluated the role of ECTR in severe CTS.

Methods: This is a retrospective cohort study of patients with severe CTS who underwent either ECTR or OCTR. We defined severe CTS with electrodiagnostic parameters: complete block of median nerve sensory response and motor response $< 4\text{mV}$ with latency $> 6.45\text{ms}$. The primary outcome variable was patient reported complete resolution of pre-operative CTS symptoms at last recorded follow-up. Secondary variables included rate of complications and recurrence/reoperations. Outcome variables were assessed by a 'blinded' reviewer who had no knowledge of pre-operative diagnostic information.

Results: We identified 138 cases of severe CTS. 28.3% ($n = 39$) were treated with ECTR and 71.7% ($n = 99$) with OCTR. The cohorts were similar in terms of demographics and comorbidities. Patients treated with ECTR had complete resolution of CTS symptoms in 81.6% of cases while those treated with OCTR had complete resolution in 39.0% ($p < 0.001$). In the ECTR cohort, complications ($n = 0$; 0%) and recurrence ($n = 2$; 2.6%) were both rare. In the OCTR cohort, complications ($n = 2$; 2.0%) and recurrence ($n = 10$; 10.1%) were more common. Reoperation was required in 4.0% ($n = 4$) of OCTR cases and 0% ($n = 0$) of ECTR cases.

Conclusions: ECTR is a safe treatment option for patients with severe CTS. Moreover, our data indicates that ECTR is at least as effective as OCTR in remediating pre-operative CTS symptoms in patients with severe CTS. Although further, high level-of-evidence studies are needed, surgeons should consider ECTR when discussing treatment options for severe CTS.

P32. Sources of Variation in Flexor Tendon Repair Stiffness Measurements

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Introduction: There is a large variation in reported flexor tendon repair stiffnesses within the same technique and a lack of uniformity in stiffness calculations. This study evaluates the importance of included tendon length and gap presence in repair stiffness calculation.

Materials and Methods: Seven cadaveric flexor digitorum profundus tendons were transected in Zone II and repaired with a 4-strand cross-stitch cruciate technique (4-0 braided suture, no epitendinous stitch). A tensile testing machine displaced the tendon ends at 0.5mm/s. Cameras tracked markers attached in a 50mm line, centered on the transection site. Gap formation was determined from video. Ten regions, 4 to 40mm in length and centered at the injury site, were formed to ensure consistent comparison of regions between specimens. Stiffness was calculated as the slope of the linear portion of the force-displacement curve for all ten regions both before and after gapping. Repeated measures ANOVA determined whether region length or gap formation significantly affected stiffness. Significant results were compared with Tukey's Method (95% confidence interval).

Results: Pre-gap repair stiffness was significantly larger than post-gap repair stiffness ($p < 0.01$). Repair stiffness calculated over 4mm was significantly larger than repair stiffness calculated over 32mm or more ($p = 0.036$). Pre-gap repair stiffness calculated over 4mm was significantly larger than pre-gap repair stiffness calculated over 12mm or more and all post-gap lengths ($p = 0.041$).

Conclusions: Prior to gap formation when bunching was present, measurements showed infinite stiffness at the transection site where the transected ends stayed in contact and from there, decreasing stiffness up to the repair zone edge (Figure 1). From the repair zone edge outwards, the pre-gap stiffness was nearly constant because the undamaged tendon's stiffness outside the repair zone was much higher than the repair stiffness.

Post-gap stiffness was nearly constant across all regions because the tendon within the repair zone was stress free and not bunched, remaining in a fixed configuration while the underlying suture stretched with increasing load. The tendon outside the repair zone was much stiffer than the suture within, so its deformation was negligible compared to the suture causing markers to translate uniformly and stiffness to be constant.

Repair stiffness can be misleading; studies should describe the length over which the stiffness is calculated and the presence of repair bunching or gap formation.

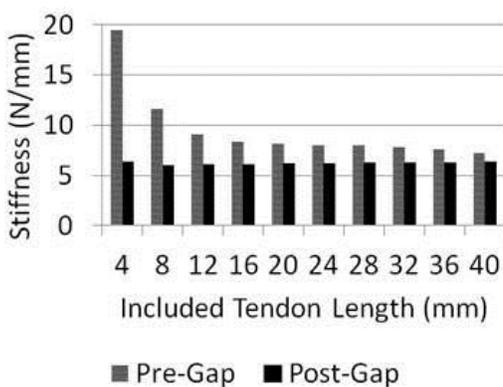


Figure 1: Average pre- and post-gap stiffness as a function of tendon length included in the stiffness calculation

P33. The Krukenberg Procedure in the Pediatric Patient: A Case Series

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Background: The loss of a hand has devastating consequences on one's functional independence, and reconstruction after hand amputation is limited, especially in the pediatric population. Commonly, pediatric hand amputees are limited to prosthetic use, but these are difficult to use due to the lack of proprioception and need for frequent adjustments. Because of this, many unilateral amputees choose to forgo prosthetic wear. The Krukenberg operation provides children with hand absence a useful and sensate pincer mechanism that is helpful for activities of daily living. Authors have described the technique of separating the radius and ulna through the interosseous membrane to the level of the pronator teres to create this sensate pincer grasp. Historically, this procedure has been reserved for blind bilateral amputee patients or in areas where prosthetic devices are unavailable. In this series, we present the long-term follow up of pediatric patients who have undergone the Krukenberg procedure for either congenital or traumatic hand deficiencies.

Methods: We performed a retrospective chart review of patients who underwent the Krukenberg procedure at a single institution. Patient demographic, pre-operative, operative and post-operative data were examined.

Results: From 1987 to 2013, we identified 7 consecutive pediatric patients who underwent the Krukenberg procedure for hand amputation. Indications for surgery included congenital transverse limb deficiency (n=4) and traumatic amputation (n=3). Average follow up was 4.4 years (range: 2 to 10 years), and all patients (n=7) were male. None of the patients were blind. Complications included skin breakdown (n=2) and heterotopic ossification (n=1). Overall, the patients did well and were able to use the Krukenberg to perform activities of daily living.

Conclusion: In this series, we demonstrate the feasibility and safety of performing the Krukenberg procedure in pediatric patients. In certain populations where there are limited resources for prostheses, this procedure offers the patient functional independence with a sensate upper extremity capable of prehension. The biggest disadvantage of this operation is its appearance.

P34. Comparison of MRI vs Ultrasound for Gap Assessment After Flexor Tendon Repair: A Cadaveric Study

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Introduction: Clinical exam is important in the assessment of tendon repair however adhesions, callous at the repair site, and recurrent rupture may be difficult to differentiate clinically. Following tendon repair, the ideal imaging modality for accurate detection of repair failure has not been determined. It is unknown how various suture materials and gapping at the tendon repair site interfere with MRI and ultrasound imaging.

Methods: 48 digits (thumbs excluded) from 12 matched fresh-frozen cadaver upper extremities were used. The FDP was transected in Zone 2, and a 4-strand locked cruciate repair was performed. Repairs were randomized to 3 gap sizes (0mm/no gap, 2mm, and 4 mm) and to suture type (4-0 Fiberwire, 4-0 Ethibond, or 4-0 Prolene). Specimens were evaluated by 1.5T MRI, 3 T MRI, and high-resolution ultrasound with the digits and wrist maintained in full extension. Images were interpreted by a board certified musculoskeletal radiologist and ultrasonographer both blinded to gap and suture material used in the repair. Gap measurements were compared using regression and GEE models. Gaps not measured confidently due to artifact were excluded. Generalized estimating equations (GEE) were used to compare predictors of error and measurability. McNemar's test for paired data compared predictability between groups. Error was plotted by imaging technique, gap, and suture type using boxplots. Lin's concordance correlation coefficient determined interobserver agreement between imaging techniques.

Results: Multivariate regression indicates that imaging method and gap are responsible for observed differences in accuracy and number of measurements that could be made. 1.5T MRI had less artifact and thus less images had to be excluded from measurement when compared to 3T MRI ($p=0.11$). Ultrasound had significantly less artifact than both MRI modalities ($p=0.001$ and 0.006 respectively), but accuracy in determining smaller gap sizes (0 and 2mm) was sacrificed and less than both MRI types. For larger gap sizes (4 mm), all 3 modalities underestimated the gap. Suture type did not have a significant impact on measurement error between imaging modalities.

Conclusions:

1. Suture type does not appear to affect measurement error as much as gap size and imaging modality.
2. Measurement of large gaps has more error (underestimation) for all 3 imaging modalities, with ultrasound being inferior to MRI.
3. Due to artifact, MRI renders fewer analyzable images compared to ultrasound, but accuracy of MRI is superior to ultrasound for smaller gaps (<4mm)
4. Further clinical work in this area is ongoing including investigation of MR protocols and sequencing.

P35. Factors Associated with Operative Treatment of Enthesopathy of the Extensor Carpi Radialis Brevis Origin

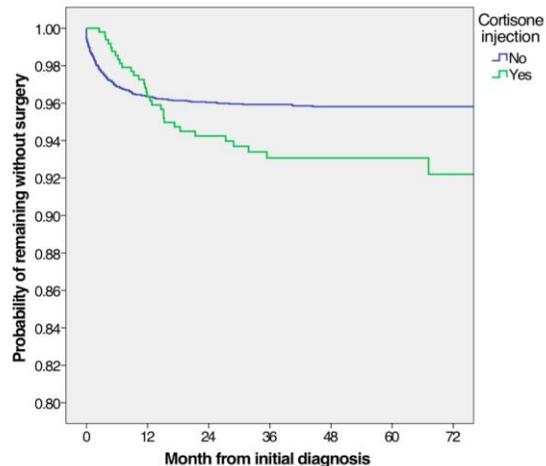
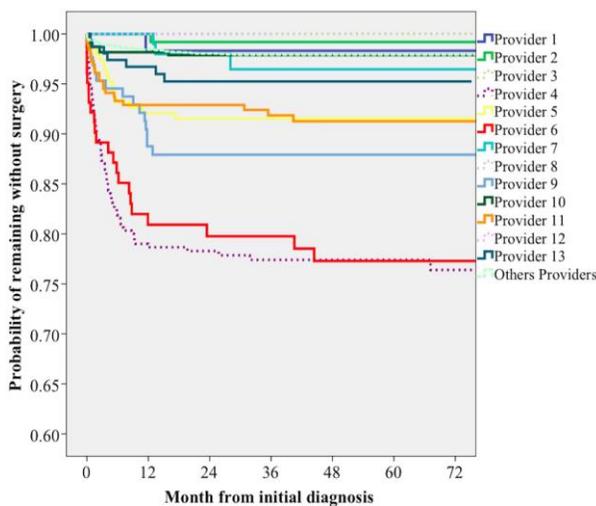
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Introduction: We aimed to study the factors associated with variation in the rate of surgery for enthesopathy of the extensor carpi radialis brevis (eECRB).

Methods: We used a large database from 3 hospitals including 5964 patients with diagnosis of eECRB from 2001 to 2007. Of those, 244 (4%) patients had surgery for eECRB. We used the date of the first encounter as the date of diagnosis. We also recorded the date of first injection and surgery for eECRB. Accounting for the time elapsed from diagnosis to surgery (event), we used Cox multivariable regression analysis to find factors associated with surgery for eECRB. We considered the following explanatory factors: age, sex, race, diabetes, a diagnosis of major depression, a diagnosis of an anxiety disorder, hospital, provider (surgeon vs. non-surgeon), corticosteroid injection, and the time from diagnosis to first cortisone injection.

Results: The odds of having surgery were 12 times greater if the initial provider was an orthopedic surgeon rather a non-surgeon. The odds of having surgery were 1.7 times greater at one of the two hospitals. Younger age was also associated with surgery. There was a substantial variation in the rate of surgery among providers ranging from zero to 22% with the highest and lowest rates both orthopaedic surgeons. Corticosteroid injection delayed the time to surgery, but was ultimately associated with a higher rate of surgery. The vast majority (86%) of surgeries were done within the one year of the first documented office visit for this diagnosis.

Conclusion: Given the substantial variation in surgery for eECRB by provider, methods for ensuring that patient preferences have a greater influence on decision-making (e.g. decision aids) merit additional study.



P36. Outcome Assessment after Aptis Distal Radioulnar Joint (DRUJ) Implant Arthroplasty

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Introduction: Conventional treatments after complicated injuries of the distal radioulnar joint (DRUJ) such as Darrach and Kapandji-Sauvé procedures have many drawbacks, which may eventually lead to a painful unstable distal ulna. The development of DRUJ prosthesis has significantly evolved over the past years. In this study, we assessed the outcome results of patients after DRUJ implant arthroplasty using the Aptis (Scheker) prosthesis.

Methods: We identified 13 patients with 14 prosthesis during the past 10 years. Patients underwent DRUJ arthroplasty due to persistent symptoms of instability, chronic pain, and stiffness. Records and follow-up visits were reviewed to find the final post-operative symptoms, pain, range of motion, and grip strength with a mean follow-up of 12 months (range: 2-25 months). Also, patients were contacted prospectively by phone in order to administer the disabilities of the arm shoulder and hand (DASH), patient rated wrist evaluation (PRWE), and visual analogue scale (VAS), and to interview regarding satisfaction and progress in daily activities. Eleven patients out of 13 could be reached with a median follow-up time of 60 months (range: 2 to 102 months).

Results: No patient required removal of the prosthesis. Only two patients underwent secondary surgeries in which both required debridement of the screw tip over the radius. The median DASH score, PRWE score, VAS, and satisfaction were 1.3, 2.5, 0, and 10, respectively. The mean range of flexion, extension, supination, and pronation was 62, 54, 51, and 64, respectively.

Discussion: Distal radioulnar joint injuries are disabling and patients usually undergo one or more salvage surgeries prior to receiving an arthroplasty. The prosthesis has shown satisfactory results with 100% survival rate in all reports. The constrained design of this prosthesis gives enough stability to prevent painful subluxation.

P37. 30-Day Readmission after Pediatric Upper Extremity Surgery: Analysis of the NSQIP-P Database

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Introduction: With increasing focus on cost reduction and quality of health care delivery, 30-day readmission rates serve as a key parameter to assess quality of patient care. There is no reference in the pediatric literature that characterizes readmission rates after upper extremity surgery. The ACS NSQIP-P (American College of Surgeons National Safety Quality Improvement Program-Pediatric) database provides a unique opportunity to confirm safety of upper extremity surgery in the pediatric population and to identify risk factors for re-admissions. The goal of this study is to determine the incidence and risk factors for complications, re-operations, and 30-day unplanned readmission after pediatric upper extremity surgery.

Methods: Retrospective analysis of the 2013 National Surgery Quality Improvement Program pediatric database to identify procedures that met the CPT code of a primary upper extremity procedure. A univariate and multivariate analysis was performed to identify patient and surgery related risk factors for complications, re-operations and 30- day unplanned readmissions.

Results: Upper extremity pediatric surgeries have low complication (1.70%), re-operation (0.5%) and re-admissions rates (0.78%). Procedures requiring re-operation, in-patient procedures, and those complicated by surgical site infection were more likely to be readmitted. In addition, multiple medical co-morbidities such as cardiac disease, gastrointestinal disease, pulmonary disease, or a central nervous system disorder were associated with readmissions. Refer to table 1-3 for patient demographics, reasons for re-admission and comparison of patient and operative characteristics requiring re-admission.

Conclusion: Pediatric upper extremity surgery is safe and associated with low complication and readmission rates. Algorithms focusing on decreasing surgical site infection and optimizing complex pediatric medical problems may further decrease complication and readmission rates.

Table 1. Patient Demographics & Characteristics			Table 2. Reason for Readmission		
<i>Characteristics</i>		<i>Number (%)</i>	<i>Reason</i>		<i>Number (%)</i>
Number of patients		4370	Total		34
Readmission		34 (.78)	Surgical		18 (52.94)
Age (years)		5.15	Superficial SSI		4 (11.77)
Gender			Deep SSI		4 (11.77)
Male		2395 (54.81)	Organ/space infection		4 (11.77)
Female		1975 (45.19)	Hardware		
Race			Complication		2 (5.88)
White		3047 (69.73)	Cellulitis		2 (5.88)
African American		502 (11.49)	Pyogenic Arthritis		1 (2.94)
Asian		145 (3.32)	Sepsis		1 (2.94)
Pacific Islander		19 (0.43)	Medical		16 (47.06)
American Indian		17 (0.39)	Pneumonia		2 (5.88)
Not Available		640 (14.64)	Fracture		3 (8.82)
Procedure			Dehydration		2 (5.88)
Inpatient		1391 (31.83)	GI Infection		1 (2.94)
Outpatient		2979 (68.17)	Asthma		1 (2.94)
Admission Location			Other		7 (20.59)
ED/OSH ED		2459 (56.27)			
Home/Office		1836 (42.01)			
OSH ICU/Floor		62 (1.43)			
Rehab/SNF		8 (0.18)			
Other		5 (0.11)			
Discharge Destination					
Home		4349 (99.52)			
SNF/Rehab		21 (0.48)			

Table 3. Comparison of Patient & Operative Characteristics Requiring Readmission

<i>Characteristics</i>		<i>No Readmit (%)</i>	<i>Readmit (%)</i>	<i>p</i>
Total Number		476 (98.14)	9 (1.86)	0.005
One Comorbidity		387 (98.72)	5 (1.28)	0.24
Multiple Comorbidities		89 (95.70)	4 (4.30)	<0.001
Medical History				
	Cardiac	91 (96.81)	3 (3.19)	0.008
	Respiratory	202 (97.12)	6 (2.88)	<0.001
	Gastrointestinal	72 (96.00)	3 (4.00)	0.002
	Immune Suppression	19 (0.00)	0 (0.00)	N/A
	Central Nervous System	178 (97.80)	4 (2.20)	0.026
	Hematology	18 (100.00)	0 (0.00)	N/A
	Failure to Thrive	12 (100.00)	0 (0.00)	N/A
Pre-mature BMI		173 (97.74)	4 (2.26)	0.025
	>18.5	778 (98.86)	9 (1.14)	0.35
	<18.5	2399 (99.21)	19 (0.79)	
Procedure				0.022
	Inpatient	1374 (98.78)	17 (1.22)	
	Outpatient	2962 (99.43)	17 (0.57)	
Wound Class				0.908
	Clean	4211 (99.20)	34 (0.80)	
	Clean/Contaminated	111 (100.00)	0 (0.00)	
	Contaminated	12 (100.00)	0 (0.00)	
	Dirty/Infected	2 (100.00)	0 (0.00)	
ASA Classification				0.315
	ASA 1	3168 (99.34)	21 (0.66)	
	ASA 2	1068 (98.98)	11 (1.02)	
	ASA 3	94 (97.92)	2 (2.08)	
	ASA 4	3 (100.00)	0 (0.00)	
Post-Operative Infection				<0.001
	No SSI	4300 (99.54)	20 (0.46)	
	Superficial SSI	33 (84.62)	6 (15.38)	
	Deep SSI	3 (42.86)	4 (57.14)	
	Organ/space infection	0 (0.00)	4 (100.00)	
Re-operation				<0.001
	No Reoperation	4336 (99.49)	22 (0.51)	
	Reoperation	10 (45.45)	12 (54.55)	

P38. Assessment of Forearm Rotational Control Using Four Upper Extremity Immobilization Constructs

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Introduction: Forearm immobilization techniques are commonly used in the management of distal radius, scaphoid, and metacarpal fractures. The purpose of our study was to compare the degree of rotational immobilization provided by a sugartong splint (SS), short arm cast (SAC), Munster cast (MC), and long arm cast (LAC) at the level of the distal radioulnar joint (DRUJ), carpus, and metacarpals.

Materials and Methods: Seven cadaveric upper extremity specimens were mounted to a custom jig with the ulnohumeral joint fixated in 90° of flexion (Figure 1). Supination and pronation were unrestricted. K-wires were placed in the distal radius, scaphoid, and metacarpals using fluoroscopic guidance to measure the total arc of motion (supination to pronation) referenced to the ulnar ex-fix pin. Baseline measurements followed by sequential immobilization with well-molded SS, SAC, MC, and LAC were obtained with 1.25, 2.5, and 3.75 ft-lbs of supination and pronation force directed through the metacarpal K-wire. Each condition was tested three times. Digital photographs were taken perpendicular to the ulnar axis to analyze the total arc of motion.

Results: All immobilization constructs demonstrated significantly improved rotational control at the DRUJ, carpus, and metacarpals compared to baseline motion (Tables 1-4). The most effective constructs from least to greatest allowed rotational arcs were LAC, MC, SAC, and SS. Above-elbow constructs (MC, LAC) demonstrated superior immobilization compared to below-elbow constructs (SAC) ($p < 0.001$). Circumferential constructs (SAC, MC, LAC) were superior to the non-circumferential construct (SS) ($p < 0.001$). There were no significant differences between the MC and LAC in all conditions tested.

Conclusions: Both circumferential and proximally extended immobilization independently improved rotational control of the wrist. Extending immobilization proximal to the elbow did not confer additional stability.

Figure 1. Photograph of testing jig with distal radius, scaphoid, and metacarpal K-wires in place for pronosupination measurements.



Table 1. The twelve testing conditions.

	Sugartong Splint	Short Arm Cast	Munster Cast	Long Arm Cast
1.25 ft-lbs torque	SS 1.25	SAC 1.25	MC 1.25	LAC 1.25
2.5 ft-lbs torque	SS 2.5	SAC 2.5	MC 2.5	LAC 2.5
3.75 ft-lbs torque	SS 3.75	SAC 3.75	MC 3.75	LAC 3.75

Abbreviations: DRUJ, distal radioulnar joint.

Table 2. Total arc of motion allowed by immobilization constructs under 1.25 ft-lbs of deforming torque.

	Sugartong Splint	Short Arm Cast	Munster Cast	Long Arm Cast	P Value
DRUJ	21.2°	17°	4.3°	2.8°	<0.001
Intercarpal	30.6°	19.9°	7.7°	5°	<0.001
Metacarpal	43.9°	27.2°	17.8°	18.8°	<0.001

Abbreviations: DRUJ, distal radioulnar joint.

Table 3. Total arc of motion allowed by immobilization constructs under 2.5 ft-lbs of deforming torque.

	Sugartong Splint	Short Arm Cast	Munster Cast	Long Arm Cast	P Value
DRUJ	38°	27.9°	5.4°	3.8°	<0.001
Intercarpal	53.4°	32.2°	10.3°	8.5°	<0.001
Metacarpal	72.9°	45.3°	26.4°	25.6°	<0.001

Abbreviations: DRUJ, distal radioulnar joint.

Table 4. Total arc of motion allowed by immobilization constructs under 3.75 ft-lbs of deforming torque.

	Sugartong Splint	Short Arm Cast	Munster Cast	Long Arm Cast	P Value
DRUJ	54.2°	38.8°	6.2°	4.2°	<0.001
Intercarpal	74.8°	47.4°	14.3°	13.7°	<0.001
Metacarpal	100.3°	65.2°	32.4°	32°	<0.001

Abbreviations: DRUJ, distal radioulnar joint.

P39. An Economic Analysis of Hand Surgery performed under MAC Versus WALANT: A Trigger Finger Release Surgery Case Study

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Introduction: There has been recent growing interest in wide awake hand surgery, also referred to as “wide awake local anesthesia no tourniquet” (WALANT) surgery. One of the purported benefits is less cost due to the elimination of pre-operative diagnostic evaluation as well as less operative and hospital time. However, little is known of the objective potential economic benefits. Using a model of single trigger finger release surgery, a hypothesis was made that WALANT surgery would result in decreased hospital time and cost than patients receiving sedation with monitored anesthetic care (MAC).

Methods: All consecutive cases of single trigger finger release surgery performed between 2010-2012 performed with MAC, were compared with all consecutive cases performed between 2013-2014 with WALANT. All surgeries were performed in the same manner, at the same facility, and by the same surgeon. Total operating room time, surgical time, and recovery time were compared and statistically analyzed. Anesthesia charges were estimated at 3 base units for CPT 01810 and 1.8 time units with the 2013 national average conversion factor of 21.9243.

Results: A total of 78 patients met the inclusion criteria, 31 with MAC and 47 with WALANT. Patients in the MAC group had an average total OR time of 27.2 minutes, while the WALANT group averaged 25.2 minutes ($p>0.05$). The surgical time in the MAC group was 10.4 minutes, while the WALANT group averaged 10.2 minutes ($p>0.05$). Post-operatively, patients in the MAC group spent an average of 72.3 minutes in the recovery room prior to discharge, compared to 30.2 minutes in the WALANT group ($p<0.01$). We estimated that each case performed under MAC had excess charges secondary to anesthesia of approximately \$105.

Conclusion: Patients undergoing single trigger finger release surgery under WALANT demonstrated a trend of less time in the operating room as well as surgical time from incision to closure, compared to MAC. Patients undergoing single trigger finger release surgery under WALANT spent significantly less time in the recovery room post-operatively, compared to MAC. Each case performed under MAC instead of WALANT had excess anesthesia charges of \$105, which is an underestimate as it excludes material and fixed costs associated with the delivery of anesthesia. Avoiding use of anesthesia services for high volume procedures such as trigger finger surgery may result in significant systemic annual savings to payers, and in the future with bundling and episode based payments may become increasingly important to facilities and surgeons.

P40. Fixation Constructs for Thumb Ulnar Collateral Ligament Avulsion Fractures: A Biomechanical Study

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Background: Thumb UCL fracture avulsions are often treated operatively in the active population. Fixation of thumb UCL fracture avulsions or reconstituting the UCL in such injuries has been shown to have more predictable results than nonoperative treatment¹. The purpose of this study was to determine if hook plate construct described by Kang et al² for fixation of thumb ulnar collateral ligament fracture avulsion injuries (Figure 1) is at least as biomechanically strong of a construct as a suture anchor with two drill holes.

Methods: The thumb UCL was exposed via a standard approach in 7 matched pairs of cadaver hands. An osteotomy was made parallel to the shaft of the proximal phalanx along the entire insertion of the UCL. The osteotomy was fixed with either suture anchor (Mini Biocoposite SutureTak with 2-0 FiberWire, Arthrex) through two drill holes in the avulsion fragment and tied, or hook plate (1.5 mm titanium plate/screws, Synthes) construct. Specimens were then mounted on an MTS device (Figure 2), and loaded to failure. Measurement of movement across the construct was accomplished by a 3 mm differential variable reluctance transducer device (Microstrain), which was implanted to detect movement perpendicular to the fracture. Differences in load to failure and construct stiffness were compared and analyzed using a t-test.

Results: The hook plate construct failed at significantly higher loads than suture fixation. There were no differences in load to failure of the unfixed specimens. Load to failure in the hook plate construct 57.9 N (± 20.2 N) compared to 27 N (± 18.6 N) in the suture anchor construct ($P < 0.006$). The difference in construct stiffness was 48.8 N/mm (± 17.3 N/mm) compared to 6.6 N/mm (± 12.7 N/mm) ($P < 0.000$). The mechanism of failure for the hook plate group was screw pullout or bending versus anchor pullout in the suture anchor group.

Conclusions: Based on this model, the hook plate construct for fixation of thumb metacarpophalangeal joint ulnar collateral ligament fracture avulsions is biomechanically superior to the suture anchor construct. The lack of cortical apposition for the suture anchor and its placement into softer metaphyseal bone appears to contribute to suture anchor pullout and this construct should be used with caution when applied to this clinical situation.

1. Dinowitz et al. Failure of cast immobilization for thumb ulnar collateral ligament avulsion fractures. *YJHSU*. 1997;22(6):1057–1063.

2. Kang et al. The Hook Plate Technique for Fixation of Phalangeal Avulsion Fractures. *J Bone Joint Surg Am*. 2012;94(11).

Figure 1

Figure 2



P41. Bone Mineral Density is not a Predictor of Loss of Alignment Following Distal Radius Fracture Fixation

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Introduction: Osteoporosis increases the risk for distal radius fractures and makes it more difficult to maintain a closed reduction. Recent studies have reported preserved functional outcomes following operative fixation of distal radius fractures in patients with osteoporosis. However, few studies have explored whether low bone mineral density (BMD) predicts loss of alignment following operative fixation. Given that strong links have been noted between poor bone quality, screw cutout and loss of reduction in other contexts such as femoral neck fractures, we hypothesized that low BMD may similarly predict loss of alignment following distal radius fracture fixation.

Materials and Methods: A prospective cohort analysis of 116 patients (103 females, 13 males) was conducted between 2007 and 2012 at Kaiser Permanente in Orange County, in which patients were stratified into three groups based on DEXA score: normal (n = 21, T-score > -1), osteopenic (n = 67, T-score -2.5 to 1), or osteoporotic (n = 28, T-score < -2.5). Patients were identified in a prospectively collected distal radius operative fracture registry. The AO classification of each fracture and radiographic parameters including palmar tilt, radial inclination and ulnar variance were measured on immediate postoperative films as well as on final 6-week postoperative films and recorded in the registry. In cases where immediate postoperative films were not available, 2-week postoperative films were used. For each group, the average immediate postoperative value for each radiographic parameter was compared to the average final value using paired t-tests (p<0.05).

Results: Several patients did have changes noted between their individual postoperative and final alignments. But the group as a whole exhibited no significant changes in radiographic parameters (radial inclination, 0.078 ± 0.57 degrees; ulnar variance, -0.03 ± 0.15 mm; and palmar tilt 0.09 ± 0.20 degrees). Additionally, after controlling for age, sex, and AO classification in a multivariate analysis, the presence of osteoporosis or osteopenia had no statistically significant relationship with the average change in radial inclination, ulnar variance, or palmar tilt.

Conclusion: Low BMD does not exhibit a significant correlation with loss of reduction following internal fixation of distal radius fractures. Other factors such as bone geometry or trabecular structure and also surgical technique may be more responsible for loss of alignment after surgery than bone density alone.

P42. From Online To In-Person: Assessing The Effectiveness Of Organic Web Content On Guiding New Patients To An Orthopedic Practice

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Introduction: As more consumers turn to the Internet to locate health services, website content strategy plays an important role in the development of an orthopedic practices' marketing plan. This study set out to examine if specific methods of website optimization had an impact on website page views, patient referrals, or number of new patient appointments.

Methods: Data provided to the researcher by the study site was collected over a six-month period from March 2013-August 2013. A quantitative, non-parametric approach was used to analyze the secondary de-identified data gathered from 12 orthopedic physicians. Data collected included web content, new patient surveys, page view statistics, and number of new patient appointments per provider in Excel Spreadsheets. Spearman's Rank Order Correlation Coefficient or "Spearman's Rho" was used with Excel spreadsheets to create tables.

Web pages from 12 individual orthopedic providers from the same practice were evaluated and compared with new patient appointment data and new patient survey responses. The researcher evaluated each provider for keyword usage (keyword density), web content readability (spelling and grammar errors and Flesch-Kincaid grade level scores), overall number of web page views, new patient survey responses, and overall number of new patients per provider.

Results: Between March 2013 and August 2013, the 12 orthopedic physicians had a combined total of 49,143 visitors to their individual web pages. During this time 3,878 new patient appointments were made. Surveys were distributed to these new patients, and of the 1,615 surveys collected, 866 met the researcher defined criteria set for this study.

A critical Spearman value of 0.4965 was used for the sample size of 12 physicians. No relationship was found between web page keyword density and page views ($R_s=0.19$). No relationship was found between number of spelling and grammar errors on physician web pages and new patient appointments ($R_s=0.08$). A relationship was found between F-K grade level scores and number of new patient appointments ($R_s=0.81$). A relationship was found between number of web page views and number of new patient appointments ($R_s=0.74$).

Conclusions: This study found that providers with a greater number of web page views are also likely to have greater numbers of new patient appointments. Web pages with lower F-K reading level scores are also likely to have higher numbers of new patient appointments. Weak keyword use was also found indicating that there may be room for optimization of language used.

P43. Novel Sigmoid Notch Radiographic View: Evaluating the DRUJ Articular Surface and Preventing Intra-articular Screw Breach

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Background: Understanding distal radius fracture patterns and their articular involvement is essential to guiding treatment. The objective of this study is to describe a novel radiographic “sigmoid notch view” to assess for DRUJ screw penetration and to direct safer screw placement.

Materials/Methods: Distal radius volar locking plates were applied to ten fresh-frozen cadaveric arms. Five cadavers were plated with a distal ulnar locking screw breaching the sigmoid notch and five without a screw violating the DRUJ. A mini-C arm captured PA, sunrise, and “sigmoid notch view” radiographs, which is an axial view obtained with 15-20 degrees of wrist extension. For each cadaver-situation, blinded hand fellowship trained surgeons answered the following questions: does the screw directed towards the sigmoid notch breach the cortex and would you reposition the screw based on your interpretation. P-values for the comparison of sensitivities and specificities across views were calculated with generalized linear mixed models assuming a binary distribution and using a logit-link function. Intraclass correlation coefficients were calculated to assess the interobserver reliability of each view using this same model.

Results: The sensitivity for diagnosing intra-articular breach was 39%, 69%, and 80% for the PA, sigmoid notch, and sunrise views, respectively. The specificity was 76%, 95%, and 95%, respectively. For clinical decision making on when to move the screw, the views had a sensitivity of 65%, 80%, and 83% and specificity of 62%, 80%, and 87%, respectively. The sensitivity for articular grading of the sunrise view was statistically significantly greater than the sigmoid notch view ($P=.04$) although there was no difference in specificities ($P>.99$). The sensitivity for screw repositioning of the sunrise view was not statistically significantly different than the sigmoid notch view ($P=.21$) nor was the difference in specificities ($P=.17$). Both the sunrise and the sigmoid notch view were superior to the PA view to identify DRUJ breach and to guide clinical decision-making ($P<0.01$). The intraclass correlation coefficients were 0.31, 0.95, 0.99 for the views, respectively.

Conclusions: Both the sigmoid notch and sunrise views performed well in identifying DRUJ breach and for directing screw repositioning. Based on these results, we recommend that either the sunrise view or the sigmoid notch view (if not both) should be obtained intra-operatively to guide clinical decision-making. Therefore, the novel sigmoid notch view should be added to the surgeon's armamentarium as a valuable tool to help improve sigmoid notch visualization, avoid DRUJ screw penetration, and prevent unnecessary screw repositioning.

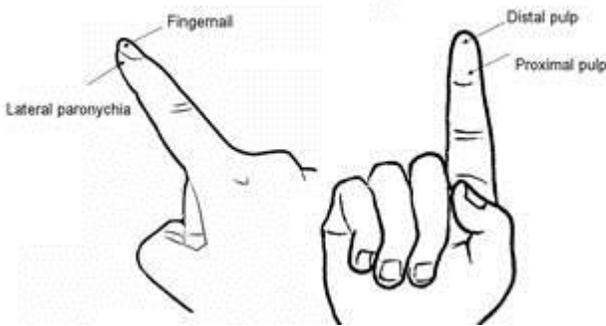
P44. Is Capillary Refill Time Still A Reliable And Useful Test For Evaluating Tissue Perfusion In Injured Limb?

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Introduction: Capillary refill time (CRT) is traditionally used as a clinical indicator of tissue vascularity either after limb injury or after revascularization. However, some argued that CRT is an unreliable method as some devascularized digits can appear to have normal CRT. In addition, previous studies failed to demonstrate the correlation between capillary refill time and tissue perfusion. CRT can be examined at several areas where the most frequently used is the fingernail, however no convincing evidence demonstrated which area is more accurate than others. We therefore investigated whether the test itself is unreliable or the area of the test is not an appropriate site to assess CRT.

Material and Method: CRT was tested in twenty four healthy volunteers, age between 20-30 years old. Three registered nurses were included as rater for evaluate inter-observer variability. Tourniquet 250 mmHg was applied to upper arm to mimic total occlusion of brachial artery of that limb. CRT was blindly assessed both tourniquet was on or off at four different areas in index finger; fingernail, lateral paronychia, proximal and distal pulp. All CRT tests were performed in controlled environment including light and temperature.



Results: CRT of all four areas of digit demonstrated significant mean different between tourniquet and non-tourniquet ($p<0.05$). However, the fingernail shown to have subtle different in CRT (1.22 seconds) compared to lateral paronychia (3.26 seconds), proximal pulp (4.46 seconds) and distal pulp (4.085 seconds). In normal limb (non-tourniquet) CRT had fair inter-observer reliability (ICC=0.51) but very poor ICC in occluded limb (ICC=0.13) when tested at fingernail. However, CRT still had reasonable inter-observer reliability when tested at lateral paronychia and finger pulp (ICC= 0.75-0.81 in non-tourniquet vs 0.62-0.68 in tourniquet).

Conclusion: CRT at appropriate area is still a useful and reliable method to evaluate tissue perfusion in injured limb. From our study, the most reliable and applicable area for CRT testing is finger pulp either proximal or distal pulp. Lateral paronychia is also one of reliable area, however difficult to assess due to its position especially in splinted hand. The unreliable fingernail CRT could explained why CRT had poor sensitivity in previous studies.

P45. Trends in Surgical Treatment for Cubital Tunnel Syndrome: Survey of Members of the American Society for Surgery of the Hand

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Introduction: Cubital Tunnel Syndrome (CuTS) is a common compression neuropathy affecting the upper extremity. Treatment options for CuTS vary, but there is considerable debate over which procedure should be performed for varying degrees of severity. The purpose of our study was to determine, based upon survey responses, how physicians are treating patients with CuTS. We then integrated the results with current literature.

Methods: We surveyed physicians from the American Society of Surgery of the Hand (ASSH). They were presented with six hypothetical cases and asked to choose their preferred treatment from the following options: open in situ decompression, endoscopic decompression, submuscular transposition, subcutaneous transposition, medial epicondylectomy, and conservative management. This was assessed independently and anonymously through an online survey (SurveyMonkey).

Results: The survey invitation was e-mailed to members of ASSH and 135 responded. When asked about occasional paresthesias presenting for greater than 6 months with a normal EMG/NCV, 64% of the respondents said they would continue conservative management. In the case of paresthesias, weakness of intrinsic, and EMG/NCV reports of mild-moderate ulnar nerve entrapment, 63.4% said their preferred treatment would be open in situ decompression. When asked about sensory loss of two-point discrimination of less than 5mm in addition to the presentation above, 67% of respondents picked open in situ decompression, 24% picked subcutaneous transposition and 21% picked submuscular transposition as their preferred treatment. There was no difference in responses if co-morbidities such as CAD, CKD or uncontrolled DM were present. If symptoms of numbness and weakness were present for more than 1 year, sensory loss of two-point discrimination of more than 10mm and EMG/NCV reports of severe ulnar nerve entrapment, 44.6% of the respondents picked in situ decompression, 21.5% picked subcutaneous transposition and 18.5% picked submuscular transposition. In addition to the above case, if co-morbidities were present, 43.4% picked open in situ decompression and 20% picked conservative management. 74% of the respondents said their treatment algorithm would change with ulnar nerve subluxation.

Conclusion: This is the first study to survey hand surgeons on their preferred treatment for CuTS. Our survey results indicate that open in situ decompression is the preferred operative procedure amongst hand surgeons for CuTS regardless of severity.

P46. The Effect of Upper Extremity Immobilization on Driving: A biomechanical study

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Although the impact that lower extremity immobilization has been well studied in the Orthopaedic literature, the effect that upper extremity immobilization has on driving has yet to be elucidated. Furthermore, there is little precedent regarding medical or legal complications of 'clearing' a patient to drive while the patient is still in an upper extremity cast. We aimed to study the mechanical deficit caused by the immobilization of one of the upper extremities of turning the steering wheel.

We analyzed the turning ability of 8 right handed healthy subjects (average age = 28) using the BTE Simulator 2 (Hanover, MD) both without casts and in single extremity long arm thumb spicas, short arm thumb spica, and short arm cast. Both the left and right arms were casted independently and isometric turning ability tested performing both left and right turns with the hands at neutral, 45 degrees and 90 degrees of both a right and left hand turn. The torque generated at each point was measured. All measurements were performed 3 times.

At all hand positions on the wheel, an immobilized upper extremity played a detrimental impact on the ability to generate torque on the steering wheel. Using a repeated measures ANOVA, all positions reached significance ($p < 0.05$) for single arm immobilization with the exception of a left short arm cast ($p = 0.40$). We also found that long arm thumb spica casts have the largest average impact, right arm having a larger deficit than left arm immobilization (71 Nm deficit vs 64 Nm deficit). In contrast to previous studies, we found that right arm immobilization has a consistently greater overall impact on torque generation than the left arm (48 Nm deficit vs 41 Nm deficit).

This is the first study to assess the mechanical detriment that an upper extremity cast plays on a driver's ability to generate torque on a steering wheel throughout a 90 degree turn in either direction. We found that a long arm thumb spica had the largest negative impact on force generation, and that right arm immobilization has a greater deficit than left. The role that this would play in a real life scenario would be contingent on several factors such as tire pressure, steering ratio, etc. A physician must be cautious in clearing a patient for driving with an upper extremity cast as the driver may not experience optimal turning conditions.

Overall Turn Force (N) Compared with Control					
	Mean	Standard Error	95% CI Lower Bound	95% CI Upper Bound	P value compared to control
Control	250.305	7.438	229.653	270.957	
L LATS	181.798	8.197	159.040	204.557	.002
R LATS	171.244	8.987	146.293	196.195	.014
L SATS	200.864	6.794	182.001	219.726	.002
R SATS	206.175	8.001	183.961	228.389	.003
L SAC	231.519	8.844	206.965	256.074	.399
R SAC	214.954	6.789	196.104	233.805	.000

P47. Revision of the Failed Thumb Carpometacarpal Arthroplasty: A Review of 32. Patients

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Introduction: Revising the failed thumb carpometacarpal (CMC) arthroplasty can be daunting. Although several surgical approaches have been described, none have adequately highlighted the ideal procedure for revising the painful failed thumb CMC arthroplasty. We retrospectively analyzed the outcomes of 32 patients from two experienced surgeons at different institutions who underwent revision surgery for this challenging problem.

Materials & Methods: Thirty-two patients who had failed thumb CMC arthroplasty were included in this study. There were 24 women and 8 men with a mean age of 57.7 years at the time of the revision surgery. The primary reason for revision was pain due to instability or metacarpal subsidence. The revision surgery included soft-tissue interposition with or without ligament reconstruction and distraction pinning. Eight patients required concomitant metacarpal phalangeal joint fusion. Eleven patients required concomitant partial excision of trapezoid for scaphotrapezoid arthritis. All patients were evaluated clinically and radiographically. Functional outcome was assessed with a pain VAS scale, measurement of grip strength, key pinch strength and range of motion.

Results: The mean follow-up was 57 months (range, 24 to 121 months). All clinical parameters demonstrated improvement at final follow-up. Twenty-seven patients (84.4%) achieved good functional results and five patients (15.6%) fair. Pain levels by VAS scale were significantly reduced in all patients after revision surgery from mean preoperative 7.2 to postoperative 0.7. Grip strength significantly increased on average from 17 kg preoperatively to 21.4 kg postoperatively. Mean key pinch strength significantly improved from 3.2 kg preoperatively to 4.6 kg postoperatively. The mean radial abduction significantly improved from 61° before revision surgery to 67° and mean palmar abduction of the thumb significantly improved from 57° to 61°. There was not a significant difference in the functional outcome in regards to the method of revision surgery (soft-tissue interposition alone versus with ligament reconstruction) all in combination with distraction pinning. All patients were satisfied with the revision surgery.

Conclusions: Surgery for failed thumb CMC arthroplasty is successful and provides satisfactory functional results with careful attention to clinical and radiographic details. Revision surgery with soft-tissue interposition with or without ligament reconstruction and distraction pinning for failed CMC arthroplasty of the thumb provides pain relief and improves grip and key pinch strength and range of motion of the thumb.

P48. Complicated Axial Fracture Dislocations of the Hand- The Leather Plating Machine Injuries

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Introduction: We report nine patients with a previously undescribed combination of injuries by “leather plating machine” resulting in a “terrible triad” of axial fracture-dislocation of wrist, third degree burn and acute compartment syndrome of hand. Leather plating machine (LPM) is used for processing leather for shoes. This has two heated plates which hydraulically compress leather sheets, cut, and iron and imprint texture. When hand gets caught between the plates accidentally, it imparts an axial compression and thermal injury along with shear component as victim tries to pull hands wedged between plates free resulting in the above injuries.

Materials & Methods: A retrospective study of patients presenting with LPM injury from January 2005 to June 2011 were done. The demographics, clinical presentation, associated injuries, treatment and final outcome of this unique injury was analyzed. Emergency fasciotomy was done for acute compartment syndrome and axial fracture-dislocations were treated by open/closed reduction and fixation. Third degree burns were treated with debridement, skin resurfacing. All patients underwent rigorous hand therapy postoperatively. The minimum follow-up was 2 years and the outcome evaluated by DASH and Mayo wrist score.

Observations: M: F ratio was 8:1. Right hand was predominantly affected (3.5R: L). The average age was 30.8 years. Six patients had axial ulnar, three patients both axial ulnar & radial and one axial radial injury. Seven patients had compartment syndrome and 3^o burn to hand. Eight patients had thumb web burst while one had hypothenar burst. The deep branch of ulnar nerve was severed in three cases requiring repair. All cases required debridement and fixation. One patient underwent amputation of non-viable fingers. One had flap cover and two required skin grafts. Seven out of nine had severe stiffness of hand. The mean TAM for the seven patients was 109^o while two patients with no compartment syndrome mean TAM was 224^o. DASH and Mayo scores also were done. None of the patient went back to old profession.

Conclusion: The leather plating machine injury to hand produces unique pattern of injury characterized by the terrible triad of axial fracture-dislocation of the wrist, third degree burn and acute compartment syndrome of the hand. The outcome of this injury was uniformly poor. Safety measures to prevent this injury are suggested.

P49. Recovery from Wrist Fracture: What Happens after Discharge from Hand Therapy?

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Introduction: While it is commonly assumed that recovery from wrist fracture continues for at least one year post injury, few studies have examined the changes to be expected after discharge from rehabilitation. This prospective single-center study addressed this gap by examining changes in ROM, strength, pain and disability over the 12 months post radius fracture, with a particular focus on changes that occur between discharge from hand therapy and the one year anniversary. This information should be useful for clinicians and patients looking for predicted outcomes from this common orthopedic injury.

P50. 2D osteotomy provides comparative results with 3D osteotomy for cubitus varus deformity

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Introduction: A variety of osteotomies have been proposed to correct posttraumatic cubitus varus deformity as well as any associated hyperextension and/or rotational deformities. However, lateral closing-wedge osteotomy and step-cut osteotomy, both of which have been used extensively with satisfactory outcomes, correct only in the coronal plane. Direct comparison has been made between three-dimensional (3D) and simple coronal two-dimensional (2D) osteotomies.

Materials & Methods: Between 1983 and 2015, we treated 102 elbows (102 patients) with a posttraumatic varus deformity. There were 72 male and 30 female patients. The average age of the patients at the time of the osteotomy was 10.8 years (range, 3 to 31 years). We classified 39 patients who underwent 3D osteotomies as 3D Group and 63 patients who underwent 2D osteotomies as 2D Group, and we compared the outcomes between the groups. Clinical evaluation included an assessment of the carrying angle and measurement of the passive range of motion before surgery and at the time of the final follow-up. To evaluate the remodeling capacity of the bone to recover elbow flexion in 2D Group, we assessed the range of motion before surgery and at the time of the final follow-up in patients who were less than ten years old and those who were more than ten years old.

Results: There was no significant difference between the groups with regard to the carrying angle or the elbow range of motion, either before surgery or at the time of the final follow-up. However, 3D Group had more significant loss of correction ($p < 0.05$). There was a loss of 4.4 degrees from immediately after surgery to the time of the final follow-up in 3D Group compared with a loss of 0.7 degrees in Group II. In 2D Group, elbow motion reached the physiological range by the time of the final follow-up in patients who were less than ten years old.

Conclusions: 2D supracondylar osteotomy of the humerus provides comparable results with 3D osteotomy for posttraumatic cubitus varus deformity. For osteotomies to correct cubitus varus deformity, correction of internal rotation is not needed. Furthermore, with a 3D osteotomy, it is difficult to maintain correction and to acquire the planned carrying angle because of the small area of bone contact from our results. It is necessary to correct hyperextension in patients older than ten years of age, as after that age bone remodeling is not expected to increase elbow flexion.

P51. Risk Factors for Early Complications in the Operative Treatment of Distal Humerus Fractures in Older Patients

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Introduction: Open reduction internal fixation (ORIF) and total elbow arthroplasty (TEA) have both been shown as valid options in the treatment of distal humerus fractures in patients over 65 years of age. Risk factors for early complications following these procedures have not been well described.

Materials & Methods: We reviewed the Surgeons National Surgical Quality Improvement Program for both ORIF and TEA performed for distal humerus fractures (Fx-TEA) and TEA for patients with rheumatoid arthritis (RA-TEA) in patients over the age of 65 years between 2006 and 2012. We examined preoperative risk factors and complications within thirty days in each of these three groups.

Results: The sample included 129 ORIF, 28 Fx-TEA, and 14 RA-TEA cases. The ORIF group experienced more early complications than the Fx-TEA group including 5 reoperations, 2 infections, 1 nerve injury, and 10 cases of blood transfusions. In contrast, the TEA group had only 2 cases of blood transfusion. In the ORIF group, preoperative hematocrit and creatinine were significant independent risk factors for complication. The TEA group had two independent risk factors: preoperative hematocrit and presence of a bleeding disorder, including use of anticoagulation. Serious clinical complications in the ORIF, Fx-TEA, and RA-TEA groups were relatively low.

Conclusions: Complications in both groups were low. Low preoperative hematocrit was an independent predictor in both TEA and ORIF groups. Age and weight were not independent predictors but were significant when combined with signs of kidney disease and preoperative anemia for the ORIF group. Identification of these predictors is important to recognize higher risk patients in an already fragile population.

P52. Opening Wedge Osteotomy to Salvage Distal Radius Fractures after a Failed Volar Marginal Fragment

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Introduction: Articular fractures of the distal radius may include a small fragment from the volar margin of the lunate fossa (VMF). While rare, this pattern of comminution carries a worse prognosis. After open reduction and internal fixation (ORIF) of the distal radius fracture, the VMF may require additional fixation. Failure to do so may result in loss of reduction and volar carpal subluxation. When this occurs, salvage is difficult. We present our experience using a radial opening wedge osteotomy to reorient the articular surface and restore joint stability.

Methods: We retrospectively reviewed the records of all patients treated at our facility with a volar opening wedge osteotomy for the management of a collapsed VMF after volar plating a distal radius fracture. Medical charts, x-rays and therapy notes were investigated and all patients were contacted for a final evaluation. The charts were examined for the presence of complications and for functional results. The surgical procedure consisted of a volar opening wedge osteotomy in order to decrease volar tilt, restore radial length and provide volar support to the carpus. Autologous bone graft was used in all cases.

Results: We treated three patients, all female, (ages 47-70) 2-5 months post-ORIF with this indication. Cast immobilization failed to prevent progression in the cases treated with this technique, and patients presented before the third month post op with either failure of initial reduction or poor progress after the initial surgical treatment. Symptoms included unexpected pain and failure to recover forearm supination. Radiologic findings progressed from collapse of the volar marginal fragment to volar subluxation of the carpus and reabsorption of the VMF. All three patients underwent a radial opening wedge osteotomy with proximal ulna cancellous autograft. Within two months post-osteotomy all three patients had improved pain and motion. Follow-up X-rays revealed concentric joint reduction alignment. At final follow-up, patient's passive and active VAS scores were 0; their QuickDASH scores were 4.5-6.8.

Conclusion: A volar opening wedge osteotomy can be used to salvage a distal radius fracture with a collapsed volar marginal fragment while preserving the radio-carpal joint.

P53. Increased Rotation Instability in Ulnar Collateral Ligament Injuries of the Thumb: A Biomechanical Study

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Introduction: In a normal thumb, there is minimal rotation about the thumb metacarpal phalangeal (MCP) joint, but with a complete injury to the medial ligamentous structures a clinically increased rotation about the MCP joint can be detected. The purpose of our study is to substantiate our clinical finding in a cadaveric model. Our hypothesis was that sequentially disrupting the dorsal capsule, the proper ulnar collateral ligament (pUCL) and the accessory ulnar collateral ligament (aUCL) of a thumb will lead to significant progressive rotational instability.

Materials and Methods: Twelve fresh from adult cadaveric upper extremities with intact thumbs and no prior history of thumb injury were used for this study. The mean age was 65 (range 49-76) with 4 females and 8 males specimens. The specimens were thawed to room temperature and dissected to expose the dorsal capsule, the pUCL and the aUCL. With fluoroscopic assistance two 0.45 Kirshner wires were placed through the distal metacarpal and proximal phalanx approximately 2 cm from the MCP joint, both parallel to the joint line and parallel to the horizon. The dorsal capsule, pUCL and aUCL were sequentially sectioned and the MCP joint was ranged manually in pronation and supination in the natural resting position of the hand. Digital photographs captured the extremes of motion (pronation and supination) at baseline and after each structure were sectioned. A digital goniometer was used to measure the relative pronation and supination using the k-wires to mark rotation. A student's paired t-test was used for statistical analysis with a threshold of $p < 0.05$.

Results: Mean baseline pronation and supination were 16° ($SD \pm 4.3^\circ$) and 12.8° ($SD \pm 4.2^\circ$), respectively. After sectioning the dorsal capsule and pUCL the mean pronation and supination were 23.4° ($SD \pm 8.8^\circ$) and 21.6° ($SD \pm 3.4^\circ$), respectively and increased to 28.2° ($SD \pm 9.2^\circ$) and 29.7° ($SD \pm 2.6^\circ$) in pronation and supination, respectively, after sectioning the aUCL. These were both significant changes from baseline ($p < 0.05$). With the pUCL sectioned, there was a mean increase in percent pronation and supination of 29.2% ($SD \pm 14.8\%$) and 39.2% ($SD \pm 22.4\%$), respectively compared to baseline. With the aUCL also sectioned, the increase in percent pronation and supination from baseline was 41.6% ($SD \pm 12.8\%$) and 57% ($SD \pm 12.9\%$), respectively.

Conclusions: This biomechanical study demonstrates a significant increase in the rotational instability (pronation and supination) of the metacarpal phalangeal joint after UCL injury. Clinically, this increase in rotational instability can help more accurately diagnose gamekeeper's thumb and supplement traditional valgus stress testing of this injury.

P54. Systematic Review Comparing Cost Analyses of Fasciectomy, Needle Aponeurotomy and Collagenase Injection for Treatment of Dupuytren's Contracture

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Background: Surgeons now have a variety of treatment options for Dupuytren's contracture including traditional partial fasciectomy (PF), percutaneous needle aponeurotomy (PNA), and collagenase *Clostridium histolyticum* (CCH) injection. An important factor in clinical decision making is the cost effectiveness of the various modalities, as will be discussed in this paper.

Methods: A literature search was performed, by two independent reviewers. A total of 8 articles and 3 abstracts met inclusion criteria. Papers were excluded for non-English language, insufficient breakdown of costs by treatment type, promotional materials, or works-in-progress. Cost data was extracted and subsequently converted to U.S. Dollars. A weighted mean was used to objectively pool data that were sufficiently similar in methodology and population.

Results: Four observational cohort studies were pooled and found to have a weighted mean cost in favour of CCH at \$1,877 per patient (SD \$76.3) compared to PF at \$6,857 (\$3,348). Two expected-value decision analysis models were in agreement that PF is not cost effective, but they differed on whether PNA or CCH was the most cost effective strategy. Two cost minimization studies agreed that CCH was less costly than PF by \$486. Overall 7 of 11 studies found CCH to be most cost effective. Only one study of eleven found PF to be the most cost effective method. Of the six studies that considered PNA, three found it to be lowest cost.

Conclusion: The vast majority of studies found PF to be the most costly treatment modality, however it is still the treatment of choice in certain clinical scenarios. It is difficult to compare CCH to PNA, as many studies did not consider PNA. More studies, especially considering indirect costs, are required to be able to accurately determine which method is most cost effective.

P55. Trigger Finger Release Surgery Performed Wide Awake : Prospective Comparison of Lidocaine, Marcaine, and Exparel

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Hypothesis: Local anesthetics are routinely used in hand surgery for procedures such as trigger finger releases. Moreover, wide awake hand surgery rely on local anesthetics with epinephrine to facilitate surgery without other anesthesia or tourniquet use. A number of local anesthetics are readily available including lidocaine, bupivacaine (Marcaine), and more recently bupivacaine liposome suspension (Exparel). To better understand the efficacy and safety of these agents in hand surgery, we prospectively evaluated the efficacy of these local anesthetics in controlling post-operative pain, opioid usage, and adverse reactions following trigger finger release surgery.

Methods: After obtaining IRB approval, all consecutive patients undergoing single digit trigger finger release surgery under local anesthesia without sedation by 7 fellowship-trained orthopaedic hand surgeons were invited. Surgeries were performed with either lidocaine (L), bupivacaine (M), or bupivacaine with post-operative bupivacaine liposome injection (E). Patients were contacted post-operatively on days (POD) 0, 1, 2, and 3 to determine their pain on a visual analog scale (VAS), daily opioid consumption, and any adverse reactions.

Results: A total of 163 patients were included in the study. On POD 0 patients in the Lidocaine group reported greatest pain with VAS of 4.40 ($p=0.01$), and Exparel with the least. By POD1, the Marcaine group reported increasing pain at VAS of 2.90 but still lower than the lidocaine group at 3.73 ($p=0.08$), whereas the Exparel group continued to experience the least pain at VAS of 2.33 ($p=0.006$). However, by POD2 and POD3 the differences were more subtle and similar. On POD 0 only 27% of patients in the Exparel group used opioids as opposed to 58% ($p=0.01$) and 59% ($p=0.004$), in the Marcaine and Lidocaine groups, respectively. Additionally on POD 0, 50% of patients in the Exparel group required no pain medications as compared to 21.8% and 29.1% in the Lidocaine and Marcaine groups, respectively ($p=0.02$). Only 3% of the Exparel patients reported adverse reactions as opposed to 13% and 12% in the Lidocaine and Marcaine groups, respectively ($p=0.005$).

Summary Points:

- To the best of our knowledge this is the first report on the efficacy of Exparel in ambulatory hand surgery.
- Overall, trigger finger release surgery results in low pain, but patients in the Lidocaine group reported the highest pain score on POD 0-1.
- Patients who received Exparel had lower pain scores and consumed less opioids on POD 0-2 as compared to Lidocaine and Marcaine.
- By POD 3, patients' pain experiences were similar.

P56. WITHDRAWN

P57. The Effect of Capitate Position on Coronal-Plane Wrist Motion After Simulated Four-Corner Fusion

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Introduction: Scaphoid excision and four corner fusion (4CF) is most often performed when the radiolunate articulation is spared in conditions such as scapholunate advanced collapse (SLAC) and scaphoid nonunion advanced collapse (SNAC). In particular, the position of the lunate in the sagittal plane is a determining factor of post 4CF wrist flexion and extension and is considered by some to be the most important step of the procedure. To our knowledge, the coronal relationship between the lunate and capitate, however, has not been studied. The objective of this study was to examine the effect of altering the capito-lunate relationship on coronal-plane wrist motion after scaphoidectomy 4CF.

Materials and Methods: Eight human cadaveric limbs were disarticulated at the elbow and mounted on a custom jig. The baseline position of the wrist was recorded with no load applied, followed by sequential loads of 44.4N, 89N and 125N applied to the FCR, ECRL and ECRB tendons to simulate maximal radial deviation (RD) and to the FCU and ECU tendons to simulate ulnar deviation (UD). A scaphoidectomy was then performed and 2 methods of simulated 4CF were studied in random order (figure 1). Range of motion (ROM) was compared using one-way ANOVA and bonferroni correction.

Results: The resting position of the “capitate covered” wrist was in significantly greater radial deviation than the pre-operative wrist position ($p < 0.01$). Under 44.4N radial load, the capitate covered position had significantly greater radial deviation than the pre-operative radial deviation at the same radial load ($p = 0.01$). The anatomic position wrist did not differ significantly from the pre-operative wrist at any position.

Conclusions: To our knowledge, this is the first study to evaluate the coronal position of the capito-lunate articulation following scaphoid excision and four-corner fusion. In this cadaveric model, the resting position of the wrist as well as the coronal arc of motion was not significantly changed from the pre-operative state when the remaining carpal bone positions are maintained after scaphoid excision. In contrast, complete covering of the capitate head by the lunate, as recommended in the literature (1-5), placed the wrist in excessive radial deviation. The extra radial deviation may be due to over tensioning of the radioscapocapitate ligament and may clinically result in a perceptible deformity and affect function.

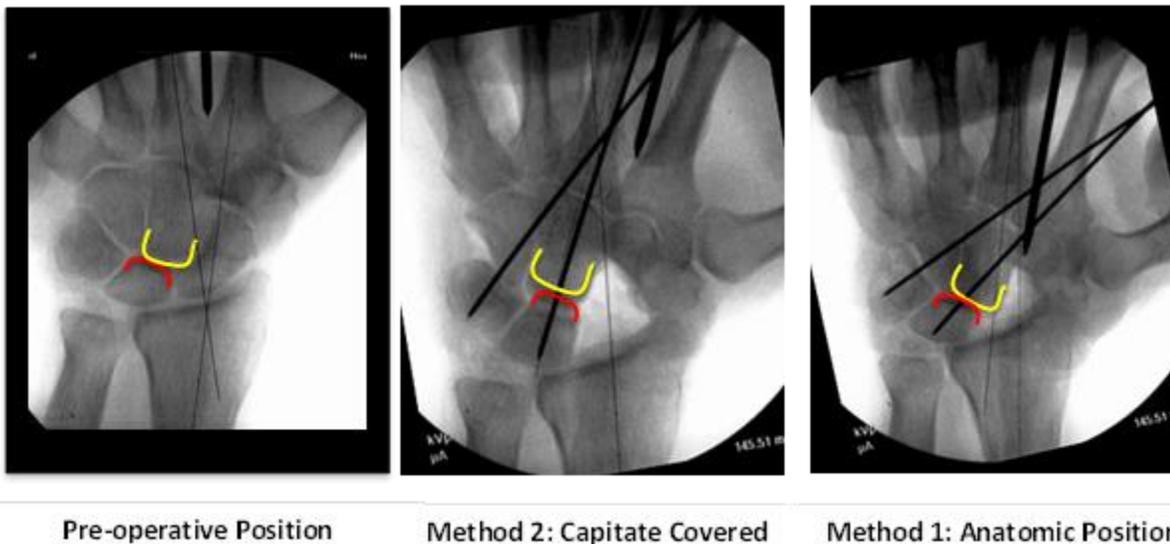


Figure 1

P58. Pediatric Traumatic Brain Injury, Heterotopic Ossification and Peripheral Neuropathy

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Introduction: Patients with severe traumatic brain injury (TBI) may suffer from heterotopic ossification (HO), mainly of the elbow or hip joints. This is well described in adults, but less so in pediatric patients. Timing of surgical excision of the HO as well as postoperative treatment with NSAID or single dose irradiation are questions debated in adults. There is very little data in children and no clear recommendations.

The aim of this study was to examine the frequency of this problem in the pediatric population and examine possible risk factors for its occurrence.

Methods: The medical records of all patients with severe TBI between the ages of 0 to 16, hospitalized at the pediatric & adolescent rehabilitation center during the years 2000-2013 were reviewed. Data regarding brain and additional injuries, diagnosis and care of HO were collected.

Results: There were 83 patients including 60 boys and 23 girls. Eight were excluded due to insufficient data. Of the remaining 75 patients, HO was diagnosed in 6 patients at an average of 4 months from the injury, 4 at the elbow and 2 in the lower limb. The age at injury ranged between 7 and 14 years and Glasgow Coma Scale at admission was between 5 and 8. Of the 6 patients, 2 had fractures in the same limb, 2 had botulinum toxin injections followed by serial casting in the same limb, and in all, the involved side was the plegic limb, with increased muscle tone. Symptoms resolved in 5 patients with NSAIDS treatment and rest. One patient required surgical excision of the elbow HO, due to a progressive ulnar neuropathy, 6 months post injury. Post-op management included NSAIDs for 6 weeks. After 3 months, the clinical signs of the ulnar neuropathy had resolved yet some of the elbow contracture recurred.

Conclusions: Severe TBI in children may be complicated by HO of the plegic, increased muscle tone limb. When diagnosed, monitoring of the limb's neurologic status is needed to detect early signs of nerve entrapment in addition to the neurologic deficits of the brain injury. A peripheral neuropathy may be an indication for more aggressive treatment of the HO.

P59. How many Trigger Fingers Get Better if you Do Not Operate on them?

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Introduction: Many of the patients we call to give a surgery date tell us their problem is resolved. Our long surgical waiting lists for this type of procedure provide us with significant numbers of patients who do get better before we can operate on them. It is important that surgeons know how many patients might get better in a given time period if they have no treatment. There is very little information in the literature about the natural history of untreated trigger fingers.

Materials & Methods: We looked at all of our trigger finger waiting lists both prospectively and retrospectively from the years 2004 to 2015. We documented how long it took between booking the patients for surgery and offering them a surgical date on the telephone. In addition to demographic data, we recorded which digits were involved and how many patients declined surgery because their problem had resolved without treatment.

Results: At the time of consultation in our office, we booked 287 patients for trigger finger release between 2004 and 2015. When we called them months after their consultation to offer them a surgical date, 141 of those patients accepted a surgical date and came for surgery. The other 146 of those patients declined to have surgery because their symptoms had improved without treatment. The average waiting time between consultation and surgical date offer in those patients *who had surgery* was 5.7 months in women and 7.7 months in men. The average waiting time between consultation and surgical date offer in those patients *who did not need surgery* was 7.3 months in women and months in 8.6 in men.

Conclusions: We found that approximately half of patients who have to wait over 6 months for trigger finger surgery get better without any intervention.

P60. Carpal Tunnel Pressure and Flexor Tendon Kinematics: A Biomechanical Study

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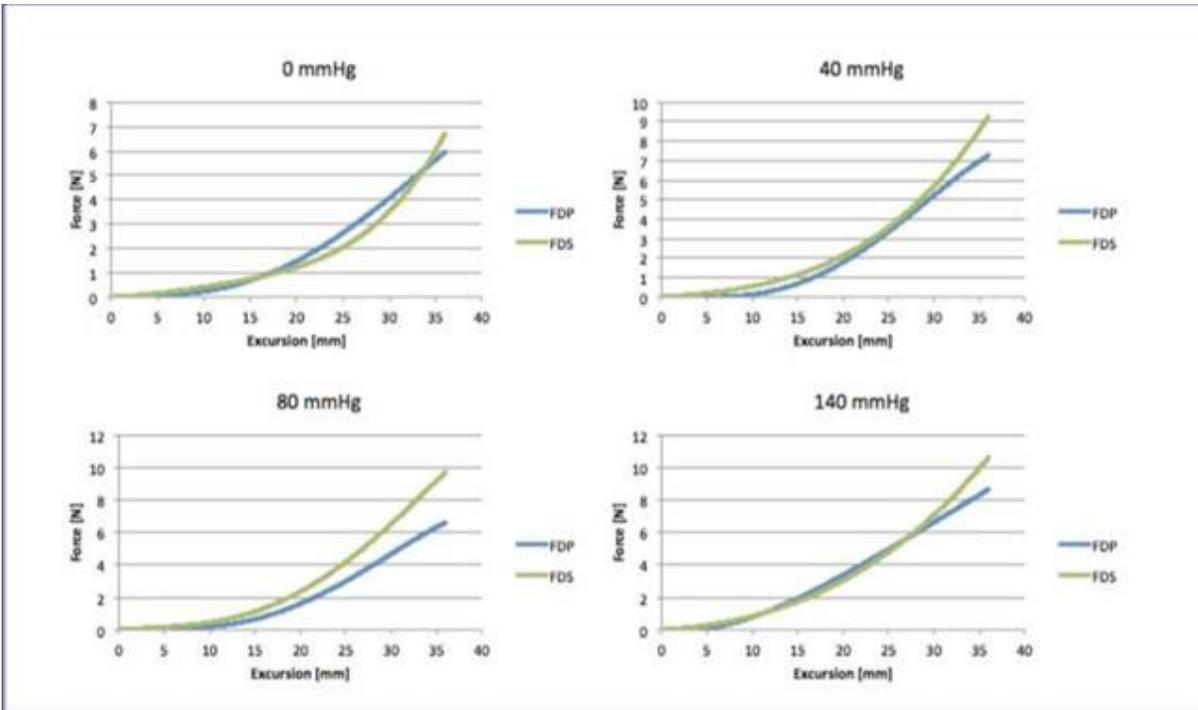
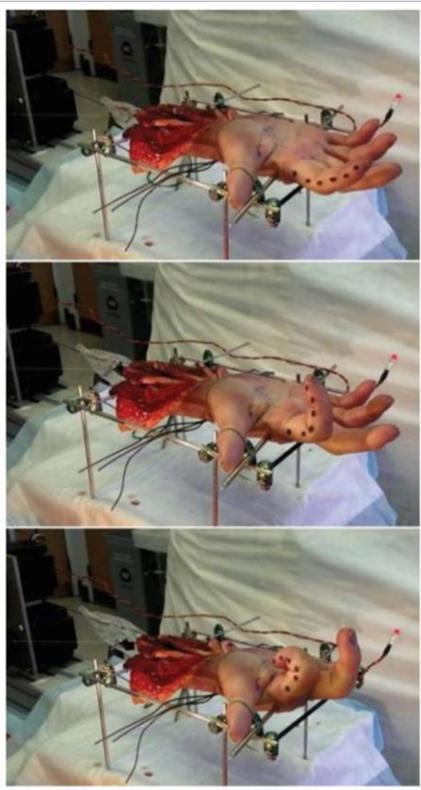
Manual dexterity may be profoundly affected in patients suffering from carpal tunnel syndrome. This study investigates the possible effect of increased carpal tunnel pressures on finger joint kinematics. Three cadaver hands were analyzed and intracarpal pressure was increased artificially by inserting a balloon into the carpal tunnel and measuring MCP and DIP joint flexion by computational motion tracking analysis.

Pressure increases of 0 mmHg, 40 mmHg, 80 mmHg, and 140 mmHg were applied. The angular displacement of the MCP, PIP, and DIP joints was tracked for an intact, partially, and fully released flexor retinaculum.

This study found that higher carpal tunnel pressures had no statistically significant effect on the angular displacement of the MCP, PIP, and DIP joints at an excursion of 35 mm and with pressure values up to 140 mmHg ($P < 0.05$). However a tendency towards reduced ROM overall with increasing pressure was identified for the MCP joint. This trend was demonstrated for an intact and partially released ligament. No drift could be detected for neither the PIP nor the DIP joints. DIP joint displacement during finger movement differed from hand to hand. For all conditions of the flexor retinaculum, two specimens did not exhibit any change in rotation of the DIP joint when pulling the FDS tendon separately. A small DIP displacement was noted to occur for the remaining specimen. Data analysis of all conditions showed a statistical significance only for the MCP joint when pulling the FDS tendon separately ($p < 0.04$). No other experimental set reached statistical significance.

When combining the values from the FDP and FDS tendon separately and together, a statistically significant difference in excursion between an intact and a partially released ligament for the MCP ($p < 0.03$) as well as PIP joint ($p < 0.009$) was observed.

This study showed that an increased intracarpal pressure did not have a significant impact on finger joint kinematics. However, a trend towards a reduction in angular displacement for the MCP joint was observed. Augmentation of pressure also had a significant effect on the required force to pull the FDP and FDS tendons. Additionally, this study determined that the integrity of the flexor retinaculum had an influence on the range of motion of the index finger. A partially and fully released ligament exhibited an increased range of motion for the MCP and PIP joints.



P61. How Long Should my Video Documents Be to Allow Others Reproduce What I Diagnosed During Wrist Arthroscopy?

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Introduction: Arthroscopy has become a cornerstone of diagnosis and treatment of various wrist disorders. Concurrently, adequate documentation of arthroscopic findings is necessary. However, photos as well as videos have to meet specific quality criteria to allow reproducibility of diagnoses based on these documents. As for videos, an adequate length of the sequences was claimed. Therefore, the purpose of this study was to examine the relationship between video length for wrist arthroscopy and interobserver reliability.

Materials and Methods: 100 consecutive wrist arthroscopies were documented by pairs of long and short videos of the radiocarpal and the midcarpal compartments. The long videos were about twice as long as the short videos. During video recording, all joints were examined by the probe in a standardized manner from radial to ulnar. The pairs of videos were presented in a random order to two independent and blinded surgeons. The diagnoses they made according to these reviews were compared to the diagnoses made at the time of the arthroscopies. Kappa coefficients were calculated. We suspected that the cartilage status could be assessed more accurately by viewing the long videos than by viewing the short videos.

Results: Kappa statistics were inconsistent and did not show that the long video provided an obvious advantage over the short video. The two surgeons' Kappa coefficients for the assessment of the cartilage status were 0.524 and 0.700 for the long videos and 0.465 and 0.639 for the short videos, respectively. Using the short videos, the independent reviewers diagnosed twice as many false-positive cartilage lesions than they did when using the long videos. The assessment of ligament lesions according to long video sequences was more accurate than according to short video sequences.

Conclusions: The results confirmed the hypothesis that the reproducibility of diagnoses based on video documents was influenced by the length of the video sequences. Long video sequences reduced the risk of false-positive cartilage lesions. Furthermore, detection of relevant ligament lesions was more likely when viewing the longer videos. Therefore, it may be advisable for video documentation to be done diligently. Assuming that the median length of the videos in this study adequately displays the findings in a simple wrist, we recommend that a sequence of the radiocarpal joint should last about 60 seconds and that the sequence of a midcarpal joint should last about 45 seconds. Videos of difficult joints should last appropriately longer.

P62. The Impact of Trigger Finger on Hand Function, Quality of Life and Activity and Participation

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Introduction: The goals of the study were to: a) evaluate the impact of trigger finger (TF) on motor function, activity & participation (A&P) and quality of life (QOL); b) evaluate the association between personal factors (age and gender, disease severity) and body functions (dexterity and strength) with A&P and QOL in patients with TF.

Methods: Sixty-six patients with TF (study group) and 66 healthy volunteers (control group) participated in the study. TF symptoms were graded using the Quinnell classification. A&P was evaluated using the Disabilities of Arm Shoulder and Hand (DASH) questionnaire and QOL was evaluated using the World Health Organization Quality of Life (WHOQOL-BREF) questionnaire. Dexterity was evaluated using the Functional Dexterity Test (FDT) & the Purdue Pegboard Test (PPT) and strength evaluated with the Jamar Dynamometer (JD) and Pinch Gauge (PG). A hierarchical stepwise analysis was used to calculate the explanatory power of the independent personal (age and gender), disease severity (Quinnell grade) and impairment (hand strength and dexterity) variables on the dependent variables (DASH and global health related QOL).

Results: The comparisons between the study and control groups revealed significant differences in all measures. The study group reported lower perceived QOL, A&P and reduced hand strength and dexterity. Hierarchical regression analyses revealed that (a) the severity of TF contributed significantly to the explained variance of QOL, while, demographics and hand functioning did not; (b) demographics, TF severity and hand function all contributed significantly to the explained variance of A&P.

Conclusion: Although TF is considered a relatively mild condition, this study demonstrated its significant impact on all domains of the study model using the International Classification of Function framework. Measuring dysfunction with the DASH questionnaire is sensitive to different factors. In contrast, it is possible that the relationship between TF severity and QOL can be attributed to a prolonged period of disruption in daily life in individuals with more severe TF, which in turn affects psychological and physical well-being. Other factors, which will affect the DASH, will not have the same significant effect on QOL.

P63. The Use of Technology to Improve Patient Outcomes: A Smart Phone Survey

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Introduction: In 2014, a survey by Endgadget demonstrated that 2/3 of Americans have smart phones. This represents a large opportunity to utilize this technology to improve patient outcomes. Distal radius fractures are an extremely common fracture (Chung KC 2001) and recent literature has suggested that formal therapy may not be necessary (Souer JS 2011). However, there remains concern over identifying those patients that are not appropriately progressing in range of motion. Therefore, we would like to utilize technology to assist patients in their independent range of motion exercises while also utilizing a smart phone app to measure their ROM and monitor their progress. The first step in this process is to provide proof of concept.

Methods: After obtaining IRB approval, all patients presenting at the hand center with a unilateral distal radius fracture who were over 18 yrs. and were capable of giving consent were provided with a survey. This assessed demographics, smart phone ownership (including type of smart phone), ability to text, and interest in using apps to track exercises and measure motion.

Results: All patients given a survey completed it for a total of 31 responses. Age ranged from 24-79 with an average age of 52.5. 43% were male,. 26/31 owned smart phones with iPhone representing 46% and an avg. age of those with a smart phone at 51.7 and the oldest participant at 79 did have a smart phone. 96% of those with smart phones expressed an interest in an app to assist in and monitor their progress.

Conclusion: We provide proof of concept that the majority of patients with distal radius fractures do own smart and are interested in an app to assist them with their exercises and monitor their progress. iPhone was the most common smartphone owned, and while younger age was correlated with smart phone ownership although this was not a linear relationship. This preliminary work will guide development and use of smartphone technology to assist in rehabilitation of distal radius fractures.

P64. The Use of Technology to Improve Patient Outcomes: A Texting Study
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Introduction: The majority of Americans own smart phones (Endgaget 2014), which may be utilized to improve patient outcome. In a concurrent study, we distributed a survey to patients with distal radius fractures, which showed that 84% owned smart phones. Additionally, 96% expressed interest in apps to assist and monitor their rehabilitation. Prior to app development we needed to provide proof of concept. We developed a daily texting study in order to test patient willingness and ability to use their phone to monitor their adherence to the prescribed therapy program.

Methods: After obtaining IRB approval, patients were recruited from the previous technology survey. Eligible patients had a unilateral distal radius fracture and were actively engaged in a home therapy program. They also owned a smart phone with no history of texting overage charges. Once enrolled, patients would receive daily texts from their health care provider asking about completion of their wrist exercises. Failure to respond or a response of no resulted in a second text. Texts were sent for 30 continuous days. Patients were then asked about their experience in a post-text survey.

Results: Of the 26 patients identified from the technology survey, 21 were eligible for enrollment in the daily texting study. 14 patients chose to enroll. 10 were female. Age ranged from 24-65. We received a response, “yes, completed” or “not done yet”, on the first text of the day 77% of the time. When patients responded on the first text, “not done yet” was the response 8% of the time. And 34.4% of the time they did complete the exercises by the second text. When patients did not respond on the first text, 81% of the time they did not respond on the second text. On average, participants reported completing their daily exercises 81% of the days in the study. Age and gender did not impact response to texts or completion of exercises. In post text surveys, 100% felt that the daily texts were useful reminders and provided them with motivation to complete their exercises.

Conclusions: Patients are willing to and capable of using their smart phone to adhere to a daily exercise program, which is monitored by their health care provider. Patients found this interaction useful and motivating, which provides proof of concept for the development of an app to assist in patient exercises and to track/ monitor patient progress.

P65. Collagenase For Dupuytren DIP Joint Contracture

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Dupuytren contracture DIP cords are radial or ulnar, and extend beyond the superficialis tendon insertion. The current treatment is only fasciotomy or fasciectomy. The current on-label treatment of collagenase is 0.58 mg placed not more than 4 mm beyond the MCP crease. The remainder of the vial 0.32 mg is to be wasted. This study entails small (0.2 or 0.1 mg) doses of collagenase given for DIP joint contractures instead of wasting.

Methods: Patients with Dupuytren contracture affecting the DIP joint were offered the opportunity to have the extra collagenase from an opened vial to be given distal to the PIP joint for DIP contracture. The vial was reconstituted with 0.45 cc of diluent to 0.9 mg of collagenase. Circular dots were 0.2 mg of collagenase, X's marks were 0.1 mg of collagenase. Nine digits were available in the study and the results are from a single injection. Three patients (4,6,9) had previous fasciectomy.

Patient	Finger and Dose mg	PIP Before	PIP After	Gain PIP	DIP Before	DIP After	Gain DIP	F/U Months
1	L little .02 mg	-30	-5	25	-10	0	10	26
2	L little 0.1 mg	-65	-70	-5	-50	-30	20	2
3	L little 0.1 mg	-55	-65	-10	-5	0	5	36
4	L little 0.1 mg	-75	-60	15	-20	-10	10	30
5	R ring 0.2 mg	0	0	0	-20	0	20	6
6	L little 0.2 mg	-70	-60	10	-40	-35	5	1
7	R little 0.2 mg	-60	-70	-10	-15	-5	10	1
8	R little 0.1 mg	-30	-15	15	-30	0	30	1
9	R little 0.2 mg	-35	0	35	-10	0	10	9
	Average	-47	-38	8	-22	-9	13	12
	Median	-55	-60	10	-20	0	10	6

Results: An average gain in DIP extension from -22 degrees to -9 degrees. There were no tendon, or nerve injuries. Average gain was 12 degrees. Median gain was 10 degrees.

Conclusions: Small doses of collagenase can release distal Dupuytren disease.



Patient 7 Before



Patient 7 marked for injection



T

Two weeks later before manipulation (Patient 7)



After manipulation (Patient 7)



Two weeks post manipulation (Patient 7)



Patient 1 before and 26 months after .



Patient 9 before and 9 months after (note previous surgery to DIP joint green line)

P66. Vascularized Fibula Grafting for the Treatment of Bone Defects

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Introduction: Vascularized fibula grafting has been used in the treatment of large skeletal defects as well as recalcitrant atrophic nonunions and infected nonunions. Few studies have examined the factors contributing to nonunion of the fibula graft at one or both graft-recipient junctions, and specifically at the relationship of graft length to rate of union. The purpose of the current study was to determine if a correlation exists between length of the vascularized fibula graft and primary union of the graft-recipient interface at the proximal and/or distal junction.

Methods: 21 patients who underwent vascularized fibula grafting from 2002-2014 for the treatment of skeletal defects were included. Radiographs were assessed for union of the graft at the proximal and distal junctions. The rates of union at the proximal and distal junctions were determined with respect to the limb and graft orientation. The relationship between the length of graft utilized and union was assessed using Pearson Correlation.

Results: 71.4% of patients, with an average follow up of 30.2 months, achieved complete union at an average of 8.7 months. With respect to the limb, a union rate of 95.2% (20/21) was achieved at the distal graft-recipient junction compared to 71.4% (15/21) at the proximal junction ($p=0.038$). With respect to the graft orientation, a union rate of 90.5% (19/21) was achieved at the distal graft compared to 76.2% (16/21) at the proximal graft ($p=0.214$). The length of the graft did not have a significant correlation to the rate of union.

Discussion and Conclusion: The length of the fibula graft does not appear to have an association with the rate of primary union. Union reliably occurs at least at one end of the graft and complete nonunion of the graft is rare. However, if primary union is not achieved, likely nonunion will have occurred at the proximal graft-recipient junction.

P67. A Comparison of Proximal Row Carpectomy and 4. Corner Fusion in Patients Under 45. Years Old

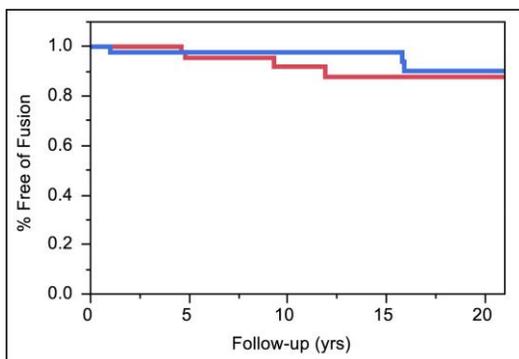
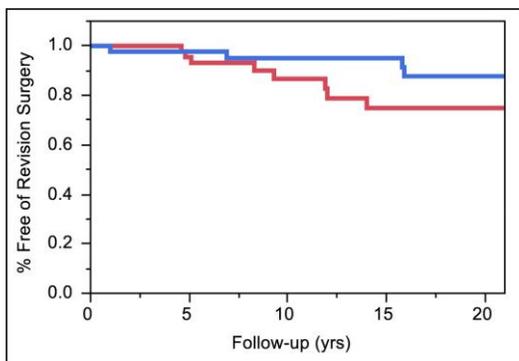
Eric Wagner, MD; Kapil Mehrotra, MD; J.D. Werthel, MD; Bassem T. Elhassan, MD; Steven L. Moran, MD
Mayo Clinic, Rochester, MN

Purpose: The purpose of this study was to examine the long-term survival-free of fusion, complications, and extremity function in patients under 45 who underwent either PRC or 4CF.

Methods: Review of 91 patients who underwent either 4CF (n=49) or PRC (n=42) under the age of 45 years from 1972 to 2008 for the diagnosis of wrist arthritis. Comparing 4CF and PRC groups, there was similar mean age (34 vs 32), but fewer laborers (47% vs 59%) and more males (92% vs 57%) in the 4CF than the PRC group. A similar percentage of patients in 4CF and PRC groups underwent AIN and/or PIN (35% vs 29%, p=0.72).

Results: The mean follow up was 15 years (2-41), including 12 years in the 4CF group and 18 years in the PRC group. There were 11 wrists that required revision to radiocarpal fusion (4 in 4CF and 7 in PRC group). Additional reoperations in the 4CF group included 4 revision 4CF for nonunion, 4 surgeries for impingement, while in the PRC group 1 patient was converted to a wrist arthroplasty, 1 ulnar head replacement, and 1 irrigation and debridement. The 10 and 20-year survival free of fusion rates for the 4CF and PRC were 92% and 88% versus 98% and 90%, respectively. The 10 and 20-year survival free of any revision surgery for the 4CF and PRC were 92% and 88% versus 98% and 90%, respectively (p=0.42). There was no difference in the number of patients reporting moderate or severe pain between PRC and 4CF groups (p=0.19). The mean flexion-extension arc was 53° after 4CF compared to 69° in PRC (p=0.01). Patients who underwent 4CF had slightly improved grip strength (65% of opposite side) compared to PRC (53%) (p=0.07). The mean postoperative DASH scores were 30 vs 20 (PRC vs 4CF) (p<0.001) and PRWE scores were 26 vs 30 (PRC vs 4CF) (p=0.20). Comparing radiographic arthritis, 63% of the PRC and 44% of the 4CF had signs of arthritis, including 40% PRC and 30% 4CF having moderate/severe arthritis (p=0.06).

Summary Points: Both 4CF and PRC represent a good surgical option for young patients with wrist arthritis, with similar survival-free of fusion, complication rates, pain levels, and wrist function. PRC has improved motion, but higher rates of radiocarpal arthritis.



P68. Short Term Results of Cemented Surface Replacement Arthroplasty in the Proximal Interphalangeal Joint

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Introduction: In 1979, the “surface replacement arthroplasty (SRA)” was reported to improve proximal interphalangeal (PIP) joint mechanics by limiting bone removal, preserving the collateral ligaments and unloading the component stems. PIP arthroplasty is an excellent option in alleviating pain and preserving motion, but revision rates range from 26 to 58%. We retrospectively reviewed our short term experience with a cemented SRA in the PIP (formerly AVANTA, now Small Bone Innovations™, Morrisville, PA USA) placed via a dorsal approach, from 2009 through 2014.

Materials and Methods: After institutional review board approval, a retrospective chart review was undertaken for all SRA PIPs from 2009 to 2014. Inclusion criteria was any patient who underwent an SRA PIP. No patients were excluded. Data included follow up duration and pre and postoperative range of motion in the PIP joint.

A dorsal approach was utilized with the collateral ligaments elevated proximally and the central slip split longitudinally. Placement of the prosthesis was undertaken in accordance with the manufacturer’s technique. Repair of the central slip and collaterals was performed through drill holes with 4-0 coated, braided polyester suture.

Aggressive postoperative therapy was instituted within one week with protective bracing followed by gentle progression with range of motion for 12 weeks with a certified hand therapist.

Results: Eleven female patients with 13 SRA PIPs were included in the data set. The average age at replacement was 63 years (range 55 to 79). Follow up averaged 8 months (range 2 to 30). Six (46%) replacements were in the middle finger, six (46%) were in the ring finger, and one was in the small finger (8%). Range of motion improved 4° (p = .30) (See Table 1). Complications included an intraoperative fracture of the middle phalanx (1/13), stiffness requiring capsulotomies (2/13), and one patient with a recurring volar dislocation requiring subsequent fusion. Total reoperation rate was 23% (3/13) for all arthroplasties.

Conclusions: Despite previous series reporting variable postoperative range of motion from 30° to 60°, we have demonstrated an average arc of motion slightly improved over other reports (65° versus 47°). We feel this is a result of aggressive supervised hand therapy focused on protected range of motion. Further research is anticipated to elucidate the optimal management of the SRA PIP.

Table 1. Passive range of motion measurements.

	Preoperative (degrees)	Postoperative (degrees)
Flexion	73	80
Extension	12	15
Arc of motion	61	65

P69. Ulnar nerve compression isolated to the motor branch: a case series of three unique etiologies

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Introduction: Compression along the motor branch of the ulnar nerve distal to Guyon's canal is both a rare and difficult clinical diagnosis with very few cases described in the literature. Here we describe a case series of four patients with compression of the ulnar nerve isolated to the motor branch, each with a unique etiology.

Materials & Methods: A chart review was performed of four cases where isolated compression of the ulnar motor branch was identified. All patients had a minimum follow up of one year. The preoperative and postoperative exam, nerve conduction studies and imaging studies were reviewed along with the operative note.

Results: Four patients were identified with ulnar nerve compression symptoms isolated to the motor branch distal to Guyon's canal. Three patients were treated surgically and each had a different cause of compression; an intraneural ganglion cyst, a constricting leash of vessels, and several soft tissue bands around the nerve. All three surgical patients had full resolution of pain and motor symptoms postoperatively. A fourth patient had full resolution of symptoms without surgical intervention.

Discussion: Intraneural ganglion cysts confined to the motor branch of the ulnar nerve are extremely rare and optimal treatment has not been established. This patient was one of four we describe with a unique etiology of compression distal to Guyon's canal. While this may present both a diagnostic and surgical dilemma, this case series demonstrates several types of unique pathology as well as successful treatment with and without surgery.

P70. Resident Exposure to Peripheral Nerve Surgical Procedures During Residency Training

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Introduction: While the effects of resident and fellowship training and case volume on surgical competence are incompletely understood, variability in training for peripheral nerve procedures may exist between specialties. The objective of this study is to assess ACGME case log data for graduating orthopaedic surgery, plastic surgery, general surgery, and neurological surgery residents for peripheral nerve surgical procedures and to evaluate the level of intraspecialty and interspecialty variability of peripheral nerve procedure case volume.

Material & Methods: Accreditation Council for Graduate Medical Education surgical case logs from 2009 to 2014 for plastic surgery, orthopaedic surgery, neurological surgery and general surgery residency were assessed and compared for peripheral nerve surgery experience.

Results: The average number of total peripheral nerve procedures performed per graduating resident was 54.2 ± 7.18 (95% CI, 48.4 to 59.9) for orthopaedic surgery residents, 62.8 ± 8.04 (95% CI, 56.4 to 69.2) for residents from independent plastic surgery programs, 84.6 ± 6.4 (95% CI, 56.4 to 69.2) for residents from integrated plastic surgery programs, 22.4 ± 2.4 (95% CI, 18.5 to 26.4) for neurosurgery residents, and 0.4 ± 0.24 (95% CI, 0.20 to 0.60) for general surgery residents. Intraspecialty comparison of the 10th and 90th percentile peripheral nerve case volume performed by orthopaedic surgery residents, neurological surgery residents and residents from independent and integrated plastic surgery programs in 2012 revealed remarkable variability in training. Within the orthopaedic surgery resident group, the bottom 10% reported 26 or fewer total peripheral nerve procedures per resident while the top 10% reported 102 or more, representing a 3.9 fold difference. Within the plastic surgery resident group from independent residencies, the bottom 10% reported 22 or fewer total peripheral nerve procedures per resident while the top 10% reported 111 or more, representing a 5.0-fold difference. Within the plastic surgery resident group from integrated residencies, the bottom 10% reported 21 or fewer total peripheral nerve procedures per resident while the top 10% reported 184 or more, representing a 8.8-fold difference. Within the neurological surgery resident group, the bottom 10% reported 6 or fewer total peripheral nerve procedures per resident while the top 10% reported 42 or more, representing a 7.0-fold difference.

Conclusions: There is significant interspecialty and intraspecialty variability in peripheral nerve surgery training for orthopaedic, plastic, neurological and general surgery trainees. Variability in residency training between the specialties is notable and may affect knowledge, skill, and practice patterns of surgeons.

P71. Flexor Tendon Repair with Looped Suture: One vs Two Knots

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Introduction: The use of looped suture in flexor tendon repair has facilitated multi-core repair with fewer needle passes and less tissue handling. We hypothesize that, after passing looped suture in the desired repair configuration, splitting the loop and tying two independent knots instead of a single knot increases the strength of flexor tendon repair.

Materials & Methods: Flexor digitorum profundus and flexor digitorum superficialis tendons were harvested and transected (n=32). The tendons were repaired with a 4-strand core suture repair completed with 3-0 looped Supramid suture. The harvested tendons were randomly assigned and repaired with either a one or two knot construct. The repaired flexor tendons were fixed to a MTS and were either loaded to failure with uniaxial tension or cyclically.

Results: The mode of failure in load to failure testing for the one knot flexor tendon repair was suture rupture for 4 repairs (50%) and suture pull out for 4 repairs (50%) whereas the mode of failure for the two knot repair was suture pullout for all 8 repairs performed (100%). The average force at failure was $43.01 \text{ N} \pm 14.22 \text{ N}$ (28.79 to 52.87) for the one knot repair and $25.04 \text{ N} \pm 9.28 \text{ N}$ (18.33 to 37.12) for the two knot repair ($p=0.031$). The mode of failure of 15 (100%) of the flexor tendon repairs that were cyclically loaded to failure was suture pullout. The average number of cycles and force in cyclic testing that caused failure of flexor tendon repairs was $134.71 \text{ cycles} \pm 65.77$ (95% CI, 68.95 to 183.43) and $31.08 \text{ N} \pm 4.89$ (95% CI, 26.19 to 34.70) for tendons repaired with looped 3-0 suture tied with one knot and $94.25 \text{ cycles} \pm 107.03$ (95% CI, -12.79 to 168.42) and 32.98 ± 29.05 (95% CI, 3.93 to 53.11) for tendons repaired with looped 3-0 suture tied with two knots ($p>0.05$).

Conclusion: This study suggests that when using looped suture, tying two independent knots instead of tying a single knot does not increase the strength of the flexor tendon repair.

P72. Predicting Failure and Complications in Total Wrist Arthroplasty; review of a 40-year experience

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Purpose: The objective of this study was to assess the results of our institution's 40 years of experience with primary total wrist arthroplasty, identifying factors associated with failures and complications.

Methods: We reviewed 425 total wrist arthroplasties with a minimum of 2-year follow-up over a 40-year period performed at our institution from 1974 to 2013. The mean age at surgery was 57 years, BMI 27, and 72% of patients were female. The average OR time was 185 minutes, while the average tourniquet time was 132 minutes. Surgical diagnoses included 22 (5%), osteoarthritis (OA), 375 inflammatory arthritis (88%), and 86 (7%) post-traumatic arthritis (PTA). There were 8 patients with a history of traumatic wrist instability. The implants in this study included Remotions (n=31), Biax (n=159), Volz (n=33), Meuli (n=138), Universal (n=7), and Swanson (n=57). Cement was used in 357 (84%), while 36 (8%) required bone graft.

Results: At a mean follow-up of 11 years (2-35), there were 110 (26%) revision surgeries performed at a mean 5.3 years postoperatively, while there was an additional 37 reoperations. Etiologies contributing to revision surgery include loosening (n=45), component fracture (n=11), infection (n=9), wrist instability (n=31), and other (n=26). The 5, 10 and 20-year survival rates were 84%, 74%, and 63%, respectively (**Figure 1**). The 10-year survival rates for the inflammatory arthritis (blue) and OA or PT (red) were 76% and 63% (p=0.06), respectively (**Figure 1**). The Remotion (HR 1.84, p=0.16), Meuli (HR 1.5, p=0.04), and Universal (HR 2.90, p=0.12) had slightly increased risks of revision surgery (Table 1). Patients with inflammatory arthritis had a slightly decreased risk of revision surgery (HR 0.63, p=0.10). There were 9 (2%) intraoperative complications involving a periprosthetic fracture, while postoperative complications included implant loosening (n=51), dislocations (n=46), recurrent subluxation (n=21) heterotopic ossification (n=7), deep infection (n=12), tendon/ligament injury (n=18), and wear (n=17). Of the 51 components with loosening, 46 had distal implant loosening. Dislocation rates were higher in the Meuli implants (p=0.03), while lower with the Swanson (p<0.01), and Remotion (p=0.01). Loosening rates were higher in older patients, as well as those receiving the Biax implant (p<0.01), but were lower in the Swanson and Remotion implants (p<0.02).

Summary Points: This series demonstrates a 74% 10-year and 63% 20-year implant survival after total wrist arthroplasty. Improved outcomes are seen in patients with inflammatory arthritis, while worse outcomes were associated with the Meuli, Universal, and Biax implants.

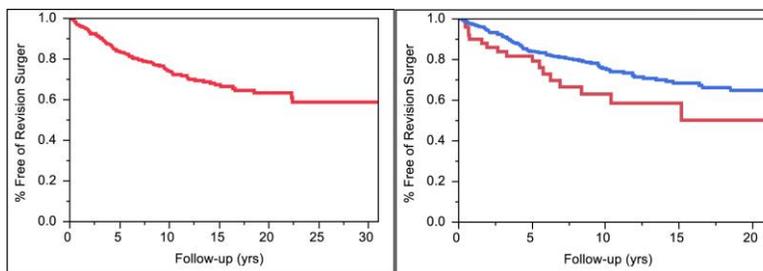


Table 1: Hazard Ratios for Implant Failure in Primary TWA			
Risk Factor	Hazard Ratio	Confidence Interval	P-Value
Age at Surgery	0.99	0.98 - 1.01	p = 0.43
BMI	1.01	0.99 - 1.02	p = 0.24
Female	0.99	0.66 - 1.54	p = 0.97
Osteoarthritis	1.65	0.69 - 3.30	p = 0.24
Inflammatory Arthritis	0.63	0.39 - 1.10	p = 0.10
Post-traumatic Arthritis	1.46	0.72 - 2.67	p = 0.28
Tourniquet Time	1.00	0.99 - 1.01	p = 0.79
Operative Time	1.00	1.00 - 1.01	p = 0.21
Preop Instability	1.87	0.31 - 5.93	p = 0.43
Remotion	1.84	0.77 - 3.75	p = 0.16
Biax	0.78	0.52 - 1.16	p = 0.22
Volz	0.51	0.16 - 1.21	p = 0.14
Meuli	1.50	1.02 - 2.18	*p = 0.04
Universal	2.90	0.71 - 7.76	p = 0.12
Swanson	0.66	0.35 - 1.14	p = 0.14
Prior ORIF	>10	13.19 - 13.19	p = 0.58
Bone Graft	1.68	0.88 - 2.94	p = 0.11
Cemented Implant	0.77	0.47 - 1.34	p = 0.34

P73. Online Patient Ratings of Hand Surgeons

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Introduction: The primary aim of this study was to evaluate online patient ratings (OPRs) of hand surgeons, hand surgeon online presence, and factors associated with positive OPRs and written comments.

Materials & Methods: 250 hand surgeons were randomly selected from the ASSH online member directory. Surgeon profiles were reviewed on three of the most commonly visited physician review websites (HealthGrades.com, Vitals.com and RateMDs.com) for demographic and rating data. Written comments were categorized as being related to professional competence, communication, cost, overall recommendation, staff, and office practice. Surgeon-specific data were also collected from Google, Facebook, and Twitter. Statistical analyses were conducted by a statistician.

Results: 245 hand surgeons (98.0%) had at least one OPR among the three websites. When Google searching hand surgeons, the mean number of top 10 results dedicated to physician review websites was 3.4. The mean number of ratings for each surgeon was 13.4, 8.3 and 1.9 and mean overall ratings were 4.0 out of 5, 3.3 out of 4, and 3.8 out of 5 stars on HealthGrades.com, Vitals.com, and RateMDs.com, respectively. Positive online ratings were significantly associated with a higher number of ratings and Castle Connolly status. No consistent correlations were observed between online ratings and surgeon gender, years in practice, practice type (i.e. private practice versus academics), and/or geographic region. “Online presence” was defined by five criteria – professional website, Facebook page, Twitter page, and personal profiles on Healthgrades.com and/or Vitals.com – and found to be the most strongly correlated variable with positive online ratings. Finally, positive written comments were significantly more often related to surgeon-dependent factors, while negative comments were related to surgeon-independent factors (see table).

Conclusions: Physician review websites feature prominently on Google and the vast majority of hand surgeons are rated online. This study highlights a fundamental difference in how patients and surgeons assess care quality.

	Mean Number of Written Patient Comments By Content Category					
	Surgeon-Dependent Factors		Surgeon-Independent Factors			
	Professional Competence	Communication	Cost	Overall Assessment	Office Staff	Office Practice
RateMDs.com						
4-5 stars (positive)	2.9	2.4	1.0	1.3	2.5	1.7
3 stars	1.3	1.3	1.0	0	1.0	1.2
1-2 stars (negative)	1.3	1.5	1.0	1.0	1.4	1.3
P Value	0.02	0.01	N/A	0.27	0.12	0.34
Vitals.com						
4 stars (positive)	2.5	2.8	1.5	1.3	2.0	1.4
3 stars	1.2	1.1	1.0	1.0	1.1	1.0
1-2 stars (negative)	1.8	1.8	1.1	1.1	1.6	1.7
P Value	0.05	0.01	0.16	0.56	0.34	0.26

P74. Regional Variations in Elective Hand Surgery Performed by Hand Surgeons in the Medicare Population

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Introduction: In this study, we aim to investigate the role that geographic region of practice has on hand surgeons' performance of elective hand surgery. We hypothesize that a significant variation in Medicare reimbursement exists among hand surgeons for commonly performed elective hand surgeries based on their primary geographic region of practice.

Methods: Using data from the American Society for Surgery of the Hand (ASSH), we identified all surgeons with active membership in the ASSH 2012. ASSH members' identifying data was matched with provider information from the Medicare database as produced by the United States Centers for Medicare and Medicaid Services (CMS). Members with inconsistent data between the two databases were excluded. Surgeons' primary state of practice was used for allocation to one of the ten established CMS regions. Raw data was analyzed to determine the most common surgeries performed across all ASSH members. Linear regression analysis was performed using data from each surgery of interest performed per region in conjunction with the 2012 United States census data. This was used to determine correlations between each region's total population, number of ASSH members, number of surgeries performed and CMS reimbursement. Average reimbursements were compared between geographic regions using ANOVA analysis for each surgery of interest.

Results: A total of 1,686 ASSH members satisfied inclusion in this study. The five most commonly coded surgical procedures across all ASSH members are outlined in Table I. There was significant variation in total CMS reimbursement per surgeon when compared geographically using ANOVA, as outlined in Table II. There was statistically significant negative correlation between the average reimbursement per surgery performed and the number of ASSH member surgeons per region and (R-sq = 26.9%, p < 0.0001) as well between the average reimbursement per surgery and the number of total cases performed per region (R-sq = 29.0%, p = 0.0). However, there was no significant correlation between the average reimbursement in a given region and that region's total population, or its population of Medicare beneficiaries.

Conclusions: Significant geographic variation exists among ASSH members with regards to CMS reimbursement for commonly performed hand surgeries. This variation does not appear to be influenced by population demands but rather due to supply of hand surgeons in a given region. This information may be especially useful for hand surgeons looking to optimize reimbursement and/or those who expect to treat a significant proportion of Medicare patients in their own practice.

I. TABLES

Table I.

	Open CTR	Trigger Finger Release	Endoscopic CTR	CMC Interposition Arthroplasty	Ulnar Nerve Transposition or Release
Procedure (Total Performed Across All Regions)	(35,320)	(25,044)	(11,292)	(3,911)	(2,068)
Region with Highest Total number of cases performed (No.)	5 (7778)	4 (6330)	4 (2445)	4 (1101)	4 (635)
Region with Highest Number surgeons performing that surgery (No.)	5 (217)	4 (165)	4 (54)	4 (57)	4 (36)
Region with Highest Median number cases per surgeon (No.)	1 (36)	4 (31)	3 (38)	4 (17)	3 (17.5)
Region with Highest Mean CMS Reimbursement per case (in USD)	2 (331.68)	8 (220.19)	1 (396.50)	1 (665.23)	3 (435.27)
Region with Highest Median CMS Reimbursement per case (in USD)	2 (347.44)	2 (202.50)	1 (401.79)	1 (665.65)	3 (440.59)

* CTR = Carpal Tunnel Release
 * CMC = Carpometacarpal

Table II.

CMS Region	No. Surgeons	Mean total CMS Reimbursement
4	333	\$89,128.00
2	162	\$76,944.00
3	183	\$76,863.00
1	123	\$68,725.00
9	184	\$63,347.00
6	133	\$58,256.00
5	312	\$57,082.00
7	73	\$51,495.00
8	70	\$45,850.00
10	88	\$45,159.00

Values in green have statistically significant difference than values in red (p < 0.0001)

P75. Orthopaedics or Plastics: Does Primary Surgical Specialty Have a “Hand” in Medicare Reimbursement?

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Introduction: The purpose of this study was to examine the relationship between hand surgeons' self-designated primary surgical specialty and their reimbursement from Medicare.

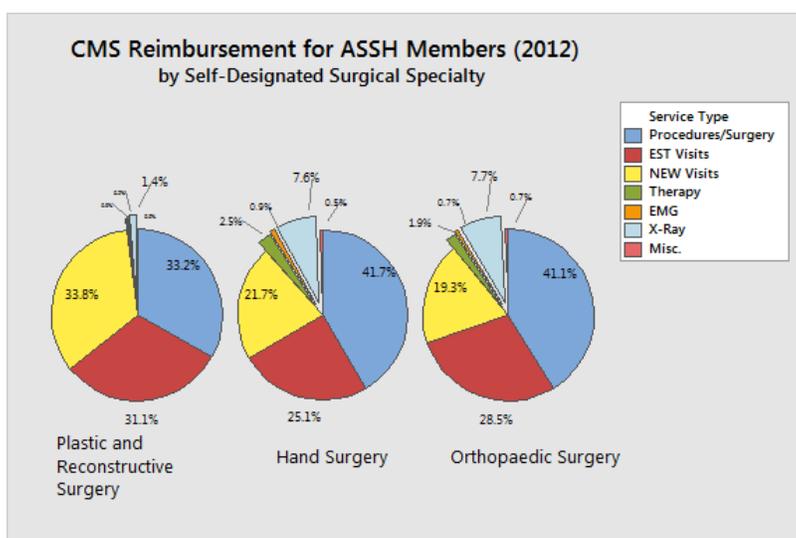
Methods: We queried data from all surgeons with active membership in the American Society for Surgery of the Hand (ASSH) in 2012. Identifying data for ASSH members was matched with provider information from the Medicare database produced by the United States Centers for Medicare and Medicaid Services (CMS). Members who did not self-designate their primary specialty as “Orthopaedic Surgery,” “Hand Surgery,” or “Plastic and Reconstructive Surgery” were excluded. Average reimbursements were compared between specialists using ANOVA analysis for each service provided.

Results: A total of 1,660 surgeons satisfied inclusion: 714 self-designated their primary specialty as Hand Surgery (HS), 764 as Orthopaedic Surgery (OS), and 182 as Plastic and Reconstructive Surgery (PRS). Surgeons designated as either OS or HS had similar total CMS reimbursement at \$72,530 and \$72,021, respectively, while PRS had significantly less total average CMS reimbursement, at \$32,477 per surgeon ($p < 0.0001$).

Among ancillary services, PRS received significantly smaller percentage of their total reimbursement from radiographs (PRS 1.4%, HS 7.6%, OS 7.7%, $p < 0.0001$), therapy (PRS 0.3%, HS 2.5%, OS 1.9%, $p < 0.0001$), and nerve testing (PRS 0.2%, HS 0.9%, OS 0.7%, $p < 0.001$). Proportion of reimbursement from office visits was greatest for PRS for both new (PRS 33.8%, HS 21.7%, OS 19.3%, $p < 0.0001$) and established patients (PRS 31.1%, HS 25.1%, OS 28.5%, $p < 0.0001$).

HS and OS had similar percentage of reimbursement from all surgical and in-office procedures (HS 41.7% vs. OS 41.1%) while PRS had a significantly lower proportion at 33.2% ($p < 0.0001$). For the most commonly billed surgical procedure, open carpal tunnel release (CPT 64721), PRS had significantly less total reimbursement (\$7,249 vs. HS \$11,046, OS \$10,848, $p < 0.0001$), though average payment per surgery was not significantly different between the three groups.

Conclusions: Though plastic surgeons receive substantially less overall CMS reimbursement per surgeon than other ASSH members, reimbursement rates are comparable to hand and orthopaedic surgeons for commonly performed elective hand surgeries. Plastic surgeons receive a majority of CMS reimbursement from office visits, whereas orthopaedic and hand surgeons receive a larger proportion of CMS payment from ancillary services and procedures. There does not appear to be a significant difference among ASSH members designated as Orthopaedic Surgeons versus Hand Surgeons for CMS reimbursement.



P76. The Prevalence of Pisotriquetral Arthritis in the Setting of Scapholunate Advanced Collapse

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Introduction: The purpose of this study was to determine the prevalence and severity of pisotriquetral osteoarthritis (PT OA) in patients with scapholunate advanced collapse (SLAC) as compared to a control population. We hypothesized that the prevalence and severity of PT OA would be higher among patients with SLAC wrist.

Materials and Methods: Magnetic resonance imaging (MRI) studies of 24 patients with SLAC wrist and 24 sex- and age-matched control patients were analyzed. Patients with SLAC wrist were selected from a database of wrist MRI studies performed at our institution from 2006 to 2015, excluding those with inflammatory arthritis, chondrocalcinosis, and incomplete or atraumatic scapholunate interosseous ligament rupture. Control patients, selected from the same database, underwent MRI for non-arthritic clinical indications. Clinical indications for control MRI studies included ganglion cyst (8), dorsal- and/or radial-sided wrist pain (4), FCR tendinopathy (2), soft tissue mass (2), median neuritis (2), CMC boss (1), index finger pain (1), radial sensory nerve lesion (1), tendon continuity (1), De Quervain's tenosynovitis (1), and spontaneous FPL rupture (1). Patients undergoing MRI for TCFE injury, ECU tendinopathy, or ulnar-sided wrist pain were excluded from the control cohort. MRI grading of arthritic change at the pisotriquetral joint was assessed by a musculoskeletal radiologist according to a 4-category scale: normal (grade 1), superficial wear (grade 2), high grade wear including full thickness chondral loss <25% of a joint surface (grade 3), and full thickness chondral loss affecting >25% of either joint surface (grade 4).

Results: The incidence of greatest arthritic severity (grade 4) at the pisotriquetral joint was found to be 8.3% in the control cohort, compared to 16.7% in the SLAC cohort (Table 2). This difference, however, was found to be not significant ($P>0.05$). Additionally, the incidence of PT OA in the control cohort was found to be 37.5% compared to 41.7% in the SLAC cohort, although binary analysis indicated that this finding did not reach significance ($P>0.05$) (Table 1).

Conclusion: We conclude that the incidence and severity of chondral wear at the pisotriquetral joint in SLAC wrist do not differ significantly from those found in control populations. Given reports of symptomatic PT OA developed following 4-corner arthrodesis requiring pisiform excision to alleviate pain, we recommend continued clinical vigilance for pisotriquetral dysfunction in patients with SLAC preoperatively to aid hand surgeons in identifying at-risk patients who may benefit from concurrent pisiform excision at the time of partial or total wrist arthrodesis.

Table 1. Incidence of Intact and Arthritic Pisotriquetral Joints in Control vs. SLAC Wrist

P-value: 0.768		Cohort		Total
		Control	SLAC	
Intact*	Count (%)	15 (62.5%)	14 (58.3%)	29 (60.4%)
Arthritic**	Count (%)	9 (37.5%)	10 (41.7%)	19 (39.6%)
Total	Count (%)	24 (100.0%)	24 (100.0%)	48 (100.0%)

*Intact joints are defined by articular cartilage that is either normal (grade 1) or affected by superficial wear (grade 2).

** Arthritic joints are defined by high grade chondral wear of articular cartilage including full thickness chondral loss up to 25% of a joint surface (3) or full thickness chondral loss affecting greater than 25% of either joint surface (grade 4)

Table 2. Incidence of Grades 3 and 4 Chondral Wear in Control vs. SLAC Wrist

P-value: 0.678		Cohort		Total
		Control	SLAC	
Grade 1 or 2	Count (%)	15 (62.5%)	14 (58.3%)	29 (60.4%)
Grade 3	Count (%)	7 (29.2%)	6 (25.0%)	13 (27.1%)
Grade 4	Count (%)	2 (8.3%)	4 (16.7%)	6 (12.5%)
Total	Count (%)	24 (100.0%)	24 (100.0%)	48 (100.0%)



Figure 1. Sagittal fast spin-echo MR image of the wrist in a 19 year-old boy demonstrates normal articular cartilage at the pisotriquetral joint (arrow).



Figure 2. Sagittal fast spin-echo MR image of the wrist in a 66 year-old man demonstrates extensively exposed bone over the pisiform (arrow).

P77. Smoking is associated with delayed bony healing following ulnar shortening osteotomy

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Introduction: The purpose of this study is to evaluate for an association between smoking and time to bony union following ulna shortening osteotomy using a dedicated osteotomy plating system.

Methods: We retrospectively reviewed the charts of consecutive patients who underwent ulnar shortening osteotomy over a five year span using a single osteotomy dynamic compression plating system. Orthogonal radiographs were analyzed by a blinded reviewer to determine time to bony union at monthly intervals. Bivariate statistical analysis with independent t-test was utilized for comparing time to union (in months) for dichotomous explanatory variables (gender, smoking status, alcohol use and hand dominance). Pearson correlation was used to analyze continuous variables (age, BMI and number of cigarettes smoked daily) relative to time to union.

Results: Seventy-two ulna-shortening osteotomies were performed in 69 patients, including 42 females and 27 males. Average age at the time of surgery was 44.2 +/- 12.2 years. 40 surgeries were performed on the dominant extremity. 17 cases were in smokers and 55 in non-smokers. The average time to union was 4.0 +/- 2.2 months for the entire cohort; time to union for smokers was 6.3 +/- 2.8 vs. 3.3 +/- 1.3 months in non-smokers ($p < .001$). Delayed union, defined as ≥ 6 months to union, occurred in 7 smokers and 1 former smoker with a history of Type II Diabetes. There were 4 revision surgeries for nonunion and hardware failure – 3 in smokers and 1 in a non-smoker. Revisions in smokers occurred at 2, 6 and 10 months. The revision in the non-smoker occurred at two months due to distal screw loosening. This patient had a known history of cerebral palsy and admitted to weight bearing through her arm for ambulation in the post-operative period. Hardware removal was performed in 13/72 (18%) of cases. Other complications included CRPS Type I in 1 patient and granuloma formation at the incision site in 1 patient which required excision. There were no post-operative infections. Gender, BMI and number of cigarettes smoked daily did not affect time to bony union. Time to union in diabetics was 5.1 +/- 2.5 months vs 3.9 +/- 2.1 months in non-diabetics, but this was not statistically significant ($p = .23$).

Conclusions: Despite the use of osteotomy-specific plating systems, smokers were found to be at higher risk for both delayed union and nonunion, the latter of which required revision surgery.

P78. Accessibility and Quality of Online Information Regarding Hand Surgery Fellowship

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Introduction: The Internet is a popular resource for applicants researching fellowship programs. Despite its wide-spread use, there is no standardization of content, quality, and accessibility of training program information on the Internet. The purpose of the current investigation was twofold: 1) to assess the accessibility of hand surgery fellowship websites and 2) to evaluate the quality of information provided via program websites. We hypothesized that fellowship websites would demonstrate highly variable accessibility and poor quality in the presentation of program information online.

Methods: The American Society for Surgery of the Hand (ASSH) Fellowship Program Directory was queried for review of American Council for Graduate Medical Education (ACGME)-accredited hand surgery fellowship programs. Provided links to program websites were explored for accessibility and quality of information. Program website accessibility from outside the directory was assessed using a Google search. Accessible websites were reviewed for the presence of the following fellowship educational components: didactic learning (lecture series), journal club, research requirements, call responsibilities, rotation schedule, operative case descriptions, office/clinic time, required meetings/courses, and list of teaching faculty. Fellowship recruitment information was also assessed and included: program description, application requirements, link to NRMP website, program contact email, current and/or past fellows, and salary. A χ^2 test was used to compare website accessibility between the ASSH Fellowship Program Directory and the Google search.

Results: Eighty-one ACGME-accredited fellowship programs were included for analysis. The ASSH Fellowship Program Directory contained a link to 72 program websites. Of the 72 websites, 11 links connected to non-functioning websites, 6 links connected to websites without program information, 29 links required multiple steps to access program information, and 26 links directly connected to program information. An independent Google search produced 70 direct links, demonstrating significantly more direct links to program websites than the ASSH Fellowship Program Directory (86% vs 32%; $P < 0.001$). Of the remaining 11 websites not accessible via the Google search, 2 were accessed via the ASSH Fellowship Program Directory for a total of 72 accessible program websites. Of the 72 accessible program websites, only 19% (14/72) featured at least two-thirds of the assessed quality components. Figure 1 summarizes fellow education and recruitment information quality, respectively.

Conclusions: Hand fellowship websites demonstrate highly variable accessibility. The vast majority of hand fellowship program information presented online is poor. Hand fellowship programs and professional societies should undertake efforts to ensure that fellowship applicants have access to high quality online program information.

P79. Use of Acellular Dermal Matrix to Prevent Recurrent Radioulnar Heterotopic Ossification

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Hypothesis: We projected that the recurrence of distal radioulnar heterotopic ossification can easily be prevented with interposition of an acellular dermal matrix at the time of excision of the heterotopic ossification while maintaining good post-operative pronation/supination range of motion.

Methods: Patient 1 is a 54 year-old otherwise healthy female who had undergone a radiocarpal fusion and a Darrach resection for severe wrist pain and decreased range of motion. The patient presented ten months later complaining of inability to supinate or pronate with X-ray confirmation of distal radioulnar heterotopic ossification. Using a saw osteotomy and an osteotome, the ossification was resected through a dorsal incision. Return of 60 degrees of pronation and supination was verified. Acellular dermal matrix (HD Flex) was sutured to itself in a cigar fashion and interposed between the radius and ulna with Tycron and Mersilene sutures. Patient 2 is an 83 year-old female with no medical problems that had a comminuted distal radius and ulna fracture treated with ORIF of the radius and Darrach resection. She presented with heterotopic ossification 3 months post-op and was treated in a similar fashion to Patient 1. Both patients were seen in follow up and were examined and had post-operative radiographs.

Results: At 1.5 years post-op Patient 1 remained without pain and has a return of her baseline pronation/supination. Radiographs show no evidence of recurrence of heterotopic ossification. Patient 2 at 1.5 years post-op is found to have complete range of motion of pronation/supination with no radiographic evidence of recurrence of radioulnar synostosis.

Summary: Radioulnar heterotopic ossification is a rare occurrence found in approximately 2% of all forearm injuries. It is even more rare to occur in the distal radioulnar joint. The main complication following resection of heterotopic ossification is recurrence. To prevent recurrence multiple methods including radiation, NSAIDs, and creation of a barrier have been proposed with mixed results. Barriers studied include a block of silicone, dermal/silicone sheet implant, interposition of muscle, free fat transfer, or even free vascularized flap transfer. We show that use of a readily available, commonly used product such as acellular dermal matrix can easily be interposed between the radius and ulna preventing recurrence of heterotopic ossification. Additional advantages include lack of donor site morbidity involved with harvesting local or distant flaps as barriers, and the facile nature of the operation making it easy to learn and implement.



Intraoperative placement of Acellular Dermal Matrix interposed between the radius and ulna (Patient 2)



Radiographs of Patient 1. Pre-op (left) showing radioulnar heterotopic ossification. Post-op (right) at 7 months showing no recurrence.

P80. Trends in the Utilization of Total Wrist Arthroplasty versus Wrist Fusion for Treatment of Advanced Wrist Arthritis

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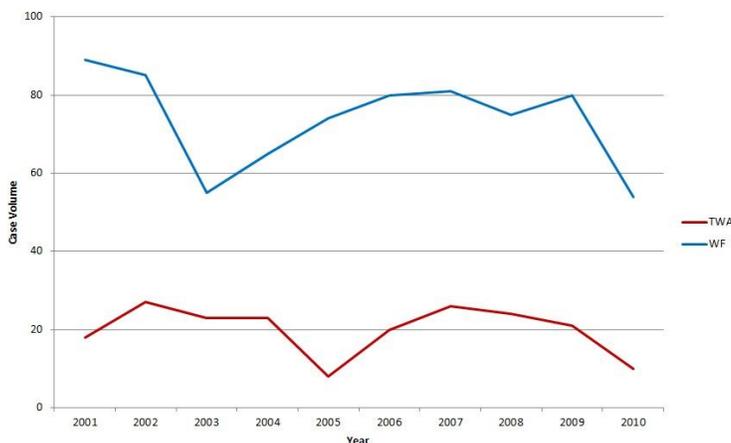
Introduction: The purpose of this study was to analyze data collected from the Nationwide Inpatient Sample (NIS) regarding Total Wrist Arthroplasty (TWA) versus Total Wrist Fusion (WF). We hypothesized that over a 10 year period utilization rates of TWA have increased.

Methods: NIS data from 2001 to 2010 was reviewed. Procedures were identified by searching for ICD-9-CM codes 81.73 (TWA) and 81.25 (WF). Patient demographic, comorbidity, and hospital charge data was compared using chi-squared tests and t tests for categorical and continuous variables, respectively. Linear regression modeling was used to determine national trends.

Results: NIS analysis identified 199 TWA and 738 WF cases that were extrapolated to a national prevalence of approximately 995 TWA cases and 3960 WF procedures. There was a decrease in the number of TWA cases per year ($p<0.05$), while the annual number of WF procedures remained relatively constant ($p=0.13$). There was, however, a steady increase in the frequency of TWA procedures observed from 2005 to 2007 following a decline from 2002 to 2005. Patients with malunion or traumatic arthritis were more likely to have undergone WF (malunion: 12% vs 3%, $p<0.001$; traumatic arthritis: 12% vs 3%, $p<0.001$). Rheumatoid patients were more likely to undergo TWA than WF (51% vs 16%, $p<0.001$). Patients receiving TWA tended to be older, female, and have rheumatologic disease. TWA patients also demonstrated a higher comorbidity burden and were more often insured by Medicare. Hospital charges were greater for TWA compared to WF (\$34,055 vs. \$27,079, $p<0.01$), though patients receiving WF had a higher percentage of perioperative device-related complications (6% vs. 3%, $p<0.001$) and respiratory complications (0.54% vs. 0%, $p<0.05$). LOS was similar between the 2 groups. Linear regression modeling demonstrated an increase in LOS from 1.7 days in 2001 to 2.9 days in 2010 ($p<0.05$) for WF.

Conclusions: Despite improvements in TWA ingrowth strategies, bearing surfaces, and the potential for preservation of wrist movement, WF was performed nearly four times more frequently. Overall TWA utilization decreased over the 10 year period despite being utilized more often in patients with underlying comorbidities. WF was associated with a higher risk of complications when compared to TWA during the index hospitalization period. Although LOS was similar between the 2 groups, TWA was associated with a higher hospitalization charge.

Figure 1. National trends of volume of total wrist arthroplasty (TWA) and wrist fusion (WF) from 2001 to 2010.



P81. The Use of the Semi-Sterile Technique for Closed Reduction and Percutaneous Pinning (CRPP) of Upper Extremity Fractures in Pediatric Patients

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Introduction: The vast majority of operative upper extremity pediatric fractures can be treated utilizing closed reduction and percutaneous pinning techniques (CRPP). While the norm is to perform a full surgical prep and drape during these procedures, this can be inefficient and wasteful of materials. The semi-sterile technique has been utilized in the treatment of pediatric supracondylar humerus fractures and was shown to have no difference in infection or complication rates. This technique utilizes only sterile towels and sterile gloves following prep of the limb with chlorhexidine paint. No scrub of the limb is performed, no drapes are utilized and no gowns are worn. The purpose of this study was to assess the use of the semi-sterile technique during CRPP of all pediatric upper extremity fractures.

Materials and Methods: A retrospective review was performed of all pediatric patients that underwent CRPP of an upper extremity fracture over a four-year period. During the study period, there was a transition from utilizing a full prep and drape to utilizing the semi sterile technique. Demographic data, the fracture location, and time period of pin fixation were recorded. Additionally, any infections or other complications were noted.

Results: 60 patients were reviewed including 44 in the semi sterile group and 16 in the full prep group. The average time to pin removal was 26 days (range 19-35 days). There was one pin tract infection in the full prep group in a four-year old female with a supracondylar fracture. Three patients had a nerve palsy following supracondylar fracture.

Fracture Types (n = 60)				
Semi Sterile Prep		Full Sterile Prep		Totals
Humerus	16	Humerus	10	26
Radius	15	Radius	4	19
Ulna	0	Ulna	0	0
Carpal	0	Carpal	0	0
Metacarpal	3	Metacarpal	1	4
Phalange	10	Phalange	1	11
Total	44	Total	16	60

Conclusion: The semi-sterile technique is a safe, efficient, cost-saving technique that can be utilized when performing CRPP of pediatric upper extremity fractures. Continuing to utilize full prep and drapes during these procedures adds medical waste while increasing costs and therefore should be abandoned. It is likely that this technique is also safe to perform in adult upper extremity CRPP procedures.

P82. Hand Surgery Fellowship Selection Criteria: A National Program Director Survey

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Background: Sub-specialty fellowships are available for those who wish to attain additional training after the completion of plastic surgery residency. While candidate requirements and characteristics desirable for plastic surgery residency are well established, those for hand surgery fellowship training still remain unclear, as no data is available in the literature. This study aims to provide information on some of the criteria that are used to select and rank applicants for the hand surgery fellowship match.

Method: A 38-question survey was sent in April 2015 to all ACGME-recognized hand surgery fellowship program directors (n=81) involved in the US match, by means of QuestionPro Survey Software™. The survey investigated the importance of a variety of factors used for selection and ranking of applicants, including medical school and residency training, research experience, fellowship interview, and candidate characteristics. A 5-point Likert scale was used to grade thirty-three factors from 1 (not at all important in making my decision) to 5 (essential in making my decision); or for five controversial factors from 1 (very negative impact in making my decision) to 5 (very positive impact in making my decision). All data was analyzed using IBM SPSS™ (IBM Corp., Armonk, N.Y.).

Results: A total of 52% (42 out of 81) of responses were received from ACGME-recognized hand surgery program directors. The most important factors were: interpersonal skills (4.6±0.7), interactions with faculty during interview and visit (4.5±0.7), evidence of professionalism and ethics (4.5±0.7), overall interview performance in the selection process (4.5±0.8), and letters of recommendation from hand surgeons (4.4±0.9). Factors that were least important included: Ph.D or equivalent (1.7±0.8), MPH, MBA, MS or equivalent (1.8±0.8), research fellowship (1.9±0.9), research grants awarded (2.3±1.0), and fluency in language(s) spoken by your patient population (2.3±1.2). Factors that have a negative impact on the selection process include: visa requirement (2.1±1.2), candidate planning to practice in the same city as the fellowship (2.4±1.0), and graduate of a foreign medical school (2.3±1.1).

Conclusion: This study provides data on hand surgery program directors' perception of the criteria important for fellowship applicant selection. The most valued criteria appear to be interpersonal skills, interview performance, and letters of recommendation. It is our hope that program directors, residency programs, and applicants find this data useful as they prepare for and participate in the hand surgery fellowship match.

P83. Ulnar Styloid Fractures: Is Their Neglect Truly Benign?

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Introduction: Fractures involving the base of the ulnar styloid may disrupt the foveal insertion of the deep portion of the distal radioulnar ligaments (DRUL). This component of the triangular fibrocartilage complex is theorized to assist with stabilization of the distal radioulnar joint (DRUJ). Thus, we hypothesize that ulnar styloid base fractures involving the ulnar fovea in a cadaveric model destabilize the DRUJ. Additionally, we predict that DRUJ stability is restored with reduction and fixation of the styloid fragment.

Methods: DRUJ stability in pronosupination was evaluated in six fresh-frozen upper extremities (4 females) aged 52-68 years (Mean: 58.7) using a custom jig, which allowed free rotation of the radius around the fixed ulna (Figure 1). Optical motion capture was used to record rotation and translation of the radius with respect to the ulna. Marker clusters were rigidly secured to the distal radius and ulna via threaded K-wires. Each specimen was subjected to 4 Nm of torque in both supination and pronation under four conditions: Intact, ulnar styloid osteotomy, ulnar styloid fixation, and DRUL transection. The styloid osteotomy freed the foveal insertion of the DRUL. Styloid fixation was performed with a headless compression screw under fluoroscopy to confirm anatomic alignment. DRUL transection was performed with a scalpel under direct visualization. Group differences were compared using a one-way repeated-measures ANOVA and Dunnett's multiple comparison post hoc tests.

Results (Table I): Ulnar styloid osteotomy and DRUJ disruption significantly increased pronation of the radius compared to the intact condition by averages of 10.0 degrees and 21.0 degrees, respectively. In contrast, only DRUJ disruption significantly increased supination of the radius compared to the native condition, by an average of 19.9 degrees. Pronation and supination after headless screw fixation were comparable to those seen after osteotomy. There were no observable differences in the translation of the radius.

Discussion: Ulnar styloid fracture treatment is controversial. Our study confirms that such fractures involving the fovea cause instability of the DRUJ in pronation. Thus, we conclude that ulnar styloid base fractures involving the fovea should be reduced and fixed to return stability to the DRUJ. In our experiment, fixation with a headless compression screw achieved anatomic reduction; however, it did not acutely return stability to the DRUJ as defined by limitation of pronation under 4 Nm of torque. While headless compression screws may adequately fixate these fractures in conjunction with forearm immobilization until healing, this will need to be confirmed.

Figure 1: Experimental Jig

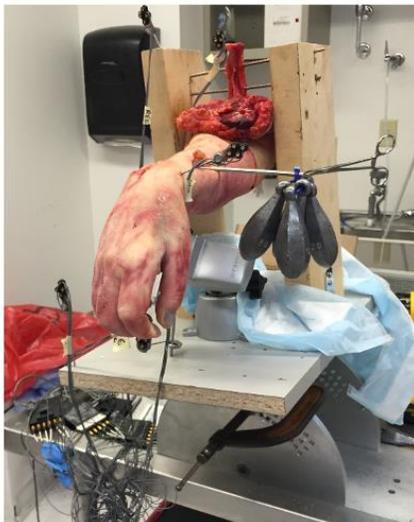


Figure 1 illustrates a cadaveric specimen in the experimental jig undergoing 4 Nm of pronation torque. Note the LED markers attached to the radius, ulna, humerus, jig base, and right jig tower. Also note the rotational capabilities of the jig base allowing the entire apparatus to be tilted left or right to ensure the torque pin is always parallel to the floor. There are two stabilizing, threaded pins in the humerus and one in the ulna (with an affixed marker).

Table I: Results

Wrist Condition:	Intact	Osteotomy	Fixed	DRUL Disruption
Pronation (degrees)	97.8 ± 16.6	107.8 ± 20.3*	107.6 ± 19.4*	118.8 ± 27.4*
Mean Difference		-10.0	-9.8	-21.0
95% CI of Difference		-16.7 to -3.3	-15.2 to -4.3	-40.0 to -2.0
Supination (degrees)	135.5 ± 30.6	143.4 ± 30.3	143.7 ± 31.4	155.4 ± 36.5*
Mean Difference		-7.9	-8.2	-19.9
95% CI of Difference		-18.0 to 2.3	-17.2 to 0.7	-32.5 to -7.4

Table I outlines the mean range of motion data for each condition averaged between all six study cadavers. Each experimental condition is compared to the intact condition to determine the mean difference.

"*" indicates statistical significance.

"CI" stands for "Confidence Interval."

P84. A New Method for Effective Screw Positioning to Support the Subchondral Bone in Volar Locking Plate Fixation in Distal Radius Fractures

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Introduction: Volar locking plates (VLPs) are widely used for the treatment of distal radius fracture. An important technical point is that distal locking screws should be appropriately positioned to support the subchondral bone and to minimize the postoperative loss of correction, which can adversely affect clinical outcomes. However, because the line of the subchondral bone is difficult to determine using radiographs during an operation, the distal screw is often positioned inappropriately, leading to the postoperative loss of correction or joint penetration by screws, which is an important complication of VLP fixation. We devised a technique that uses cannulated screws for distal screws. This study aimed to evaluate the effectiveness of our new method for adequate positioning of distal screws to support the subchondral bone.

Materials and Methods: Our new method for effective subchondral support involved a newly developed VLP that consists of cannulated locking screws for distal locking screws. A 0.8-mm guidewire was inserted along the subchondral bone via palpation along the bone, and cannulated locking screws were set in position. Our technique was applied to 29 patients (29 wrists) treated between October 2014 and June 2015. Twenty-eight patients showed distal radius fractures. One patient underwent correction osteotomy for radius malunion. Nineteen patients showed AO type-C fractures, 3 showed type-B fractures, and 6 showed type-A fractures. The follow-up period was 6–250 days (average, 96 days). We evaluated screw positions to measure the minimum distance between the screws of the first row and the joint surface by sagittal computed tomography on the day after the operation; further, we evaluated the degree of loss of correction by radiography.

Results: The average minimum distance between the screws of the first row and the joint surface was 1.15 mm (range, 0–3.91 mm), and joint penetration by screws was not observed. The average degree of loss of correction was -0.075° (range, from -1.6° to 1.3°) in volar tilt and -2.78° (range, from -10.3° to 0°) in radial inclination; the ulnar variance was -0.75 mm (from -1.64 to 0 mm).

Conclusions: Our technique of fixation of distal locking screws of VLPs can be used to achieve effective subchondral support.

P85. Inhibition of Cell Migration in Dupuytren's -derived Fibroblasts by Activation of Cyclic AMP (cAMP)

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Hypothesis: We hypothesized that increased activation of cyclic AMP (cAMP) pathways would reduce both basal and PDGF-induced cell migration of Dupuytren's contracture-derived fibroblasts.

Method: Fibroblasts harvested from actively diseased Dupuytren's contracture cord (DC) and from the adjacent grossly unaffected palmar fascia in the same patients (PF) were compared to fibroblasts derived from the palmar fascia of carpal tunnel (CT) patients. Cells treated with or without PDGF (2ng/ml) and/or forskolin (10 μ M, a known cAMP inducer) were subjected to an *in-vitro* wound healing "scratch" assay to measure cell motility into the denuded zone; photographs were taken at 0h and 48h and quantified.

Results: We found higher basal motility in DC- compared to unaffected palmar fascia (PF-) and CT-derived fibroblasts. PDGF stimulated cell motility in all three populations, and the addition of forskolin inhibited both basal and PDGF-induced cell migration in all three cell types. Interestingly, the inhibitory effect of forskolin on PDGF-induced cell migration was more pronounced in DC-derived fibroblasts compared to the other two cell types. Western blot analysis showed that neither PDGF nor forskolin exposure had any effect on phosphorylation of p38 and PI3 kinase in DC-derived fibroblasts. Both forskolin and PDGF increased p42/44 MAP kinase phosphorylation. In contrast, elevated cAMP resulted in increased RhoA phosphorylation and a subsequent decrease in the level of activated RhoA in DC-derived fibroblasts.

Conclusions: These results for the first time examine the effects of PDGF and cAMP on DC fibroblast motility and show that elevated cAMP can inhibit the actions of PDGF, possibly through a RhoA intermediary. Since fibroblast motility is one element that contributes to the tissue deforming forces that can result in clinical contracture, these results suggest that increasing cAMP in DC cells may be a means of forestalling clinical disease progression or recurrence.

P86. In Vivo Measurement of the Thenar Muscles and First Dorsal Interosseous in Thumb Carpometacarpal Joint Osteoarthritis Using Ultrasound Imaging

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Introduction: Osteoarthritis (OA) of the thumb carpometacarpal (CMC) joint is a significant medical problem, with an age-adjusted incidence of 7% in men and 15% in women. For the thumb CMC joint, stability has been implicated as one of the causes of OA. The focus of this study was to understand the role muscle integrity plays in thumb CMC OA pathogenesis by investigating whether the size of the abductor pollicis brevis (APB), opponens pollicis (OP), and first dorsal interosseous (FDI) varies between healthy control subjects and CMC OA patients.

Methods: APB, OP, and the distal FDI cross-sectional area (CSA) as well as first metacarpal (MC) bone length were measured using ultrasound. 13 control subjects (7 females, 6 males; ages 23-78) and 3 CMC OA patients with bilateral disease (2 females, 1 male; ages 46-49) participated in the study. A hand surgeon determined clinical and radiographic CMC OA. The CSA of each muscle was scaled by the MC length to account for differences in hand size. The effect of hand dominance on scaled CSA was evaluated using a paired, 2-tailed t test. The effect of OA on scaled CSA was determined using an unpaired, 2-tailed t test.

Results: The scaled CSA values for the APB, OP, and distal FDI muscles were compared between dominant and non-dominant hand in control subjects. The mean values are shown below along with p-values that indicate that there is no significant difference based on handedness. The scaled CSA for each muscle was compared between healthy hands and hands with OA. There was a significant difference between the two groups in the distal FDI, but not in the other muscles.

	Dominant Hand (N=13)	Non-dominant Hand (N=13)		OA Hands (N=6)	Healthy Hands (N=26)	
	Mean (SD)	Mean (SD)	P-value	Mean (SD)	Mean (SD)	P-value
APB	0.38 (0.12)	0.40 (0.08)	0.72	0.31 (0.06)	0.39 (0.10)	0.10
OP	0.48 (0.13)	0.46 (0.10)	0.57	0.37 (0.19)	0.47 (0.11)	0.08
FDI	0.67 (0.09)	0.70 (0.13)	0.46	0.68 (0.11)	0.43 (0.19)	0.0001

Conclusions: This study demonstrated that ultrasound is an effective method for measurement of hand muscles. Using this method, the study established that there is a decrease in scaled CSA in each of the muscles, with the distal FDI having a statistically significant decrease. Future prospective studies could be used to further evaluate the association between changes in muscle CSA and CMC OA disease, and determine if this method is viable for identification of at-risk patients and evaluation of interventions.

P87. Mangled Upper Extremities: Our Experience

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Introduction: Severe blast injuries represent a surgical challenge for the concomitant poorly vascularized soft tissues and multiple hand fractures. Controversies of treatment exist regarding the need of multiple surgical attempts to save the severely amputated limb

Materials & Methods: Two cases of severe blast and avulsion injuries are presented. Clinical examination in both cases showed severe right mangled hands with devascularization of the thumb, index, middle fingers. Multiple metacarpals, phalangeal fractures were present. Soft tissues were devascularized. Surgical priorities in order of importance consisted of: 1) debridement of devitalized tissues, 2) thumb reimplantation, 3) open carpal tunnel release and forearm fasciotomies, 4) reconstruction of the soft tissues with fillet flaps, groin flap and Integra placement, 5) open reduction and internal fixation of multiple fractures

Results: Postoperative, one patient required further debridement and soft tissue coverage with groin flap. Hand therapy was initiated and good progresses were achieved. Sensation of the right thumb was present in both cases and assessed with light touch and two point discrimination test. Pinch and grasping was achieved in both cases. \

Conclusions: Severe blast injuries represent a challenge and should be address with the following algorithm: debridement, reimplantation and revascularization, stable soft tissue coverage and bone fixation.

P88. Ultrasonication of Human Tendon Hydrogel Improves Cellular Integration into a Nano Matrix Scaffold

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Background: Hydrogels are an important class of biomaterial used in drug delivery and tissue engineering. They can act a delivery vehicle for cells and as a scaffold for three-dimensional guided tissue regeneration, with the potential to provide an ideal healing environment for improved repair strength after tendon injury or chronic tendinopathies. The aim of this study is to optimize human tendon hydrogel with ultrasonication to further decrease collagen fibril size, enhance cellular integration and create a modulable collagen network for delivery.

Methods: Ultrasonication at several settings were applied to human tendon hydrogel and compared to control hydrogel. Cell proliferation and viability were assessed by MTS and Live/Dead cells assays after one week. Hydrogel dimensions, porosity and cell-to-matrix interactions were characterized using a Scanning Electron Microscope and a Confocal Laser Microscope. Fiber measurements were quantified utilizing ImageJ Software. *In vivo* injection of control hydrogel and ultrasonicated hydrogel were injected into the rat dorsum.

Results: Increased cell proliferation was seen at day 7 with ultrasonicated hydrogel compared to control ($p=0.0002$) and Live/Dead assay confirmed viability. Scanning Electron Microscope demonstrated the creation of a porous network with an average pore diameter of $1.38\pm 0.73 \mu\text{M}$. The average collagen fiber diameter was $0.17\pm 0.06 \mu\text{M}$, which confirmed nano-hydrogel properties. Scanning Electron Microscope and Confocal Laser Microscope demonstrated the presence of cell clusters at day 1 post-reseeding in ultrasonicated gel with preserved hydrogel properties and therefore easier cell-hydrogel injection delivery compared to controls.

Conclusion: Human tendon hydrogels are a viable therapeutic delivery agent to enhance tissue healing. The application of ultrasonication further enhances the collagen network into nano fibers resulting in improved reseeding with retained hydrogel properties and therefore facile clinical application for combined cell-hydrogel delivery.

P89. Where the Sun Shines: Industry's Payments to Hand Surgeons

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Background: The Physician Payment Sunshine Act (PPSA) was recently implemented in the US to provide transparency regarding the financial transactions between industry and physicians. Under this law, the Open Payments Program (OPP) was created to publically disclose all transactions and inform patients of potential conflicts-of-interest (COI). Awareness of the OPP is crucial for hand surgeons, as its interpretation or misinterpretation can potentially affect trust between patients and hand surgeons. The goals of this study are to comprehensively evaluate non-research payments made to hand surgeons by industry and explore whether certain quantitative and qualitative variables affect payment amounts.

Methods: We performed a retrospective cross-sectional review of the first wave of OPP data (August 2013-December 2013) to quantify industry payments made to hand surgeons.

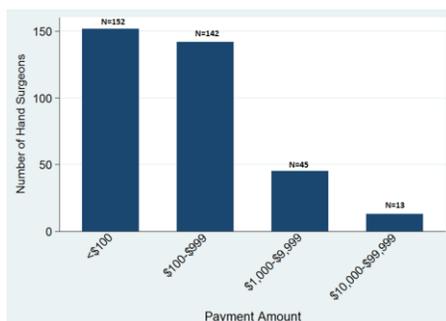
Results: Hand surgeons (N=352) received a total of \$598,705. Among these surgeons, 43% received payments <\$100 and 4% received payments >\$9,999. The median (IQR) was \$127 (\$42-337) and mean was \$1,701. The largest payment to an individual was \$93,591. The largest payment categories were for royalties (\$250,854) and consulting (\$95,110). Hand surgeons in academic practice received higher payments compared to those in private practice (median [IQR] \$250 [121-2,284] vs. \$110 [37-274], p<0.001).

Conclusion: Among hand surgeons, 50% received <\$127. Academic hand surgeons received greater payments compared to those in private practice. Although the PPSA brings transparency to the physician-industry landscape, it also highlights the OPP's risk for misinterpretation.

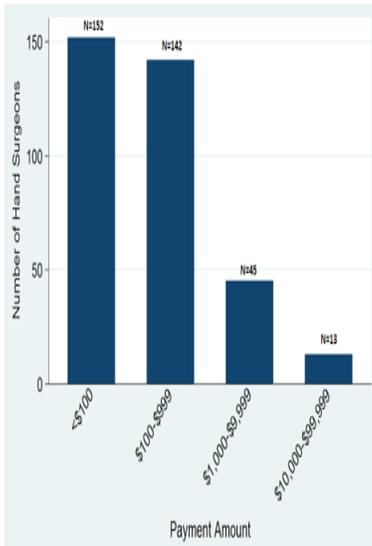
Industry Payments by Expense Category

Payment Category	Total Payment (%)	Median (IQR) per Hand Surgeon	Number of Hand Surgeons
Royalty or License	\$250,854 (41.90%)	\$8,069 (4,808-16,099)	16
Consulting Fee	\$95,110 (15.89%)	\$2,750 (700-7,250)	59
Speaker non-CEP	\$86,937 (14.52%)	\$4,000 (2,000-6,543)	17
Investment	\$58,010 (9.69%)	\$58,010	1
Interest			
Food and Beverage	\$50,973 (8.51%)	\$100 (33-203)	331
Travel and Lodging	\$38,210 (6.38%)	\$541 (141-1,072)	52
Education	\$12,594 (2.1%)	\$102 (3-277)	32
Honoraria	\$4,023 (0.67%)	\$2,011 (1,023-3,000)	2
Gifts	\$1,563 (0.26%)	\$114 (40-742)	4
Grant	\$431 (0.07%)	\$215 (131-300)	2

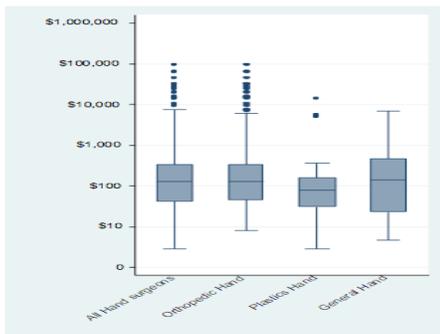
Payments Received per Hand Surgeon by Amount Category



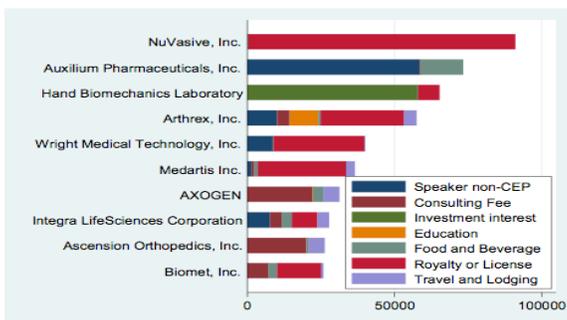
Payments by Hand Surgery Subspecialty



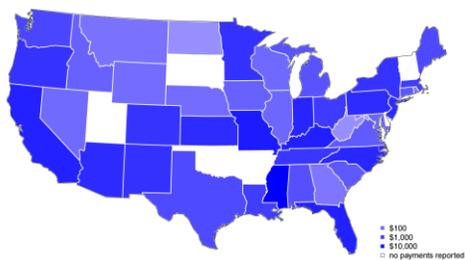
Category Payments of the Top 10 Companies



Total Payments made to Hand Surgeons by State



Average Payments/Surgeon by State



P90. A Novel Surgical Technique in Treating Mild Volkmann's Contracture

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Purpose: Traditionally, mild Volkmann's contracture was treated with tendon lengthening or scar tissue release. Although those procedures have good results, they are relatively complicated and traumatic. We recently have found a pathological structure in mild Volkmann's contracture, which originated from the proximal ulnar and connects to the affected muscle. Purpose of this study was to review the clinical results of resecting this structure for the treatment of mild Volkmann's contracture.

Methods: Twenty-nine patients with Volkmann's contracture were treated over a 9-year period. Among them, six patients were mild type according to Tsuge's classification. The median age of the six patients was 23 years (18-29). Interval from injury to operation ranged from three months to 15 years. Dissection of the contracture tissue was performed. The functional outcome was determined by comparing the range of motion of the affected finger, grip strength, and overall patient satisfaction.

Results: A small cicatricial band were found and excised on 4 patients who suffered from Volkmann's contracture for more than 8 years. The entire band was originated from the proximal ulnar. Divided the small band leads to instant extension of the contracture finger. The other 2 patients, who had the history less than 3 years, there was no similar structure found. Dissection and release of the scar tissue was performed in these 2 cases. All the 4 patients treated with band resection got normal range of motion at 3-5 weeks, and there is no recurrence during up to 39-month follow-up. There is no difference in grip strength before and after surgery at long-term follow-up. All the patients were satisfied with the outcome.

Conclusions: Chronic mild Volkmann's contracture commonly has a small band that limits finger movement. Resection of this band produces complete functional recovery. This is an easy and mini-invasive procedure with quick recovery.

P91. Ischemic Hand Complications from Intra-arterial Injection of Sublingual Buprenorphine/Naloxone Among Patients with Opioid Dependency

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Introduction: Sublingual buprenorphine/naloxone is a common treatment for opioid dependence. The buprenorphine component is a partial agonist of the mu opioid receptor and reduces the symptoms of opiate withdrawal. Naloxone produces an antagonistic effect when administered parentally, reducing the potential for abuse. Despite its design, the medication is still sometimes abused. A common misuse of the medication is to dissolve the gelatin strip and inject the medication intravenously. Inadvertent intra-arterial injection of buprenorphine/naloxone can produce acute ischemic insult to the hand due to gelatin embolism. Our purpose was to review a series of these patients in order to describe the clinical entity, review the outcomes, and propose a rational treatment algorithm.

Materials and Methods: A review was performed of all patients evaluated by the hand surgery team with ischemia of part or all of the hand following buprenorphine/naloxone injection between 2011 and 2015. Clinical records were reviewed. Demographic data, co-morbidities, smoking status, medical and surgical treatments, complications, and amount of tissue loss were recorded. Those patients presenting within 48 hours of the injection were treated with intravenous heparin and warming for 5 days, after which they were maintained on oral aspirin and clopidogrel for 30 days. Those presenting after 48 hours were treated with aspirin and clopidogrel only. Average follow up time was 13 weeks.

Results: A total of 10 patients presented during the review period. Eight patients had ischemia of the radial hand or digits, one had ischemia of the ulnar hand/digits, and one had both. Three patients presented within 48 hours of the injection and were treated with intravenous heparin. Five patients were treated with oral agents. Two patients presented over 30 days after injection with dry gangrene and did not receive anticoagulation. All patients experienced tissue loss, and there was no difference seen in outcome regardless of type of anticoagulation administered. Four patients required surgical intervention for debridement and reconstruction.

Conclusions: With the increasing use of sublingual buprenorphine/naloxone in opioid dependency, ischemic hand injuries from inadvertent intra-arterial injection will be seen with greater frequency. It is important for prescribers of this medication to inform their patients of the potential risks of attempted intravenous abuse. Whereas outcomes did not vary with treatment modality in this series, further study is needed to determine the most effective treatment of these injuries.

P92. Clinical and Radiographic Outcomes of Simultaneous Unilateral Basal Joint Arthroplasty and Scaphoidectomy with Four-Corner Fusion

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Introduction: Basal joint arthritis of the thumb and wrist arthritis are frequently treated with surgical intervention upon failure of conservative management. Not infrequently, patients will present with coexisting, symptomatic basal joint and wrist arthritis requiring surgical intervention. There is no current standard of care for these patients. It has become our practice to offer basal joint arthroplasty in the form of ligament reconstruction and tendon interposition (LRTI) along with scaphoidectomy and four-corner fusion at a single surgical intervention.

Methods: A retrospective case series was performed of patients who underwent simultaneous LRTI and scaphoidectomy with four-corner fusion for advanced basal joint and wrist arthritis respectively. Preoperative and postoperative visual analog scale (VAS) pain scores, postoperative active wrist flexion and extension, time to radiographic fusion, and first metacarpal subsidence (referenced from second metacarpal-trapezoid joint) were recorded.

Results: 6 patients and a total of 7 wrists were identified. The average age at time of surgery was 67 years (51-81). There were 4 males, 2 females. 4 out of 7 operative wrists were in the dominant extremity. The average operative time was 169 minutes (90-230). A 1-2 metacarpal pin was placed in 4 of 7 wrists according to surgeon preference. The average follow up was 12 months (3-64). Average time to radiographic fusion of midcarpal arthrodesis was 15.6 weeks (9-34). VAS scores decreased from an average of 8.3 (5-10) to 3.3 (0-8). Average postoperative flexion and extension were 37.6° (10-50) and 34.9°(10-45) respectively. Postoperative first metacarpal subsidence was an average of 6.3mm (3.9-10.9). No patients noted functional impairment from metacarpal height loss. Complications were a result of the arthrodesis hardware: 2 patients underwent loose screw removal; and another had the plate removed due to extensor tenosynovitis.

Conclusion: Simultaneous unilateral basal joint arthroplasty and scaphoidectomy may be performed safely in a single operative setting in the context of concomitant wrist and thumb arthritis. Patient outcomes demonstrate decreased pain with preserved wrist motion and metacarpal height. When compared to the historic studies, first metacarpal subsidence in these patients is similar to that of patients who undergo LRTI alone, despite the absence of the scaphoid.

P93. Evaluation of Percutaneous First Annular Pulley Release: Efficacy and Complications in a Perfused Cadaveric Study

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Background: Trigger finger is the most common entrapment tendinopathy, with lifetime-risks of 2-3 percent (diabetics ~10%). Open tenovagotomy is standard therapy associated with high success rates. Despite percutaneous trigger finger release (PTFR) success rates over 94%, controversy remains over its use due to fear of digital neurovascular injury. This study aimed to assess the safety of blind versus sonographically-guided (US) first annular (A1) pulley releases performed on a perfused cadaveric model (fig.1).

Methods: 155 (124 fingers and 31 thumbs) percutaneous A1 pulley releases were performed on un-embalmed cadavers (65 female, 90 male fingers) with restored perfusion (fig.2) and an 18-gauge needle. 45 fingers and thumbs were completed with US while 110 were completed without US. Each digit was dissected and assessed for A1 pulley release completeness as well as neurovascular, flexor tendon, and A2 pulley injury (fig.3).

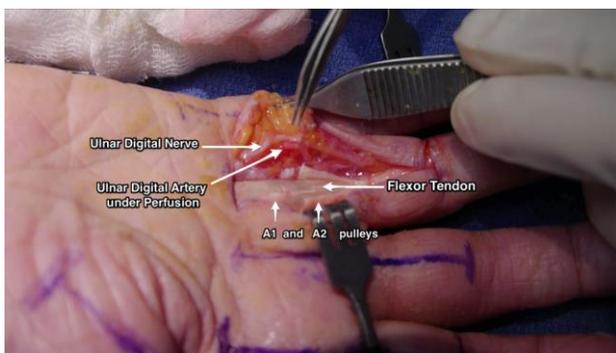
Results: Overall, 114 (74%) A1 finger and thumb pulleys were effectively released. There were 38 (24%) partial releases and only three digits were completely missed (2%) (fig.3). Thumbs had 28 complete (90%) and 3 partial releases (10%). Index fingers had 23 complete (74%), and 8 partial releases (26%); long fingers had 23 complete (74%), 3 partial (23%), and 1 missed release (3%); ring fingers had 15 complete (48%), 15 partial (48%), 1 missed release (3%); while little fingers had 25 complete (81%), 5 partial (16%), and 1 missed release (3%) (fig.1). Average percent of A1 pulley length released for all fingers was 93%. No significant flexor tendon injury (partial or complete lacerations) was seen in any digit, although longitudinal scoring was found in 35 fingers (23% overall; total of 9 ring fingers, 8 thumbs, 6 index, 6 middle, 6 little fingers). No digital, radial or ulnar, nerves was found to be injured (fig.5). Only one ulnar middle finger digital artery was lacerated (1%) in a finger with a partial flexion contracture. The ultrasound-guided PTFR technique was not more likely to result in a complete pulley release compared to the blind needle technique (80% versus 72%; $P < 0.26$).

Conclusion: Both blind and ultrasound-assisted percutaneous releases of the A1 pulley can be performed safely and effectively for all fingers including the thumb. Perfusion of cadaver digits enhances surgical simulation for PTFR training, especially for in-vivo identification of structures by US with doppler-flow. Our cadaveric data support published clinical investigations recommending percutaneous A1 pulley release in the management of trigger finger.

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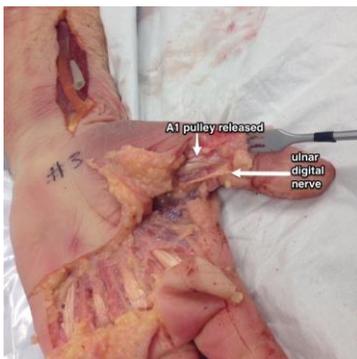
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FINGER	A1 Pulley Released (mm)	A1 Pulley Length (mm)	A1 Pulley Released (Total %)	A1 Pulley Effectively Released	A2 / Oblique Pulley Released (mm)	A2 / Oblique Pulley Length (mm)	A2 / Oblique Pulley Released (Total %)	FPL / FDS Tendon Injury	Radial Digital Artery Laceration	Ulnar Digital Artery Laceration	Radial Digital Nerve Laceration	Ulnar Digital Nerve Laceration
THUMB	9.3	9.5	98%		0.2	11.5	1%		23	31	31	31
				Complete 28	90%		No injury		8	0	0	0
				Partial 3	10%		Injury					
			Missed 0	0%								
INDEX	10.0	10.7	94%		0.8	13.3	6%		25	31	31	31
				Complete 23	74%		No injury		6	0	0	0
				Partial 8	26%		Injury					
			Missed 0	0%								
MIDDLE	10.5	11.4	92%		0.8	13.7	6%		25	31	30	31
				Complete 23	74%		No injury		6	0	1	0
				Partial 7	23%		Injury					
			Missed 1	3%								
RING	8.1	9.5	85%		0.6	12.0	5%		22	31	31	31
				Complete 15	48%		No injury		9	0	0	0
				Partial 15	48%		Injury					
			Missed 1	3%								
LITTLE	7.4	7.9	93%		0.6	10.7	5%		25	31	31	31
				Complete 25	81%		No injury		6	0	0	0
				Partial 5	16%		Injury					
			Missed 1	3%								

5.



P94. Evaluation of Skin Temperature in Cold Sensitivity after Fracture

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Purpose: The mechanisms related to abnormal cold sensitivity after hand trauma remain unknown and previous studies have indicated no change in digit skin temperature with cold sensitivity. The purpose of this study was to evaluate skin temperature responses with cold air exposure using continuous temperature monitoring in patients with cold sensitivity following hand fractures.

Methods: Adult patients with hand fractures more than 3 months after injury were evaluated. Using a validated protocol, cold air exposure was produced in a climate laboratory (1°C for 20 minutes) with baseline and recovery periods (20 minutes) at room temperature. Continuous skin temperatures were monitored by placing thermistor tips in direct contact with the skin on the dorsum of each middle phalanx to compare the injured and uninjured digits. The temperature data were collected with a data logger at a sampling rate of 8-second intervals during baseline, cold air exposure and recovery. Statistical analyses evaluated the relationships between the injured and uninjured hands and fracture location (distal vs. middle phalanx).

Results: Our preliminary data included four patients with hand fractures (distal phalanx n = 2, middle phalanx n = 3). There was a similar pattern of cooling in all digits with lower skin temperatures in the injured digits in 4 of 5 fractures. With cold exposure, the mean lowest skin temperature of the injured digits was $15.2 \pm 2.5^{\circ}\text{C}$ (range 17.9-12.1°C) and of the uninjured digits was $17.0 \pm 3.6^{\circ}\text{C}$ (range 21.4-12.5°C) which indicated wide variability in baseline and cold exposure skin temperatures. Comparison between injured and uninjured fingers showed significantly lower skin temperatures in distal phalanx fractures ($p = 0.01$). The mean difference between hands (injured vs uninjured) was significantly greater ($p = 0.01$) for distal phalanx fractures ($4.1 \pm .13^{\circ}\text{C}$) compared to middle phalanx fractures ($.25 \pm .87^{\circ}\text{C}$).

Conclusions: Our preliminary data indicated variability in the cold air responses following hand fractures. There were significant decreases in skin temperature in digits with cold sensitivity after hand fracture and these skin temperature changes were most evident with distal phalanx fractures. These results indicate that cold air exposure with continuous temperature monitoring may be a superior method to induce cold stress and to identify subtle physiologic changes associated with cold sensitivity. Future study is needed to evaluate skin temperature changes in a larger sample of patients and the relationship to self-report in cold sensitivity following hand trauma.

P95. “Diabetic Hand”: Clinical and Biochemical Profiles

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Introduction: “Diabetic Hand” denotes infections of the hand when diabetes associated complications accentuate the severity of infection and complicate its treatment. There is a paucity of literature regarding the clinical and biochemical profile of patients with diabetic hand.

Materials and methods: A retrospective analysis of patients admitted with diabetic hand infection at our tertiary care specialist hand unit between June 2004 to May 2010 were done, to identify and correlate the clinical presentation, biochemical and microbiological parameters, treatment and final outcome. The resulting data was analyzed using SPSS™.

Observations: Thirty nine patients (M:F 1.6:1) with Type 2 Diabetes Mellitus (DM), mean age 50.89 years with an average 6.42 years of diabetic treatment prior to presentation were identified. Only 11 patients had a prior history of trauma. 11 were newly detected diabetic. Others had a mean prior diabetic treatment of 6.42 years. Seven patients had undergone surgery elsewhere before presenting to us. 54 % of patients presented as necrotizing fasciitis (NF); 26% as abscess(AB), and 20 % as suppurative tenosynovitis(STS). The mean delay in seeking expert treatment was 6.1 days. The mean value of HbA1c was 10.07% and was statistically significant with type of infection; blood glucose value at presentation with the duration of treatment and delay in seeking treatment with the type of infection. The mean stay of patients in hospital was 17.72 days. The mean fasting glucose values at presentation and discharge were 17.42 mmol/land 6.29 mmol/l respectively. Gram negative bacterial infection was predominant with gram positive bacteriae seen only in nine patients. In patints with MRSA (n=5), the mean HBA1c was 13.52%. 31% (n=12) patients had only debridement as surgical procedure. 38% (n=15) patients needed skin and soft tissue cover procedures. 7 % (n=3) had flap (cross finger =2 & Reverse Posterior Interosseous Artery flap= 1) cover. 31% had Split skin grafting. 18% (n=7) required amputations. Three patients required bony stabilization and skin cover. Total 53.85% (n=21) patient required skin cover procedures.

Conclusions and clinical relevance: Diabetes mellitus turn the simple infection into grievous type, makes its treatment complicated and accentuates its morbidity. There is a narrow window of opportunity to diagnose and save diabetic hands. Control of Blood sugar is the best way to prevent diabetic hand infection. Early detection of infection saves limb and its function. All hand infections in diabetic patients must be aggressively treated.

P96. Risk of Injury to the Dorsal Branch of the Ulnar Nerve with Percutaneous Pinning of Ulnar-Sided Structures

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Introduction: Percutaneous pinning is a commonly used technique for stabilization of fifth metacarpal fractures, lunotriquetral joint instability, ulnar styloid fractures, or distal radioulnar joint (DRUJ) instability. However, ulnar-sided pinning of these structures may place the dorsal branch of the ulnar nerve (DBUN) at risk. The purpose of this study was to assess the risk of injury to the DBUN with percutaneous pinning of commonly stabilized ulnar-sided structures.

Methods: Eleven fresh-frozen cadaveric upper extremities were assessed. Percutaneous pinning of the neck and base of fifth metacarpal, lunotriquetral joint, ulnar styloid, and DRUJ with 0.045 inch Kirschner wires was performed under fluoroscopic guidance. Each specimen was then carefully dissected and the distance from the each pin to the DBUN was measured using a digital caliper. Direct injury to the DBUN was recorded. Pins that were found immediately adjacent to the DBUN were recorded. Comparisons between fixation locations were performed using Kruskal-Wallis/Mann-Whitney U tests and Fisher's Exact Test to analyze continuous and categorical data, respectively. The level of significance for all tests was $P < 0.05$.

Results: A significant difference in distance from pin to the DBUN was found among the pin locations ($P < 0.001$). Pairwise comparison revealed that the ulnar styloid pin was significantly closer to the DBUN than the fifth metacarpal neck ($P < 0.001$) and DRUJ pins ($P < 0.001$). The lunotriquetral pin was significantly closer to the DBUN than the fifth metacarpal neck ($P < 0.001$) and DRUJ pins ($P = 0.004$). Both the fifth metacarpal base ($P = 0.005$) and DRUJ ($P = 0.025$) pins were significantly closer to the DBUN than the fifth metacarpal neck pin. Two (18%) ulnar styloid pins and one (9%) lunotriquetral pin directly penetrated the DBUN, though no significantly greater risk of DBUN injury was found at any individual pinning location ($P = 0.493$). Of note, four (36%) ulnar styloid pins were directly adjacent to the DBUN. Data summarized in Table 1.

Conclusions: The current study demonstrates the close proximity (< 2 mm) of ulnar styloid and lunotriquetral pins to the DBUN. Although the occurrence of direct DBUN penetration was not significantly higher from ulnar styloid and lunotriquetral pinning in our series, we recommend performing mini-dissection with identification and protection of the nerve to mitigate the risk of iatrogenic injury due to its proximity to these sites.

Table 1. Data summary. N = 11.

Pin Location	Mean distance to DBUN \pm SD	Direct DBUN injury (%)	Pin immediately adjacent to DBUN (%)
Fifth Metacarpal Neck	4.97 \pm 1.47 mm	0 (0)	0 (0)
Fifth Metacarpal Base	2.33 \pm 2.16 mm	0 (0)	3 (27)
Lunotriquetral Joint	1.82 \pm 1.61 mm	1 (9)	2 (18)
Ulnar Styloid	0.84 \pm 1.05 mm	2 (18)	4 (36)
DRUJ	3.06 \pm 0.88 mm	0 (0)	0 (0)

Abbreviations: DBUN, dorsal branch of the ulnar nerve; SD, standard deviation; DRUJ, distal radioulnar joint.

P97. The Effect of Decentralization in Digital Replantation: A Study of the National Inpatient Sample

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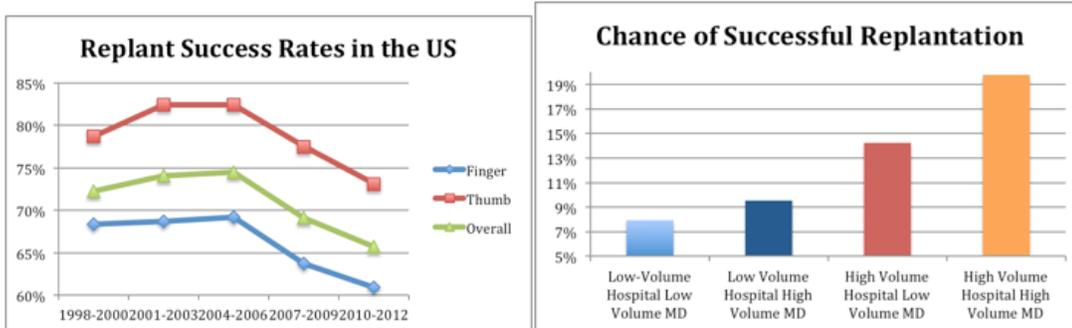
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Introduction: Recent reports suggest a decrease in success rates in digital replantation in the United States. We hypothesize that this may be occurring due to the decentralization of replants away from centers of excellence.

Materials and Methods: All amputation injuries and digital replantations captured by the National Inpatient Sample during 1998-2012 were identified. Procedures were characterized as occurring at high-volume hospitals (>20 replants per year) versus low-volume hospitals, and as being performed by high-volume surgeons (>5 replants per year) versus low-volume surgeons. A successful procedure was defined as one in which a replantation occurred without a subsequent revision amputation. Hospital and surgeon volume were tested for association with both the year of procedure and the success of the procedure.

Results: 101,693 amputation injuries resulting in 15,822 replantations were identified. The overall rate of success of replants dropped from 74.5% during 2004-06 to 65.7% during 2010-12 ($p<0.001$). The percentage of high-volume centers decreased from 15.5% during 2004-06 to 8.9% during 2007-09 ($p<0.001$). Similarly, the percentage of high-volume surgeons decreased from 14.4% during 1998-2000 to 2.6% during 2007-09 ($p<0.001$). High-volume surgeons had a higher rate of success than low-volume surgeons (79.3% versus 72.2%; $p<0.001$). Similarly, high-volume hospitals had a higher rate of success than low-volume hospitals (77.1% versus 70.9%; $p<0.001$). High-volume surgeons operating at high-volume hospitals had higher success rates than low-volume surgeons operating at low-volume hospitals (92.0% versus 72.1%; $p<0.001$). In addition, high-volume surgeons operating at high-volume hospitals attempted replantation at greater rates than low-volume surgeons operating at low-volume centers (21.5% vs 11.0%; $p<0.001$). Overall, an amputation injury presenting to a high-volume surgeon at a high-volume hospital had a 2.5 times greater likelihood of obtaining a successful replantation than a low-volume surgeon at a low-volume hospital.

Conclusions: These data suggest that one possible reason for decreased success rates of digital replantation in the United States is the decentralization of digital replantation away from high-volume surgeons at high-volume hospitals. The establishment of national centers of excellence for digital replantation referral may increase overall replantation success rates in the United States.



P98. Reorganization of Bilateral Control in Motor Cortex after Peripheral Nerve Crossing

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Objective: The results of treating upper extremity spastic paralysis, one of the most serious sequelae of severe CNS injury, are far from satisfactory due to limited fibers in the ipsilateral pathway. We conducted a peripheral nerve crossing surgery to increase the ipsilateral control of the hemiplegia limb by transferring 20% of the contralateral fibers to the ipsilateral side, generating a unique model in which both upper extremities are innervated simultaneously by one hemisphere.

Methods: After CCI injury of the left motor cortex in Thy1-ChR2-EYFP transgenic mice, peripheral nerve crossing surgery (CC7) were performed. These mice were subjected to behavioral tests to evaluate motor recovery of bilateral upper limb function and in vivo optogenetic-electromyography examination to map the dynamic changes at different stages postsurgery.

Results: For mice model of the CCI, the surgery caused higher score of the contralateral forelimb in rotarod and skilled walking tests after 5-month post-surgery. In vivo electromyography studies revealed that optogenetic stimulation of the intact motor cortex could evoke potentials in the bilateral triceps and forelimb extensors after 5-month and 7-month postsurgery, respectively. During this period, the cortical representations of the ipsilateral triceps and forelimb extensors shranked gradually and moved close to the cortical representations of contralateral muscles.

Conclusion: Peripheral nerve crossing could promote the functional recovery of contralateral upper extremity in mice with severe CCI. The intact hemisphere dynamically participates in controlling movements of the bilateral upper limbs. Such surgery could be a potential novel application in clinical treatment of brain injury.

P99. Assessment of Resident Technical Skill with the Use of a Novel Cubital Tunnel Release Technique

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Introduction: Current options to surgically treat cubital tunnel syndrome include *in situ* decompression, medial epicondylectomy, and several varieties of anterior transposition. A minimally-invasive cubital tunnel release using lighted retractors typically used for dissection of the breast and pectoralis muscle in general and plastic surgery has been developed. This project aims to illustrate the ease with which this novel approach can be taught to novice surgeons as well as describing a validated tool for assessment of surgical skill directly relating to a procedure commonly performed by plastic and orthopedic surgeons.

Materials & Methods: Ten plastic surgery and orthopedic surgery residents of varying years participated in this study. The lighted retractor technique that the residents were tested on was presented to them via Powerpoint format fifteen minutes prior to their examination. The resident evaluation was performed by one of our CAQ board-certified hand surgeons and included a detailed checklist of required surgical steps; a global rating scale; timing the procedure; and finally, performing a dissection to assess for complications. Study data was compared between junior and senior residents as well as a rho correlation analysis was performed to verify the validity of the assessment tools.

Results: Ten residents participated in the study. Validation measurements showed strong correlations between the pass/fail grade and the detailed checklist ($r=0.8$) and the global rating scale ($r=0.6$). Training year was most strongly correlated with the global rating scale ($r=0.8$) and there was a trend towards faster surgical time in the senior resident cohort. All residents completed a survey describing their prior experience with the procedure showing all senior residents had prior experience with this procedure however only two had previously performed the lighted retractor technique. All residents found the examination to be useful for their education.

Conclusion: This study demonstrated that surgical residents learned this novel cubital tunnel release technique and immediately performed the procedure in an examination setting with ease. This study also highlighted the importance of simulated clinical assessments to the advancement of a resident's education. While multiple choice examinations are a well-validated measure of assessing clinical knowledge, surgical residents have the added component of learning technical skill during their training. Furthermore, all residents favored including this and similar technical skill assessments in their curriculum to ensure they obtain targeted areas of improvement required for them to be well prepared for their practice after completion of their training program.

P100. Overdiagnosis of Distal Radius Buckle Fracture in Children

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Introduction: Distal radius buckle fractures are incomplete compression fractures of the distal radius metadiaphysis that commonly occur in children. These fractures can be treated with a splint or cast and their management continues to transition from specialty care to the primary care setting. This study hypothesizes that children who have complete fractures with cortical and/or physeal disruption are frequently misdiagnosed as having buckle fractures.

Materials & Methods: Hospital records were searched to identify children under age 18 years diagnosed with a distal radius fracture from January 1, 2013 to June 30, 2013. Exclusion criteria were: 1) substantial joint/bone deformity, 2) previous wrist surgery, 3) systemic disease, 4) multiple trauma, and 5) infection. Three blinded raters experienced in the interpretation of pediatric musculoskeletal radiographs, independently reviewed wrist or forearm radiographs to assess whether or not the distal radius fracture was a buckle fracture. A buckle fracture was diagnosed if there was buckling of the cortex on both the AP and lateral views without any cortical disruption, indicative of complete fracture, or without radiolucency to the physis, indicative of a Salter-Harris II fracture. Diagnostic accuracy was determined by comparing the diagnosis made by the radiologist and treating clinician to the gold standard diagnosis made by the reviewers.

Results: 585 patients (ages 0.9-17.9 mean 8.8 ± 3.7 years; 309 boys, 276 girls) with unilateral distal radius fractures met inclusion criteria. In cases of discrepancy between all 3 reviewing physicians, a consensus was obtained and used as the gold standard. The radiologist showed a sensitivity of 81% (115) for the 142 buckle fractures, a specificity of 79% (351) for the 443 non-buckle fractures, and a positive predictive value of 56% for diagnosing buckle fractures (207 diagnosed, 115 accurate). The treating clinician had a sensitivity of 87% (124), a specificity of 76% (338), and a positive predictive value of 54% (229 diagnosed, 124 accurate).

Conclusions: Fractures with cortical buckling but also with evidence of cortical disruption or physeal injury were frequently mistaken for benign buckle fractures in children. These non-buckle fractures are at risk for substantial complications, such as displacement and subsequent malunion. Salter-Harris II fractures are at risk for growth arrest and deformity. Careful attention must be taken for the proper diagnosis of buckle fractures in children. The establishment of rigid diagnostic criteria and subsequent education of those interpreting radiographs may help to limit misdiagnosis, incomplete follow-up, and possible adverse outcomes.

P101. A radiographic classification system of fifth metacarpal fractures

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Purpose: The current literature on 5th metacarpal fractures is riddled with differing opinions and a lack of consensus regarding ideal management. Due to this uncertainty, we aimed to review the demographics and create a classification system of 5th metacarpal fractures based on the rates of surgical intervention and radiographic characteristics to guide the practitioner in the management of these injuries.

Methods: 100 x-rays of patients with 5th metacarpal fractures were reviewed. Demographics and radiographic data collected included fracture location, pattern, amount of displacement, angulation, shortening, comminution and other associated fractures or dislocations. It was also assessed whether patients underwent a closed reduction or operation (percutaneous pinning or open reduction internal fixation).

Results: 70% of patients were male and 30% of patients were female. The mechanism was a punch injury in 80% of cases. 48.3% of fractures were Boxer's (neck) fractures. 15% of cases had multiple fractures on radiograph. 57.5% of all patients underwent a closed reduction and 18% of patients had surgical management of their 5th metacarpal fracture. Fracture patterns found to carry a higher likelihood of surgical intervention were spiral oblique fractures and transverse midshaft fractures requiring surgery in 80% and 33.33% of cases respectively. Most of the transverse midshaft fractures fixed operatively were angulated greater than 30 degrees. No neck fractures with angulation <40 degrees were fixed operatively. Patients with multiple fractures had a higher chance of undergoing an operative procedure than patients without multiple fractures. Based on these findings the following classification scheme was created.

Type 1 - Non-displaced fracture

Type 2 - Head/neck fractures

a - < 40 Degrees angulation

b - > 40 Degrees angulation

Type 3 - Shaft fractures

a - < 30 Degrees angulation

b - > 30 Degrees angulation

Type 4 - Base fractures

a - Extra-articular

b - Intra-articular

Type 5 - Spiral/oblique Fractures

Type 6 - Multiple fractures/fracture-dislocations

Conclusions: Certain fracture patterns (Type 3b and Type 5) appear to have higher rates of surgical management. This classification system allows practitioners to identify radiographic patterns more likely to require surgical intervention and therefore guide referrals to plastic surgery. For low risk radiographic types physical examination and patient demographics should guide the need for operative intervention.

P102. Utility of Ultrasonography versus EMG/NCS in the Diagnosis of Cubital Tunnel Syndrome

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Introduction: Electrodiagnostic testing (EDT) is the most common test used to confirm the diagnosis of ulnar nerve entrapment at the elbow. In comparison to EDT, the diagnostic accuracy of ultrasonography (US) is unknown. We hypothesize that US has a higher correlation to clinical examination findings and is more accurate at detecting ulnar nerve entrapment at the elbow than EDT.

Methods: Between January 2012 and January 2015, 51 patients were identified who underwent ulnar nerve decompression at the elbow by the same surgeon. 32 patients met the inclusion criteria of having a pre-operative EDT. 24 of those 32 patients also had an US evaluation of the ulnar nerve. Pertinent pre and post-operative clinical examination included: Tinel, elbow flexion compression test, Semmes Weinstein, 2-point discrimination, intrinsic muscle strength, and FDP strength testing. Chi square and fisher exact test were used for nominal variables. Wilcoxon / Kruskal Wallis tests were used for continuous variables. Statistical significance was set at a p-value of 0.05.

Results: 15 patients had a positive EDT result and 17 had a negative EDT result. All 24 patients who had US evaluation of the ulnar nerve at the elbow had a positive finding of ulnar nerve compression. There was a positive correlation between intrinsic strength improvement and FDP strength improvement for the patients with a positive EDT result (Table 1). All patients had an improvement in their DASH score with an average pre-operative DASH score of 51.04 and average post-operative DASH score of 20.67 (Table 2).

Conclusion: Ultrasonography is a fast, inexpensive, and accurate screening tool for diagnosing ulnar nerve compression at the elbow. EDT testing had an unacceptably high false negative detection rate of ulnar nerve compression at the elbow. US can be used to improve the diagnosis of ulnar nerve compression at the elbow and potentially change the current standards for diagnostic evaluation.

TABLE 1 – CLINICAL TESTING

EDT result	Percussion of ulnar nerve at elbow (Tinels)	Elbow Flexion Compression test	Semmes Weinstein (improvement)	2-pt disc (improvement)	Intrinsic Strength (improvement)	FDP Strength (improvement)
Positive (n = 15)	13 (86.7%)	10 (66.67%)	11 (73.3%)	14 (93.3%)	14 (93.3%)	12 (80%)
Negative (n = 17)	15 (88.2%)	15 (88.2%)	11 (64.7%)	10 (58.8%)	8 (47%)	6 (35.3%)
p-value	1	0.107	0.857	0.107	0.005	0.02

TABLE 2 - DASH

	Positive EDT, Positive US	Negative EDT, Positive US	All patients
Mean Preop DASH	58.029	46.05	51.04
Mean Postop DASH	24.66	17.82	20.67

P103. Patient Comprehension of Carpal Tunnel Surgery: an Investigation of Health Literacy

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Introduction: Health literacy has been suggested to include a set of individual abilities that allow a patient to acquire information about their medical conditions. Previous studies have suggested a lack of patient comprehension in orthopaedic trauma patients. The purpose of this investigation is to determine if elective surgical patients are able to obtain a satisfactory level of comprehension of carpal tunnel syndrome and release.

Methods: Patients with a diagnosis of carpal tunnel syndrome who elected to undergo isolated carpal tunnel release with a single surgeon were enrolled in the study. The patients were informed that they would be asked to complete a questionnaire at the post-operative visit regarding their surgery and post-operative instructions. The questionnaire was created directly from information that was provided through verbal instruction at the preoperative visit and a handout that was provided postoperatively.

Results: 45 patients (13 males, 32 females) were enrolled. 38 (84.4%) patients reported that their age was between 30 to 65 years, 2 (4.4%) patients reported that their age was between 18 to 30 years old, and 5 (11%) patients reported that their age was 66 years or greater. The average percentage of correct answers was 74.9% (95% CI, 69.6%-80.4%). Only 49% (n=22) percent of patients responded that the surgery was performed to decompress the median nerve. 46.7% (n=21) of patients reported that they did not know what nerve is involved, 4% (n=2) reported ulnar nerve, and 2% (n=1) reported axillary nerve. Education level (p=0.3), gender (p=0.29), and age (p=0.36) did not reveal any significant differences.

Conclusion: Although significant efforts to help patients achieve health literacy in carpal tunnel surgery were made, we found that patients continued to lack comprehension of pertinent components of carpal tunnel surgery, particularly understanding the involved anatomy.

P104. Biochemical Effects of Sagittal Band Continuity on Extension at the Metacarpophalangeal Joint

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Introduction: Subluxation of the extensor digitorum communis (EDC) tendon at the metacarpal phalangeal (MCP) joint is a result of both acute and chronic injuries to the sagittal bands. Although there are many published techniques to address chronic subluxation, none address the function and continuity of the sagittal bands. The purpose of this study is to determine the biomechanical impact of the sagittal bands on joint function. Our hypothesis is that any discontinuity in the sagittal bands will increase the effort required to extend the digit at the MCP joint.

Materials & Methods: 20 digits from 10 cadaver hands were studied in this experiment. Each hand was secured to a testing base with the extensor tendon of either the long or ring finger attached to a torsion frame to measure the force and tendon displacement. A digital camera was used to record high resolution video that was used to track the joint angles. Measurements for each digit were group by weight (0g, 50g, 100g, and 150g serially added at the proximal interphalangeal joint) as well as defect (control, ulnar, and bilaterally incised sagittal bands). Force, power, work, and the change in joint angle as a function of tendon displacement were calculated and expressed in each group a percent change from control. Variables were compared using Student's *t*-test; $p < 0.05$ is considered significant.

Results: In the experiments with no weight added (unloaded), the magnitude of force, power, and work decreased by 21%, 22%, and 28% respectively ($p < 0.0001$) in the groups with defects in the sagittal bands in comparison to their respective controls. However, these values were increased by up to 13% once there was weight added, although not by a significant margin. In unloaded digits, the change in angle correlating to each unit change in linear tendon displacement was increased by 15% ($p < 0.0001$) with a defect in the sagittal bands, but this was diminished once any load was introduced. There were no significant differences between the ulnar and bilateral defect groups.

Conclusions: Sagittal bands relate to the relationship between joint angle and tendon excursion in the unloaded digit. Although the amount of effort to extend the finger against load tends to increase when the sagittal bands are not intact, a higher powered data may be needed to find a significant difference if one exists. Nonetheless, the restoration of sagittal band continuity is an important consideration for centralization of the subluxed EDC tendon.

P105. Conventus DRS Intramedullary Fixation for Distal Radius Fractures: A Case Series

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Hypothesis: Conventus DRS is a novel FDA-approved intramedullary fracture fixation device used for distal radius fractures. We examine a series of 15 patients and report the outcomes. This is the first **Methods:** report of this device in the US.

15 patients with distal radius fractures (12 AO type C1 and C2; 3 AO type A2 and A3) underwent ORIF using Conventus DRS by a single surgeon. No tourniquet was used. Data including fracture type, angle of displacement, grip strength, wrist ROM, PRWE, and VAS pain scores were recorded at time of surgery and at follow-up.

Results: All patients (average age of 51 years; range 25 to 74) underwent uneventful ORIF. At first follow-up visit (average 9 days) all patients had full digital ROM (measured as 0 cm tip-to-palm distance). No patients required refilling of their immediate post-operative narcotic prescription. At average follow-up of 3 months (range 1.5 - 7) the VAS pain scores averaged 0.4 (range 0-7; median 1) and the PRWE averaged 22.7 (range 10.5-67). Grip strength was 30.9 kg (range 5-60) and ROM was as follows: WF 65 degrees (50-90), WE 71 (40-105), pronation 74 (60-80), supination 78 (70-90), ulnar deviation 26 (15-45) and radial deviation 14 (5-20). Two patients underwent prophylactic screw removal to prevent tendon irritation from a screw judged above the subchondral line on lateral view (Figure 1). One patient had 1-2mm settling of the distal fragment. Concern for hardware prominence is prompting prophylactic hardware removal. There were no other complications, including CRPS, in the series to date.

Summary Points: Conventus DRS is a promising alternative to established methods of distal radius ORIF. The complication rate of Conventus as published in their white paper was 8.3% (5 out of 60 patients): 1 hardware-related complication and 4 transient radial neuritis cases (1). The complication rate of volar plating ranges 3-34% in the literature. While we had an initially high prophylactic hardware removal rate (19%), we have modified the technique to reduce the potential for future hardware removal. The technique is notable for minimal postoperative swelling, rapid return of digital function, low pain scores, and lack of soft tissue complications. The Conventus DRS intramedullary device appears to be safe and effective for articular and non-articular distal radius fractures. A randomized trial is underway.



Figure 1. PA and lateral wrist radiographs of an asymptomatic post-op patient showing prominent dorsal screw, which was removed prophylactically to prevent tendon irritation.

P106. Decline in Hand Surgery Procedure Reimbursements Vary Widely Over Last Fifteen Years in the United States

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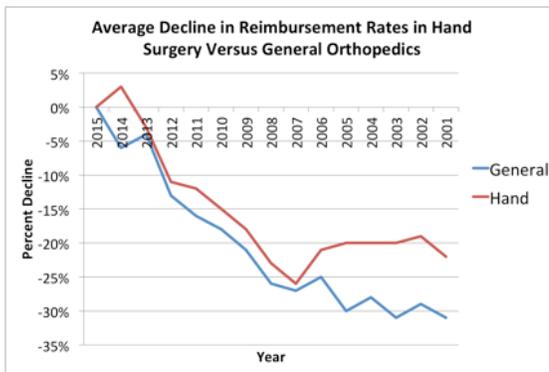
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Introduction: Reimbursement rates for surgical procedures have been slowly declining over the past 15 years in the United States. We sought to examine the rate of decline in the most commonly performed hand surgery procedures and compare that decline to the overall decline in general orthopedic procedures.

Materials and Methods: The top 25 most common current procedural terminology (CPT) codes were selected for hand surgery and general orthopedics from the American Academy of Orthopedic Surgeons Part 2 database. Medicare reimbursement rates were identified for each CPT code from the yearly Physician Fee Schedule provided by the Centers for Medicare and Medicaid Services. Reimbursements were adjusted for inflation throughout the study period according to the Consumer Price Index. T-tests were utilized to examine differences in average reimbursement declines over time.

Results: 48 of 50 (96%) CPT codes experienced a decline throughout the study period. The average rate of decline for hand surgery procedures was 22.2%. However, reimbursement declines varied widely from a 5.5% increase (open treatment of metacarpal fracture) to a 40.9% decrease (wrist arthroscopy; $p < 0.001$). In comparison, general orthopedic procedures declined significantly more than hand surgery procedures over the study period (33.5% versus 22.2%; $p < 0.001$). Overall, the average reimbursement for the most common hand procedures has not declined since 2007, while general orthopedic procedures have continued to decline.

Conclusions: There are wide discrepancies among declining reimbursement rates in hand surgery. These wide discrepancies could mean large differences in practice revenues based on procedure volumes and subspecialties within hand surgery. Overall, hand surgery reimbursements have plateaued since 2007, while general orthopedic procedures continue to decline.



CPT Code	Description of Procedure	Percent Decline
Top 5		
29846	Arthroscopy, wrist	40%
26115	Excision, tumor or vascular malformation	35%
24685	Open treatment of ulnar fracture	31%
25000	Incision tendon, (e.g., De Quervain disease)	31%
26055	Incision tendon, (e.g., for trigger finger)	31%
Bottom 5		
26615	Treatment of metacarpal fracture	12%
26951	Amputation, finger or thumb	12%
11760	Repair of nail bed	5%
64718	Neuroplasty and/or transposition; ulnar	5%
26746	Treatment of metacarpal fracture; articular	5% Increase

P107. Suture Button Suspensionplasty with Trapeziectomy: A Retrospective Analysis Utilizing a Novel Staging System for Proximal Migration

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Introduction: The purpose of this study is to retrospectively review the results of a technique for suture button suspensionplasty with full trapeziectomy utilizing a novel staging system for proximal migration. Traditional post-operative measuring systems, which measure the space between the metacarpal base and the scaphoid do not adequately account for arthritic changes and osteophyte formation, position of the metacarpal, or adduction contractures. Our goal was to create a postoperative staging system, which would be consistent irrespective of the degree of osteoarthritic changes or adduction contractures (Figure 1).

Materials & Methods: We evaluated 100 patients who received suture button suspensionplasty and full trapeziectomy with follow-up ranging from 1-2 years. We performed a radiographic analysis of proximal migration according to a novel staging system and measurement of abduction angle pre- and post-operatively.

Results: This staging system yielded excellent intraobserver and interobserver reproducibility. We found that 49 of the 50 control X-rays reviewed revealed that the thumb marker rested within stage 0. We demonstrated that 98% of our patients maintained a proximal migration stage of 0 or 1 (Figure 1 and 2). We also showed a statistically significant improvement in post-operative abduction angle (Figure 3).

Conclusions: Preliminary results of this staging system are favorable, but long-term follow-up studies are warranted. Our results indicate that this staging system is reliable and an improvement upon earlier methods for evaluating the degree of proximal migration pre- and post-operatively. We encourage this staging system to be utilized by other hand surgeons when deciding whether to operate on CMC arthritis of the thumb and/or to evaluate the success of the suspensionplasty.

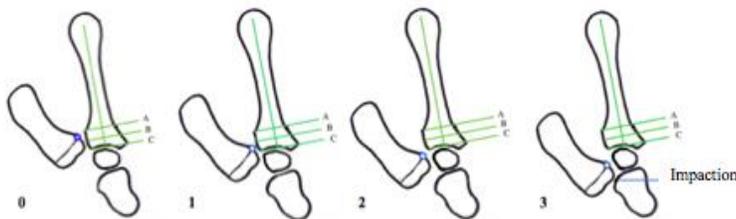


Figure 1. (0) Stage 0, (1) Stage 1, (2) Stage 2, (3) Stage 3—Failure/Impaction



Figure 2.



Figure 3.

P108. Patients Transferred to a Regional Medical Center for Emergent Hand and Upper Extremity Problems

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Introduction: Hand and upper extremity injuries are one of the leading causes of injury in the United states, making up to 10% of all emergency room visits. The complex nature of these injuries can often exceed the services available in rural and less populated areas, requiring the service of a fellowship trained upper extremity specialist. The purpose of this study is to identify the demographics, specific injuires, and reason for transfer of patients referred to a regional level one trauma center.

Methods: A retrospective review of our Hand trauma database was performed over a three year period from July 2011 to June of 2014. All patients accepted as transfers from another institution were identified. Demographic data were collected to include, gender, age, race, insurance status, injury type, mechanism, need for emergent surgery, reason for transfer. Descriptive statistics were calculated including means and standard deviations for continuous variables and frequencies for categorical variables.

Results: Patients transferred from outside institutions to MUSC are more likely to be uninsured or poorly insured, totaling 67.8%. Ninety five percent of patients were transferred from a level II hospital or higher. The most frequent reason for transferring was higher level of care needed or no hand specialist available. The average age was 38 years of age, 77% were male. Seventy percent of patients were white, 24% african american, 5 % hispanic. Patients were no more likely to be transferred on weekends than on week days. However, 61% of all transfer patients accepted to MUSC were transferred outside of normal hours of operation. Furthermore, 58.1% of the patients transferred outside of normal hours of operation required subsequent surgical correction by a hand or upper extremity specialist.

Conclusion: Hand injuries result in frequent emergency room visits. Many hospitals are lacking in hand specialist coverage and require transfer to regional medical centers for coverage. These patients tend to be male, younger and poorly insured.

P109. Lean and Green: Minimizing Waste in Hand Surgery

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Introduction: Costs associated with hospital waste disposal approximate \$360 million dollars, representing a significant portion of hospital resources. Approximately 30% of hospital waste is generated in operating rooms (ORs) representing a volume vastly disproportionate to their space utilization. Efforts to streamline OR processes and standardize practices has substantially increased waste production but may not benefit patient care or operating efficiency. Surgeon involvement is necessary to ensure patient safety and quality of care during coordinated efforts to improve efficiency and reduce the environmental burden of surgical procedures.

Materials & Methods: Routine hand surgeries appropriate to be performed under local anesthesia with a streamlined instrument set were identified. These included carpal tunnel releases, trigger finger releases, and cyst excisions. A subset of instruments necessary and adequate to perform these surgeries was culled from a standard instrument tray and processing costs determined. OR setup was altered to include minimal draping of the surgical field to reduce waste. Cases performed under local anesthetic using the streamlined hand pack were compared to similar cases performed under sedation using standard draping and instrumentation. Data from all applicable surgeries performed over nine months at a University-affiliated Surgery Center was collected to assess patient outcomes and measures of OR efficiency relevant to environmental impact. Red-bag and non-biohazard waste generated were weighed to the tenth of a pound to assess high-energy-disposal costs associated with biohazard materials. Two weeks post-operatively, patients rated their overall experience and anesthesia experience. Costs associated with performing surgery were determined from hospital charges and medical records.

Results: 67 cases performed under experimental conditions were compared with 103 cases performed with standard OR setup and sedation. Mean total weight of waste generated was 5.2kg for local cases and 5.6kg for sedation cases. The mean rating of overall surgical experience was 9.8 for both groups. The mean rating for anesthesia satisfaction was 9.7 for local and 9.2 with sedation.

Conclusions: While differences in trash generation, overall experience, and anesthetic satisfaction are not statistically significant, the immediate cost-savings are substantial. Standard cases cost more than double to setup with \$230 in material costs versus \$105 with easily streamlined processes. Furthermore, cases performed with local anesthetic avoided pre-operative testing and reduced overall costs by \$791-\$1,493 per case compared to using sedation which requires pre-operative physical, blood work, chest x-ray, EKG, and anesthesia. There were no differences in infection rate or recovery time.

P110. Congenital Syndactyly: Surgical Treatment of 391. Webspaces

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Introduction: Syndactyly is a common congenital hand anomaly characterized by the aberrant fusion of adjacent digits and obliteration of the interdigital webspace. We describe a large retrospective cohort of patients who underwent repair of congenital syndactyly to evaluate evaluate demographics, surgical technique and postoperative results of reconstruction.

Methods: A retrospective review was completed of all patients who underwent repair of congenital syndactyly between 1996-2014 by the senior author. Data included patient demographics, medical history, anatomic involvement, complexity of defect, surgical technique, postoperative follow up, and the need for operative revision. Univariate and logistic regression analysis uncovered factors which were associated with the primary outcome, post-operative wound complications.

Results: A total of 182 patients underwent reconstruction of 391 webspaces. The median age at initial surgery was 12.5 months and mean follow up was 3.0 years after initial surgery. 64.8% of patients were male, 35.2% were female. 64% of patients were Caucasian, 23% African American, 5% Asian and 3% Hispanic. 29% had a syndromic diagnosis, most commonly amniotic band syndrome (11%), Apert's Syndrome (10%) and Poland syndrome (8%). 17% of patients had a family history of congenital hand difference. Webspaces were affected in a 1:3:6:3 ratio (radial to ulnar respectively) with the third webspace making up 47.0% of all webspaces (Figure 1). 68.2% of involved webspaces had simple syndactyly while 31.8% were complex (Figure 2). Excluding patients who were referred for revision of previous syndactyly surgery complications (n = 20), 30 patients had complications after surgery (18.5%) of which 16 required revision (9.9%). Web creep was the most common complication (7.4%). Requirement of a skin graft significantly increased the risk of complication (OR=15.4, p = 0.001) as well as use of a z-plasty or variant thereof (OR=10.4, p < 0.001).

Conclusions: We describe our surgical experience at a high throughput children's hospital based on epidemiologic characteristics, surgical treatment and postoperative course. We show complication and reoperative rates that are comparable with published reports.

Figure 1:

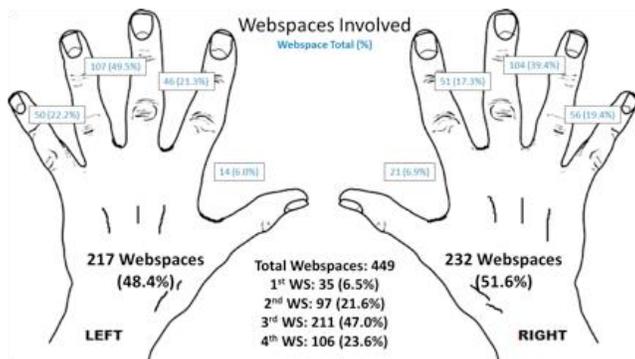
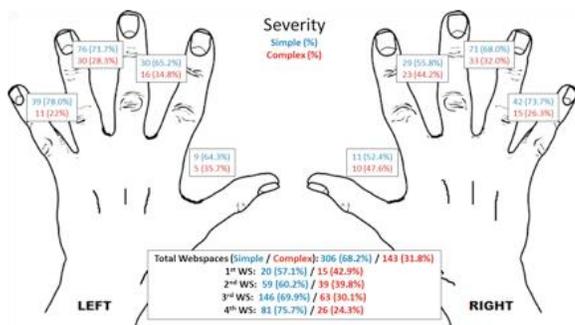


Figure 2:



P111. Recurrence of Ganglion Cysts Following Re-excision

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Introduction: The recurrence of ganglion cysts after surgical excision has a reported rate of 4% to 40%. However, recurrence after revision surgical excision is unknown. The purpose of this study was to define the incidence of recurrent ganglion cysts in patients who underwent secondary excision procedure.

Materials & Methods: With Institutional Review Board approval, we retrospectively identified by Current Procedural Terminology (CPT) code and reviewed charts of patients who had recurrent ganglion cyst excision. Recurrence was defined as reappearance of a cyst in the same area as prior. Patients were interviewed via phone or email. Demographics, recurrence, 3rd revision surgery and other variables were collected along with outcome variables such as patient satisfaction, pain levels, and functional limitations.

Results: Of the 44 revision cases identified 15 patients were reached. Time to recurrence of the cyst after the first ganglion cyst excision ranged from 1 month to 13 years with an average of 3.3 years. After the second ganglion cyst excision only 2 patients (13%, both volar) had a recurrence. The time to recurrence was 9 and 12 months.. One of the two patients underwent a third ganglion cyst excision successfully after reporting difficulty with day to day activities due to the cyst. The other patient declined surgical intervention and had no pain. Patients without a second recurrence (n=13) reported an average pain score of 0.2 ranging from 0-2 on a scale of 1-10. Two (15%) reported some difficulty with day to day activities due to the scar. Four patients (27%) reported other symptoms related to the scar and six patients (40%) reported at least transient numbness or tingling.. Patients reported an average satisfaction of 9.5 on a scale of 1-10. All patients would undergo another ganglion cyst excision should they have another recurrence.

Conclusions: Patients should be advised about the risk of recurrence after re-excision of ganglion cysts. Even though the incidence is similar to the recurrence of primarily excised cysts, all patients would undergo the procedure again if the cyst recurred.

P112. Patient-Reported Outcome Measures in Adults with Hand Trauma: A Systematic Review

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Introduction: Hand-related injuries are common. Several patient-reported outcome measures (PROMs) may be used in the clinical and research setting to measure the extent and impact of these injuries. At this time, it is unclear as to which PROM/s is/are appropriate in this population. The purpose of this review was to (a) identify the available validated PROMs in the hand trauma population, (b) report on their psychometric properties, (c) outline the domains addressed by each PROM, and (d) offer recommendations for their use in clinical practice and research.

Methods: A systematic review was performed using a standard search strategy on publications from January 1990 to Oct 2014 from MEDLINE, CINAHL, Cochrane Library, PubMed Clinical Queries, Scopus and Web of Science. Data extraction and synthesis was conducted therein.

Results: The search strategy yielded 416 hits. A total of 10 PROMs were identified, of which 8 PROMs were found to be validated in the hand trauma population. These were: Disability of the Arm, Shoulder and Hand (DASH), Manchester-Modified Disability of the Arm, Shoulder and Hand (M²DASH), QuickDASH, Michigan Hand Outcomes Questionnaire (MHQ), Cold Intolerance Symptom Severity questionnaire (CISS), Cold Sensitivity Severity questionnaire (CSS), Injured Workers Survey (IWS), and Hand Assessment Tool (HAT). In addition to validity, reliability and responsiveness data was also identified for these PROMs in the hand trauma population.

Conclusions: A well-selected PROM(s) is essential to measure change following treatment and throughout the recovery period, be it in a clinical or research setting. The DASH and the MHQ are the only two PROMs that have been sufficiently studied in the hand trauma population, and for which data are available on validity (criterion and construct), reliability (test-retest and internal consistency), and responsiveness. The domains of the DASH and MHQ are relatively inclusive with respect to hand trauma outcomes. Based on our findings, we recommend that the DASH, the MHQ, or possibly the QuickDASH be considered in all clinical and research cases of hand trauma. The CISS or CSS may be used as additional PROMs in geographically cold environments and the IWS in work-related injuries with suspected psychological overtones.

P113. Management of Idiopathic Segmental Axillary to Brachial Artery Thrombosis With Upper Limb Ischemia In A Newborn: A Case Report and Algorithm for Care

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Introduction: Literature regarding limb ischemia in the pediatric population is controversial and sparse; management of acute limb ischemia in neonatal patients is even less well described. Most of the literature in regards to the latter focuses on iatrogenic causes. We report a case of idiopathic segmental axillary to brachial artery thromboses in a neonate; we also report the successful management of this problem and suggest a protocol for the further treatment of such cases.

Methods: *Case Report*

A fullterm male with an uneventful prenatal course was born by elective C Section at an outside institution. At birth the left upper extremity was noted to be white. Radiographs were negative for fracture or dislocation. The extremity progressively became completely ischemic from the mid-humerus distal. There were no palpable or dopplable pulses in the limb and capillary refill was > than 10 seconds. Bedside duplex US showed obstructive clot from the axillary artery to the brachial artery with no arterial flow in the limb.

Results: *Clinical Course*

The patient's clinical picture deteriorated and the patient was transferred to the IR suite for intervention given the long segment of clot. Angiography showed thrombosis of the axillary artery with further thrombosis just distal to the profunda brachii. Reconstitution was seen at the brachial artery, and contrast was seen in the radial artery and palmar arch. Tissue plasminogen activator was then introduced into the clot in the axillary artery. After a delay, repeat angiogram showed increased perfusion. A heparin bolus and drip were started.

Prophylactic fasciotomy was performed in IR by the plastic surgery team from the carpal tunnel to the antecubital fossa. At the end of the procedure the muscle was pink and the skin edges were bleeding.

Over the ensuing 24 hours a triphasic signal was found on handheld Doppler in the palmar arch and there was normal capillary refill. At day of life 10, duplex US showed resolution of the thrombus in the left upper extremity.

Conclusions: Acute upper limb ischemia in the neonate and small child require prompt assessment and team care for treatment and optimal outcome. Often, in an acute traumatic iatrogenic injury that is isolated to a small segment of the artery, surgical exploration by a surgeon comfortable with microsurgery is best. If the thrombosis is congenital or is a long segment of thrombosis then an interventional radiological approach with angiogram and an attempt at thrombolytics may be prudent.

P114. A Novel, Less-Invasive Treatment Option for Traumatic Fingertip Amputations

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Introduction: Many treatment options for traumatic fingertip amputations are available to the surgeon, each with its advantages and disadvantages. Powdered porcine urinary bladder matrix (UBM) is a novel product that has shown promise for improving outcomes in a wide variety of settings. We hypothesize that powdered porcine UBM is a novel and viable treatment option for fingertip amputations because it is safe, effective, and well tolerated, providing successful healing and preserving maximum length.

Methods: UBM powder was applied to patients presenting with fingertip amputation injuries to the senior author's clinical practice. The treatment was used on 7 patients over the course of 3 years (2011 to 2014). Powdered porcine UBM was applied regularly until the digit healed. The total number of applications ranged from 3 to 31. Complications, presence or absence of neuroma, final range of motion, and DASH (Disabilities of the Arm, Shoulder, and Hand) scores were recorded. Patient satisfaction was determined through follow-up patient surveys. Statistical analysis was performed. Complication rates, incidence of neuroma, average time to healing, and the results of the DASH assessment were recorded.

Results: Ultimately, 86% of patients returned for follow-up. All returning patients displayed successful healing of the digit with maximum length preserved. Notably, there were no complications encountered. No patients had to undergo secondary operations. Additionally, there was no incidence of neuroma. No allergic reactions occurred. Significantly, these results came from a patient series with diverse mechanisms of injury and a range of comorbidities. Affected fingers treated with UBM showed excellent recovery, with maximum length preserved and healthy tissue growth in the affected regions. Time to healing averaged 54.33 days, with a standard deviation of 33.03 days. This time period varied with the severity of the injury.

Conclusions: Porcine UBM powder provided successful healing while preserving maximum length in a series of patients presenting with traumatic finger amputations. In addition to its marked efficacy, the treatment proceeded without any complications. It was well tolerated and patients were highly satisfied. Each case displayed complete and successful healing. The application of porcine UBM is a novel, advantageous, non-operative approach to the treatment of finger amputations that is safe and effective. Porcine UBM application is a promising non-operative alternative to the current treatment options for traumatic finger amputations.

Table 1: Patient Data

Patient	Age	Gender	Chief Complaint	Comorbidity	Number of Applications	Time to Healing (Days)	Complications
1	27	F	LSF amp.	Smoking	9	31	None
2	49	F	R-Thumb amp.	Depression, Hepatitis B	15	DNR	None
3	50	M	LIF amp.	None	6	12	None
4	70	M	RIF amp.	Coumadin, Thyroid Disease	3	63	None
5	5	M	RIF amp.	None	17	33	None
6	38	M	LSF crush/amp.	Smoking	17	111	None
7	24	M	LMF amp.	None	31	76	None

P115. Screw Penetration through Dorsal Cortex during Volar Plate Fixation of the Distal Radius: A Cadaveric Investigation

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Introduction: The surface of the distal radius is irregular, making it difficult to discern penetrating screws through the dorsal cortex during volar plate fixation. Undetected screw penetration or drill plunging puts the extensor pollicis longus (EPL) tendon at risk for injury or even rupture. Intra-operative detection of possible screw penetration is important since it can be corrected. This study was designed to investigate the incidence of screw penetration through the dorsal cortex of the distal radius relying solely on the careful use of the depth gauge to determine the screw length.

Methods: Ten fresh frozen human cadaver arms were instrumented with a commercially available distal radius volar plate system under direct supervision of a fellowship trained upper extremity specialist. Plates were sized to best fit the contour of each specimen. Pending on plate width, 7-8 screws were placed in each plate; 1 proximally and 6-7 distally. Screw lengths were measured twice using a standard depth gauge to improve accuracy. After plate fixation was complete the specimens were dissected dorsally to investigate for screw penetration through direct visualization. Screws protruding into soft tissues from dorsal penetration were removed and replaced with screws of proper length.

Results: Ten cadaveric specimens had a total of seventy-four screws placed into a volar distal radius locking plate. Seven (9.5%) of the screws had to be replaced secondary to dorsal penetration into soft tissue. Five of the seven screws were noted to be in direct contact with the EPL tendon. Protruding screws had to be reduced on average 2mm.

Conclusion: Relying on the depth gauge alone to determine screw length resulted in 9.5% of volar plate screws penetrating the dorsal cortex and protruding into the surrounding soft tissue. Interestingly, approximately 72% of the screws penetrating the dorsal cortex were in plate positions that put the EPL at risk. Use of the depth gauge alone provided accurate measurement for the majority of the screws placed, however this data supports the need for proper intra-operative radiographs to guide screw length and placement.

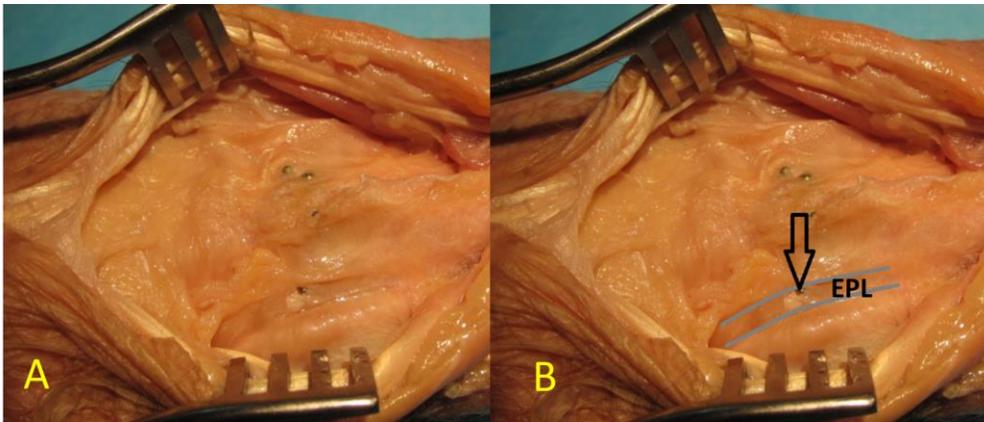


Image A Showing Screw Protrusion into Soft Tissue

Image B Pathway of Extensor Pollicis Longus (EPL)

P116. Accuracy of Emergency Room and Urgent Care Center Pediatric Upper Extremity Diagnoses

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Introduction: Urgent care centers and emergency rooms are the first line in diagnosing and managing acute pediatric upper extremity injuries. Diagnosis and management of acute upper extremity injuries in the pediatric population can be challenging because of the difficulty obtaining a thorough physical examination and skeletal immaturity on radiographs. The purpose of this study is to assess the accuracy of the diagnosis patients receive from emergency rooms and urgent care centers.

Materials and Methods: All patients who presented for initial injury evaluation after being seen in an urgent care center or outside emergency room were recruited prospectively for this study. Patients who were not given official documentation detailing their injury were excluded. A blinded comparison was made between the official discharge diagnosis and the diagnosis made at evaluation by the orthopaedic surgeon. Simple statistics were performed.

Results: 48 patients were enrolled including 33 patients triaged in emergency rooms and 15 in urgent care centers. The overall correct diagnosis rate was 73% (35/48). Emergency rooms diagnosed acute pediatric upper extremity injuries 70% (23/33) correctly in comparison to 80% (12/15) in urgent care centers. Of the 13 incorrect diagnoses, nine were missed fractures (both-bone forearm, supracondylar, distal radius, proximal humerus, metacarpal, scaphoid, and monteggia variant), one was a missed elbow sprain, two were misdiagnosed fractures as sprains, and one patient with a healing supracondylar fracture was misdiagnosed as a new injury.

Conclusion: Emergency room and urgent care center diagnoses of acute pediatric upper extremity injuries are only accurate 73% of the time. Better education is likely needed for emergency room and urgent care center providers in order to improve accuracy when diagnosing acute pediatric upper extremity injuries.

P117. Long Term Outcomes of Wilson Osteotomy for Thumb Carpometacarpal Arthritis

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Purpose: An abduction wedge osteotomy at the base of the thumb metacarpal, as described by Wilson, can be an effective treatment option, especially for younger patients with early carpometacarpal (CMC) arthritis, who fail to respond to conservative management. The purpose of this study was to evaluate the long-term survival and outcomes in patients who had previously undergone a metacarpal osteotomy for CMC arthritis of the thumb.

Methods: This was a retrospective case series. We identified 24 patients who had undergone thumb metacarpal osteotomy at least 10 years previous to initiating our study. A 5mm wedge osteotomy was performed and secured with k-wires outside the skin. Exclusion criteria included: pregnancy, surgeries performed on the thumb outside of the primary surgeon's practice, post-traumatic arthritis, inability to complete the questionnaire, osteotomy done for web space contracture. Participants in the study were asked to return for a clinical evaluation and underwent x-rays of the hand, maximum grip and key pinch strength testing and submitted responses to PRHWE and Quick-DASH questionnaires. Complications were noted.

Results: Of the 24 patients identified, 21 met inclusion criteria. Mean age at surgery was 41.5 years, (range, 19-54), n=22 patients. There were 8 males and 13 females. Two patients (3 cases) subsequently underwent basal joint arthroplasty. Mean time since surgery for patients that have not undergone additional CMC-related surgery is 12 years, (range, 10.5-13.3), n=22. Records reviewed showed 6 patients with perioperative complications, including pin site infections (5) and 1 with a fibrous non-union. Three patients were available for complete follow-up and demonstrated a mean PRWHE score of 34.8, QuickDASH score of 28.8, 89% pinch and 93% grip of the contralateral side respectively. One patient progressed from Eaton Stage II to Eaton Stage IV, while two remained at Stage II.

Conclusions: Our preliminary results indicate that abduction wedge osteotomy appears to be a durable option in surgical management of early thumb CMC arthritis, assuming that our patients have not sought care elsewhere. The majority of patients have not required any additional surgery for over 10 years. A relatively high infection rate can be attributed to protruding k-wires, which are a modifiable part of the procedure. Results are widely variable with respect to the 3 respondents at this point in the study. We are continuing to contact patients for follow-up at this point in the study with the hope to attain a larger number of respondents.

P118. Does Self-Citation Influence The H-Index Among Full-Time Academic Hand Surgeons Affiliated With Fellowship Programs?

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Purpose: Academic promotion is based, in part, upon achievement in research. In recent years, numerous studies have linked the h-index (number of papers h with at least h citations each) to academic rank among various surgical specialists, including plastic and hand surgeons. One criticism of the h-index is its susceptibility to manipulation via self-citation. Self-citation rates in the literature have been reported to be in the range of 3-5%. Surgeons who frequently cite their own work may artificially inflate their h-index, due to its dependence on citations as a unit measure of productivity. The purpose of this study was to estimate the magnitude of self-citation among a cohort of academic hand surgeons and estimate the effect of self-citation on the h-index.

Materials and Methods: This was a cross-sectional study of full-time academic hand surgeons affiliated with fellowship programs in the United States. The primary predictor variable was the frequency of self-citation. The primary outcome of interest was the h-index. Descriptive, bivariate, and regression statistics were computed to assess the associations between self-citation and the h-index. For all analyses, a p-value < 0.05 was considered significant.

Results: The study sample was comprised of 364 full-time academic hand surgeons. Approximately 70% were members of the American Society for Surgery of the Hand (ASSH). The majority (71.4%) had primary academic appointments in Orthopedic Surgery. Eighty-five percent of the surgeons were male; nearly all (99.5%) had completed post-residency fellowship training. The average number of years since completing training was 17.4 + 11.0. Study subjects had an average of 45 + 73 publications. The mean total number of citations was 800 + 1738, the median number of self-citations was 2.5 (IQR 0-14.8), and the average frequency of self-citation was 2.2 + 3.7%. The h-index decreased as a result of self-citation in 57 surgeons (15.7%). After adjusting for ASSH status and academic rank, increasing rates of self-citation were associated with a decrease in the h-index (OR 1.4, 95% CI 1.2-1.5, p < 0.001). Surgeons with 7 or more self-citations were more likely to have their h-index influenced by self-citation.

Conclusions: The rate of self-citation among full-time academic hand surgeons affiliated with fellowship programs is comparable to rates in plastic surgery and other specialties. For the majority of surgeons, self-citation did not affect the h-index.

P119. Treatment of Carpal Tunnel Syndrome By Injection With Corticosteroids. Experience in Argentina

Maria Solange Ferraguti, MD

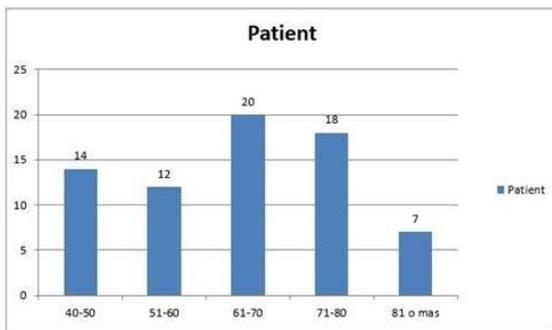
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Introduction: The carpal tunnel syndrome results from compression of the median nerve in the wrist, can be caused by multiple factors. Typical symptoms are pain (most often by night), paresthesia, hypoesthesia, and numbness in the territory of the median nerve. We prospectively studied patients clinically diagnosed with carpal tunnel syndrome and treated with the injection of corticosteroid. This study aims to evaluate the efficacy of corticosteroid injection at the carpal tunnel, such as treatment of mild and moderate cases of carpal tunnel syndrome.

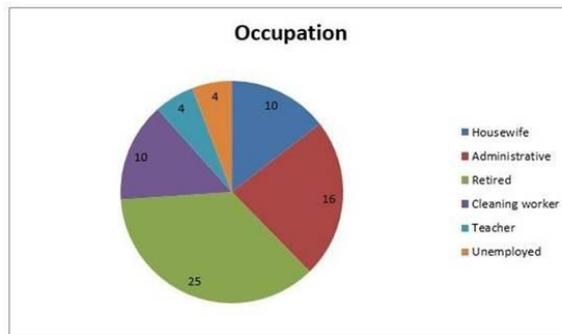
Methods: We enrolled patients who presented to our hospital from March 2013 through December 2014. The patients were clinically diagnosed with carpal tunnel syndrome, but only those who had mild and moderate electromyogram results were accepted for this study. Exclusion criteria were: previous treatment with surgical release or injection of corticosteroids, inflammatory disease or pathological etiology (such as rheumatoid arthritis), previous adverse reactions to corticosteroids or local anesthetics.

Results: The procedure was performed on 71 hands: 45 women and 26 men. The ages were between 42-85 years. They were infiltrated those with mild or moderate electromyogram result. Steroid solution was used (each vial contains: Betamethasone, dipropionate and 10 mg, and betamethasone as disodium phosphate, 4 mg; Excipients of 2 ml.). And 1 ml of 1% lidocaine. No immediate or mediate adverse effects were observed after injection. Follow-up was four dates at 15, 45, 90 and 180 days after injection. A number of 20 from 71 patients had a poor outcome, recurrence or persistence of symptoms, this represents 28, 5% of the population studied (average age was 59,8 years; 80% were women).

Conclusion: We agree with the published literature that injections of corticosteroids are more effective in the short-term treatment of carpal tunnel syndrome, as we have registered more patients with recurrences at 90 days. Also, influence the success of this technique, the degree of compression using electromyogram and the patient's age at diagnosis. We did not get significant differences in the ratio of time of diagnosis of the disease.



Graphic 1: age ranges of the patients studied



Graphic 2: Occupation of patients

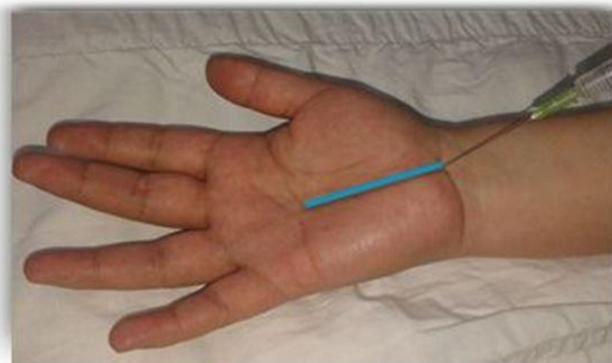
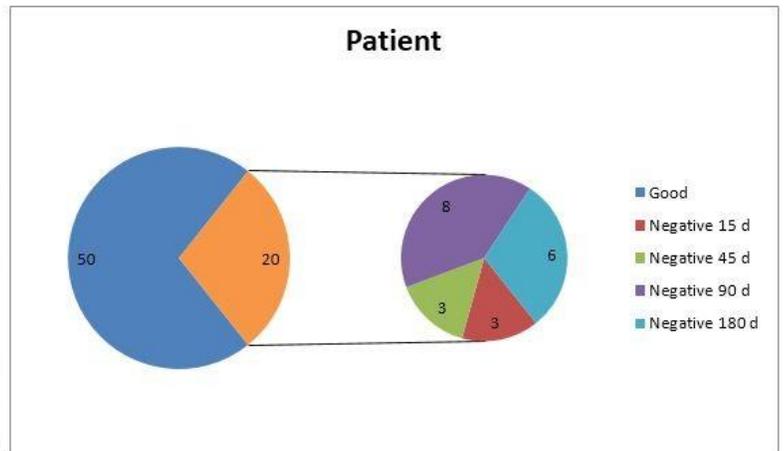


Figure 1: The patient's wrist is flexed against resistance and palmaris longus tendon is observed, the radial side is the best place to infiltrate. With the wrist in a straight position, the needle is inserted 2 cm at an angle of 90°, ensuring that the solution is deposited in the carpal tunnel behind the flexor retinaculum.



Graphic 4: Evolution during follow up

P120. Practice Patterns In The Management Of Common Scaphoid Injuries

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Purpose: To determine the current practices among Canadian hand surgeons for scaphoid injuries and potential determinants of these practices.

Methods: A survey consisting of 4 demographic questions and 11 management questions was constructed. Canadian hand surgeons were identified from registered databases. Potential participants were contacted through email with a link to the survey. A follow-up email was sent 4 weeks later. Frequencies of responses were collected and analyzed. A multinomial regression analysis was completed to determine any relationship between demographic data and operative choices. All data was analyzed using SPSS version 22.

Results: 76 surgeons responded to the survey giving a response rate of 20%. Surgeons having completed a Plastic Surgery fellowship in hand surgery in Canada were the most common. Surgeons practiced for an average of 15.2 years and performed greater than 20 operative wrist cases per year. Conservative therapy with a below elbow cast was the most common therapy for non-displaced scaphoid fractures. Scaphoid nonunions were most commonly treated with either a distal radius cancellous graft or iliac corticocancellous graft, depending on the presence of a humpback deformity. For patients with avascular necrosis regardless of location, vascularized distal radius was most frequently chosen. Acute SLD was treated with direct repair and capsulodesis while chronic SLD was treated either conservatively with eventual salvage or Brunelli procedure depending on symptoms. Multinomial logistic analysis revealed no association between demographic questions and the operation performed.

Conclusions: Treatment of scaphoid fractures was most likely to be conservative, regardless of location. Strategies varied for scaphoid non union, avascular necrosis, and scapholunate injuries. No association was demonstrated with treatment choices and training location, specialty, number of cases or time in practice. While response rate was lower than anticipated this can be rationalized as a selection bias from including professional groups that would appreciably increase the number of surgeons participating but not the number of wrist surgeons.

Learning Objectives: Participants will be able to identify the most frequently performed management strategies for scaphoid injuries.

P121. Stable Rates of Surgical Management for Distal Radius Fractures in Ontario: a 10-year Review

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Objective: Open reduction and internal fixation (ORIF) management of distal radius fractures has become increasingly common. Amongst Medicare beneficiaries in the United States, the number of fractures treated with ORIF increased from 4% in 1997 to 17% in 2007. This was matched by a decrease in cast immobilization (from 83% to 74%). This shift is seen in other countries, such as Sweden and Finland, which have a single payer model similar to Canada. Systematic review comparing the four common methods of management found equivalent functional outcomes amongst patients age 60 and over. This has some authors questioning whether this shift is justified. The purpose of this study is to examine population trends in the treatment of distal radius fractures over a 10-year period in Ontario, Canada.

Methods: This is a population based, retrospective cohort study examining the treatment of distal radius fractures over a 10-year period (2004-2013). It utilizes the Canadian Institute for Health Information administrative discharge abstract database, National Ambulatory Care Reporting System and Ontario Health Insurance Plan billing data sources. Access is available at the Institute for Clinical Evaluative Sciences and datasets are linked using patient-specific encrypted identifiers. OHIP billing codes were used to categorize primary treatment modality as (1) cast immobilization, (2) cast immobilization with percutaneous pinning, (3) external fixation, (4) ORIF. We report on the yearly gross number of fractures, fracture treatment type, and frequency of fracture treatment type.

Results: Ontario has a population of 13.6 million, representing almost 40% of the entire Canadian population. On average, 22 290 distal radius fractures occur yearly amongst individuals 18 years and older. The rate of cast immobilization remained stable at 83.2% (range 82.1-84.1%) over the 10-year period. While the rate of ORIF increased from 7.1% in 2004 to 12.6% in 2013; this was matched by a decrease in the rates of cast immobilization with percutaneous pinning and external fixation. Rates of ORIF were influenced by patient age, sex and region.

Conclusions: This study shows that Ontario has experienced stable rates of non-operative and operative treatment over a 10-year period. The mix of operative treatment has shifted to favor ORIF. This once again points to the need for high-quality studies evaluating outcomes after operative and non-operative treatment of distal radius fractures. In the future, it would be interesting to evaluate what factors are driving the shift towards surgical management in some countries and not others.

P122. The Long Term Results of PyroCarbon Implant Hemi-Arthroplasty for Trapeziometacarpal Arthritis

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Introduction: The aim of this study is to examine the long term outcomes (> 2 years) of PyroCarbon implant hemi-arthroplasty for the treatment of osteoarthritis of the carpometacarpal joint of the thumb at a single center.

Materials and Methods: We retrospectively reviewed 20 patients who failed conservative treatment for trapeziometacarpal arthritis and were treated with a PyroCarbon implant hemi-arthroplasty with long term followup of at least 2 years. In all cases, strong dorsal capsular reconstruction and post-operative immobilization in abduction and extension was performed to prevent implant subluxation. Patients were followed clinically and radiographically. Patient demographics, implant position on radiographs and complications were recorded. Post-operative range of motion, grip strength and key pinch were compared to the contralateral side. Subjective outcomes were assessed using a visual analog pain scale.

Results: Twelve saddle, 6 hemispheric and 2 nugrip Ascension implants were placed in 17 women and 3 men with an average age of 66 years. Average follow up was 56.9 months (range 24 – 95 months). All 20 patients achieved excellent range of motion, and were able to oppose their operated thumb to the base of the small finger (Kapandji score 10). Grip strength returned to 87 % and pinch strength returned to 80% compared to the contralateral hand. The subjective pain score decreased from a range of 7-10 pre-operatively to a range of 0-2 post-operatively. Serial radiographs showed no increasing lucency or significant deterioration. There were no implant dislocations or infections. No patients required surgical revision or implant removal.

Conclusion: This cohort of 20 patients with greater than 2 year follow up suggests that PyroCarbon implant hemi-arthroplasty can provide satisfactory return of strength and range of motion with minimal post-operative pain and stiffness. These clinical and radiographic outcomes were maintained for an average 4.7 years (range 2 – 8 years). By focusing technically on strong dorsal capsular reconstruction, there was a 0% incidence of implant subluxation or revision, which is significantly lower than previously reported.

P123. The Use of UV Light to Compare Two Methods of Pre-Operative Sterilization For the Hand

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Introduction: The purpose of our study was to determine the effectiveness of two popular pre-surgical preparatory application processes for surgical sterility. A commercially available “prep-stick” and the manual use of two 4x4 sponges were compared. Our group hypothesized that the use of two sterile 4x4 sponges would leave fewer missed spots when compared to a commercially available “prep-stick” for surgical sterilization of the hand and wrist.

Materials & Methods: Two orthopaedic surgeons simulated the standard pre-surgical prep protocol on forty upper extremities distal to the wrist crease of healthy volunteer subjects. Each surgeon prepared ten arms with a commercially available “prep-stick,” and ten arms with two sterile gauze pads. The prep-solution used in all cases was a commercially available solution that enhances under exposure to a UV-A light. Spots on the skin that did not illuminate under the UV-A light were identified as un-prepped sites. Prior to all simulated sterilizations, each hand was visualized under the UV-A light to ensure no illumination as an internal control. The location of all missed skin spots were identified and noted.

Results: The average number of missed spots when using the “prep-stick” applicator was 2.25 (0-5, std dev 1.37), and when using two sterile 4x4 gauze sponges was 0.5 (0-4, std. dev. 0.97). This difference was found to be statistically significant with a p-value <0.0001 when using a paired, two-tailed t-test. Among the hands prepped with the “prep-stick,” there were 45 missed spots. When using the two gauze sponges, only 10 missed spots were identified. The volar and dorsal aspects of the fingers, distal to the proximal interphalangeal (PIP) joint were the most common sites for un-prepped skin with both sterilization methods; 29/45 for the prep-stick, and 9/10 for the gauze sponges.

Conclusions: Our group advocates for the use of two sterile 4x4 gauze pads immersed in sterilization solution, instead of commercially available “prep-sticks.” With either sterilization method, the most common un-prepped area was the volar and dorsal finger distal to the PIP joint.

P124. Epidemiology Of Distal Radius Fractures: A Registry Analysis Containing >1 . Million Patients Per Year In Ontario, Canada, 2004-2013

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Objective: The distal radius is the most common fracture site seen by physicians. This fracture is associated with age and gender, increasing in incidence in older women. Distal radius fractures are typical of active persons with osteoporotic bone. The societal repercussions of these fractures are significant and include medical costs, loss of work hours, loss of independence and lasting disability. Trends in the incidence of distal radius fractures in the adult population remain unclear. There was hope that the widespread uptake of osteoporosis treatment guidelines would lead to decreased rates of distal radius fractures over time.

Methods: We examined age-sex trends in the incidence and treatment of distal radius fractures across a complete provincial population, representing almost 40% of the total Canadian population, over a 10-year period (2004-2013).

Ontario, with a total population of 13.7 million, has a public health care system. Patients receive health care through the Ontario Health Insurance Plan (OHIP), and there is no private care available for the diagnosis or treatment of distal radius fractures. This population-based study identified all individuals aged 18 years and older with a distal radius fracture by utilizing the Canadian Institute for Health Information administrative discharge abstract database, National Ambulatory Care Reporting System and OHIP billing data sources. Access is available at the Institute for Clinical Evaluative Sciences and datasets are linked using patient-specific encrypted identifiers. The population was divided into males and females aged 18-34, 35-49, 50-64, 65-79 and 80+ years old. We report on the gross number of fractures per year and the yearly age-adjusted incidence rate.

Results: In 2013, 25 355 distal radius fractures occurred in the province of Ontario amongst individuals 18 years and older. The male and female age-adjusted incidence rate for individuals 35 years and older was 1.63 per 1000 and 3.4 per 1000 persons, respectively.

Seventy percent of all fractures occurred amongst women. Women aged 50-64 year old represent the majority subgroup (26% of all distal radius fractures occurring in Ontario). There is a steady increase in incidence rate amongst both sexes; with women experiencing a sharper increase to 8.02 per 1000 persons in women 80 years and older.

Conclusion: This is a comprehensive description of the epidemiology of distal radius fractures in the province of Ontario. It illustrates the importance of studies targeted towards women aged 50-64 as they represent the majority of distal radius fractures.

P125. Nonoperative Versus Operative Treatment of Diaphyseal Humerus Fractures: A Systematic Review

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Purpose: To determine if there is a significant difference in clinical outcome scores, union rates, and radial nerve injuries between operative and non-operative treatment of diaphyseal humerus fractures.

Methods: This review was performed using PRISMA guidelines and registered with PROSPERO on December 6, 2013. Study inclusion criteria included any investigation published in English language, with a minimum of one-year follow-up that compared outcomes between operative and non-operative treatment of diaphyseal humerus fractures in skeletally mature individuals. Exclusion criteria were investigations of skeletally immature patients, fractures not involving the humeral shaft; studies with less than one year follow-up, and level V evidence.

Results: 9 studies were included for evaluation. Mean patient age was 39.4 +/- 1.31 years. Mean follow-up was 26.4 months. 486 fractures in 485 patients were included (64% male and 36% female; 69% closed and 17% open). 89.9% treated operatively (171 ORIF, 262 intramedullary nailing). There were 49 patients that were treated non-operatively. There were 22 non-unions reported, (15 operatively treated group, 5 non-operatively treated group). There were 6 malunions overall (3 operatively treated group, 3 non-operatively treated group). There were 9 reported delayed unions all in the operatively treated group. When the complications of nonunion, malunion, and delayed union were considered together, there were less complications in the operatively treated group ($p = 0.019$). There was no difference in the rate of complication between intramedullary nailing and open reduction internal fixation ($p = 0.346$) or between intramedullary nailing and non-operative treatment ($p = 0.086$). There was a significant difference between open reduction internal fixation and non-operative treatment ($p = 0.0057$) There were 108 radial nerve injuries with an overall mean recovery time of 6.1 months. There was no standardization to the reporting of functional outcome scores between studies.

Conclusions: Diaphyseal humerus fractures are common injuries that have been shown to be treated successfully both non-operatively and operatively. There was a higher rate of non-union in the non-operatively treated group while there was not difference in union rate between intramedullary nailing and open reduction internal fixation within the operative group. Of those radial nerve injuries that were explored at the time of surgery, the most common pathology was a traction injury. There is little standardized data to compare the functional outcomes of patients treated non-operatively to those treated operatively. This review found that there needs to be more research performed in the area of functional outcomes for these fractures.

P126. Seasonal Variation and Epidemiology of Upper Extremity Infections in a Community Based Hospital over a Six-Year Period

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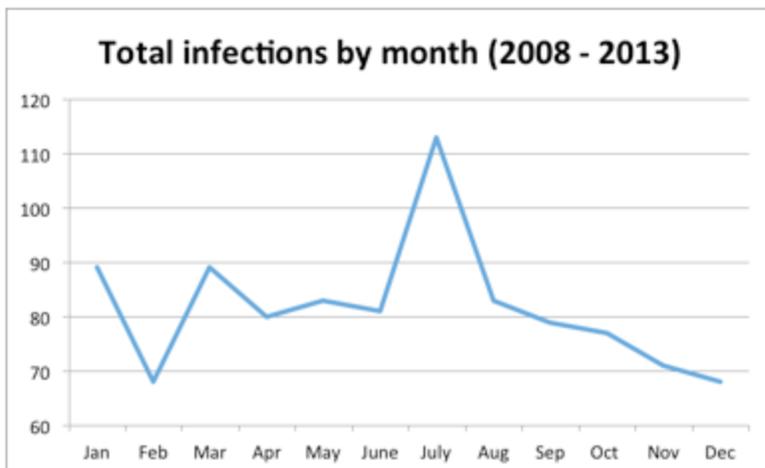
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Introduction: The empiric treatment of hand infections requires knowledge of common infecting organisms for different types of infections. Several recent studies indicate an increasing trend of methicillin resistant organisms in upper extremity infections.^{1,2} There have been few recent epidemiologic studies identifying common organisms for different types of hand infections.³ Knowing the expected organism allows the clinician to better select empiric antibiotic therapy while awaiting final culture results.⁴ There have been no studies regarding the seasonal variation in upper extremity infections. We looked at the seasonal variation and epidemiology of upper extremity infections to identify possible correctable factors.

Materials & Methods: A retrospective chart review was performed at a community-based hospital in Southern California over a six-year period, from March 2008 to December 2013. We searched the electronic health record for International Statistical Classification of Diseases (ICD-9) diagnosis codes specific to hand infections (681.0, 682.9, 711.4, 727.89, etc.), and procedural codes related their surgical treatment (86.04, 78.26, 86.2). We identified the following: type of hand infection; geographic location; month of treatment; season of the year. Student t-test was used to compare month-to-month, seasonal and annual differences. Significance was defined as $p < 0.05$.

Results: There was a significant upward trend in the total incidence of upper extremity infections in the summer (June, July, August) annually when compared to the winter seasons (December, January, February). There were on average 16.35 documented cases per month (SD 2.31+/- 0.67) of upper extremity infection. We found 55.4 cases reported on average during the summer. In the spring, fall, and winter, there were 50.4, 45.4, and 45.0 cases reported on average over that same time period, respectively. Additionally, there was a significant spike in infections in July ($p = 0.0196$), with an average of 22.6 (SD 6.82 +/- 3.05) cases annually when compared to the winter month of February with 13.6 (SD 6.46 +/- 2.89) cases on average [Figure 1]. There was trending significance when comparing the number of annual infections in July to May ($p = 0.0813$) and July to October ($p = 0.0855$).

Conclusion: There appears to be a significant seasonal trend in incidence of upper extremity infections, peaking in the month of July annually. There are also trends toward significant seasonal differences when comparing the summer months to the other seasons of the year. Further studies and data are needed to potentially find a correctable factor attributable to the seasonal variation in the incidence of upper extremity infection.



P127. The Reduction Maneuver is More Accurate than the Grind or Shift Tests for Diagnosing Thumb Basal Joint Arthritis

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Background: Physical examination remains essential to establishing most diagnoses in hand surgery. We sought to compare the accuracy of the three most common provocative tests – grind test, shift test, and reduction maneuver – when examining patients for thumb basal joint arthritis.

Methods: Patients evaluated by a single provider for symptomatic thumb basal joint arthritis from 2011-2015 were identified from an institutional database. Charts were reviewed for results of provocative tests (*grind*, *shift*, *reduction*) and classified as positive if they elicited pain. Five surgeons blindly scored radiographs, and the median Eaton stage for each hand was used for comparison. Tests were also performed on asymptomatic control subjects. McNemar’s test was calculated for each provocative test; Cohen’s kappa was used to define the agreement between each test and the diagnosis of thumb basal joint arthritis.

Results: Thirty-seven patients (48 thumbs) were identified in the experimental group. The median Eaton stage was 3. *Grind*, *shift*, and *reduction* were positive in 29%, 27% and 81% of subjects ($p<0.001$). Sensitivity, specificity, positive predictive value and negative predictive value were higher for *reduction* (100%, 63%, 82%, 100%) compared to *grind* (93%, 30%, 33%, 92%) and *shift* (92%, 29%, 29%, 92%). Each test was separately evaluated for accuracy in diagnosing thumb basal joint arthritis (**Table 1**). *Grind*, *shift*, and *reduction* were positive more often in patients with arthritis than in control subjects (McNemar’s $p<0.001$, $p<0.001$, and $p=0.004$, respectively). There was a poor level of agreement for having arthritis and a positive *grind* or *shift* ($k=0.103$, $p=0.13$ and $k=0.095$, $p=0.16$, respectively), but a substantial level of agreement for *reduction* ($k=0.634$, $p<0.001$). There was a 100% correlation between obtaining a positive *shift* or *grind* and a positive *reduction* ($p<0.001$ and $p<0.001$, respectively), indicating that if the *grind* or *shift* is positive the *reduction* will also be positive.

Conclusion: The reduction maneuver is a more accurate test for diagnosing thumb basal joint arthritis than the grind or shift test. *Grind* or *shift* are more likely to be positive in higher stages of arthritis, but do not reliably make the correct diagnosis. *Reduction* was highly accurate regardless of stage. *Reduction* was appropriately positive in every case in which *grind* or *shift* also elicited pain.

Table 1. Comparison of positive tests by stage

	Percentage of Positive Exam by Arthritis Stage			
	I	II	III	IV
Grind Test	0%	20%	33%	50%
Shift Test	0%	33%	20%	41%
Reduction Maneuver	100%	70%	86%	92%

P128. Novel Flexor Digitorum Superficialis Tenodesis for Traumatic Digit Amputation at the Level of the Proximal Phalanx

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Introduction: When revision amputation at the level of the proximal phalanx is indicated, flexor digitorum superficialis (FDS) tenodesis is an intriguing management tool. Salvaging flexor function at the metacarpophalangeal joint (MCPJ) allows improved grip and function. To our knowledge this technique has not been described. This study reviews the outcomes of patients treated with FDS tenodesis.

Traumatic amputation of the digit requiring revision amputation provides the opportunity to improve flexor function via tenodesis of remaining FDS tendons. Salvage of remaining FDS and performing tenodesis to the proximal phalanx allows flexion at the MCPJ which leads to improved hand function. Preserved flexion also improves prosthesis function if indicated.

Methods: IRB-approved retrospective study was performed of patients undergoing FDS tenodesis for amputation at the level of the proximal phalanx by the senior author. At latest follow up data including range of motion, grip strength and need for revision surgery were recorded.

Results: Twelve digits in 8 patients (7 male, 1 female) with average age at surgery of 57 (range 15-92) were included. Average follow up was 8 months (range 3-25). All patients sustained open, traumatic amputations. On average 3 digits were involved in trauma (range 1-5). Demographics included dominant hand involvement (4/8), smoker (2/8) and Workers' Compensation case (2/8). Average flexion-extension arc of affected metacarpal was 82 degrees (range 45-95) and average grip strength was 70% of unaffected extremity (range 50-100%). No patients required revision surgery or revision amputation. One patient had minor wound infection treated successfully with oral antibiotics.

Discussion and Conclusion:

- FDS tenodesis is a reliable motion preserving procedure for amputations at the level of the proximal phalanx to maintain flexion at the MCPJ
- In this series MCPJ flexion-extension arc measured 82 degrees on average at 8 months postoperatively
- No major complications were noted
- The significance of these results better enable surgeons to utilize FDS tenodesis in digital amputations at PIP level to preserve flexion at MCPJ for improved hand function after devastating traumatic injuries

Average MCP Flexion-Extension Arc	82 degrees (range 45-95)
Average Grip Strength	70% unaffected side (range 50-100%)
Average Follow Up	8 months (range 3-25)
Average # Digits Involved in Injury	3 (range 1-5)
Workers' Compensation	2/8
Open Traumatic Amputation	8/8
Smoker	2/8
Major Complications (required return to OR)	0/8
Minor Complication (did not require return to OR)	1/8



P129. Sonographic Location of Distal A-1. pulley by means of a bony acoustic landmark on the proximal phalynx: an anatomic study

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Purpose : The objective of this study was to identify the anatomic relationship (if any) between the distal extent of the A-1 Pulley and the insertion of the palmar plate into the base of the proximal phalanx at the so called P-1 peak, a bony acoustic landmark easily identifiable on sonography of the finger corresponding to the distal palmar plate.

Methods We studied 48 fingers from 12 fresh frozen human cadaver hands. 12 index, 12 long, 12 ring and 12 small fingers were studied. A high resolution sonogram of each finger was performed. The insertion of the palmar plate at the MP joint was located at the P-1 peak area and marked with a needle sonographically with each finger in neutral flexion/extension. Dissection of fingers proceeded and measurement of the actual distance between the needle and the distal edge of the A1 pulley was performed this was followed by further dissection and location of the distal palmar plate at the P-1 peak with comparison to the actual location of the distal A-1 pulley.

Results We found location of the P-1 peak sonographically with a needle reliably predicted the distal edge of the A-1 pulley within an average distance of 0.5 mm distal to the distal A-1 pulley in all fingers (range 0 to 1.0mm). In all dissections the distal edge of the A-1 pulley was reliably found correspond to the distal palmar plate insertion at the P-1 peak area within 0.5 mm (range 0 to 0.5 mm).

Conclusions The so called P-1 peak may be used as a reliable, clearly identifiable sonographic landmark on the palmar surface of the finger to identify the distal extent of the A-1 pulley within 1 mm in cases where a clear distinction between the A-1 and A-2 pulley is not evident sonographically. Using this bony acoustic reference will help to ensure greater safety, accuracy, completeness of release in sonographically assisted percutaneous trigger finger release techniques.

P130. Outcomes of Arthroscopic Ganglionectomy in a Pediatric Population

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Introduction: Arthroscopic resection of dorsal wrist ganglia is an established alternative to open excision. However, arthroscopic ganglionectomy has only been reported in adults. The purpose of this study is to evaluate the outcomes and complications of arthroscopic ganglionectomy in a pediatric population, and compare them with those of open excision.

Materials and Methods: A retrospective chart review was performed of all pediatric arthroscopic and open dorsal wrist ganglionectomies performed by two surgeons over a 4 year period. In addition, patient families were contacted and the outcomes of surgery were evaluated by questionnaire.

Results: Eight patients with arthroscopic ganglionectomy (mean age 15 years, range 12-18), and 19 patients with open ganglionectomy (mean age 13 years, range 7-18) were included in the study. No patients in the arthroscopic cohort reported any residual functional limitations at an average of 3 years follow-up, compared to 3 patients in the open cohort that reported mild functional limitations at an average of 2 years follow-up. No patients in the arthroscopic cohort reported residual pain, compared to 9 patients in the open cohort with residual pain at the surgical site. There was one recurrence in the arthroscopic cohort and two recurrences in the open cohort. On a ten-point scar appearance scale, with 1 being not satisfied at all, and 10 being highly satisfied, the average score in the arthroscopic cohort 9, compared to an average score of 7.6 in the open cohort. All patients in the arthroscopic cohort would have the surgery again, whereas two patients in the open cohort would not have the surgery again. Other than the cases of recurrence, and the cases of persistent pain described above, there were no other complications in either cohort.

Conclusion: Arthroscopic ganglionectomy is a reasonable option for the treatment of dorsal wrist ganglia in the pediatric population. Although this study population was small, outcomes after arthroscopic excision compared favorably with those after open excision.

P131. Tear Drop Angle, Dorsal Metacarpal Distance and Capitate Distance in Normal Wrist Radiographs

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Introduction: Distal radius fractures are the most common fractures of the upper extremity and account for up to one-sixth of all skeletal fractures. Treatment of these fractures requires an understanding of the displacement and angulation of the fracture. While standard radiographic measurements of the distal radius (articular alignment, length, volar tilt and inclination) are used to help define treatment plans, other measurements are available to understand the deformity of the fracture or malalignment of the wrist. Medoff introduced the tear drop angle (TDA) measurement, reinforcing the importance of the position of the volar lunate facet. We sought to determine the variability of the TDA as well as to measure the dorsal metacarpal translation and the volar and dorsal capitate distance in a series of consecutive wrist radiographs.

Materials and Methods: A random selection of patients undergoing comparison radiographs of the wrist from April 2012 to August 2012 was performed with institutional approval. After initial review, 33 wrists with adequate radiographs were selected with an average patient age of 35 years (18 - 58 y). Electronic radiographs were evaluated for the TDA and the dorsal metacarpal distance, measuring from dorsal radial line to third metacarpal dorsal cortex. The center of capitate distance was also measured to the dorsal and volar radial lines. A method for standardizing the TDA measurement was proposed from the volar radial line.

Results: The average value for TDA from the volar radial line was $52.2^{\circ} \pm 3.7^{\circ}$. The average dorsal metacarpal distance was $5.6\text{mm} \pm 4.9\text{mm}$, the average distance of capitate center to the volar radial line was $3.0\text{mm} \pm 2.5\text{mm}$ and the average distance of capitate center to the dorsal radial line was $9.0\text{mm} \pm 3.6\text{mm}$.

Conclusion: Our results demonstrate that the mean TDA (based on the volar radial line) was 52.2° (44° - 63°) with a standard deviation of only 3.7° . This suggests that the volar radial line could be a reliable reference line when measuring radiographs. This has a relative similar standard deviation as measurements from the center axis proposed by Medoff (70.7°) which had a SD of $\pm 4.2^{\circ}$. The dorsal metacarpal translation had a mean of 5.6mm (0 - 21.3mm) with a relatively high standard deviation of 4.9mm . The volar capitate distance ($3.0\text{mm} \pm 2.5\text{mm}$) was more reliable compared to the dorsal capitate distance ($9.0\text{mm} \pm 3.6\text{mm}$). The volar radial line may serve as a reliable reference line for measuring capitate translation and the teardrop angle.

P132. Expert Witness Qualification in Malpractice Litigation in Hand Surgery

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Background: Many hand specialists are dropping their on-call privileges due to decreasing reimbursement rates and high malpractice insurance costs. More than 42% of physicians have been involved in a legal dispute over the course of their careers. One of the critical factors in juror decision is expert medical testimony. Historically, the role of medical experts has been controversial. We aim to examine the credentials of expert witnesses (EWs) and their impact on malpractice litigations against hand surgeons.

Methods: The Westlaw legal database was accessed for jury verdict and settlement reports related to hand surgery malpractice from 2009 to April 2015. Cases included for analysis were examined for expert witness testimony, year of report, procedure performed, alleged injury, cause of action, verdict, and indemnity payments. Board certification, training, and practice setting information of the expert witnesses were obtained from hospital/department, personal practice, and state licensing websites.

Results: Of 45 cases, 91.2% were favorable to the defendants. The most commonly litigated injuries were carpal tunnel syndrome (18.2%) and finger fracture (15.9%). Of 57 EWs specified as hands surgeons in the court documents, 34 (59.6%) were board certified in surgery of the hand and 32 (56.1%) testified on behalf of plaintiffs. Plaintiff EWs had similar years of clinical experience compared to defendant EWs (24.7 vs. 24.8), but had lower h-index (3.0 vs. 8.1, $p=0.03$), number of publications (8.8 vs. 47.2, $p=0.0004$), and were less likely to practice in an academic setting (9.4% vs. 44.0%, $p=0.005$).

Conclusion: Hand surgery experts testifying on behalf of defendants had greater scholarly impact and were more likely to be academic faculty. As medical malpractice continues to raise healthcare costs, the role of expert testimony in legal judgments is more important than ever. Qualifications of EWs must be vigilantly reviewed by professional organizations as well as on a national level.

P133. The risk of Dupuytren's disease is lower in obese individuals

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Introduction: Dupuytren's contracture is a benign fibroproliferative disorder causing contracture of the palmar fascia of the hand. The exact etiology of the disease is unclear but known risk factors such as increased age, male gender and northern European ethnicity have been established. Other risk factors such as diabetes, alcohol, occupation, and phenobarbital usage remain speculative. A previous study with a homogenous patient population showed affected males to have statistically significant lower body mass index (BMI) compared to unaffected males. No other studies have investigated the link between BMI and Dupuytren's disease. The purpose of the study was to test the hypothesis that lower BMI is associated with increased rates of Dupuytren's disease.

Methods: After obtaining IRB approval, a retrospective review using the electronic medical record and administrative database was performed to identify all patients in our healthcare system diagnosed with Dupuytren's disease (ICD-9-CM diagnosis code 728.6) from 2007-2014. Basic demographic data including age, sex, ethnicity and BMI were collected. Univariate and multivariate logistical regression analyses were performed to evaluate for associations between Dupuytren's disease and BMI.

Results: 2,049,803 patients aged 18 and older were enrolled in the healthplan from 2007-2014. 14,844 patients were identified with Dupuytren's disease during this time period. Our data was consistent with well-defined demographic trends with increased rates of Dupuytren's disease seen in males, caucasians, and patients aged 50+. The multivariate analysis, when controlling for age, race, and gender, showed the risk of Dupuytren's disease was inversely proportional to BMI. Using a BMI of 18.9-25.0 as the normal reference the odds of Dupuytren's disease was 0.748, $P < 0.0001$ for BMI 30.0-34.9, 0.642 $P < 0.0001$ for BMI 35.0-39.9 and 0.526 $P < 0.0001$ for BMI 40+.

Conclusion: Previous studies have shown diabetes and increased age to be a risk factor for Dupuytren's disease. An Icelandic study with a limited patient population showed that decreased BMI could potentially be a risk factor for Dupuytren's disease. Our study, with a much larger and ethnically diverse patient population, clearly shows higher BMI to be associated with decreased odds of Dupuytren's diagnosis. Given previous findings that diabetes may be a risk factor, the findings of lower BMI as a risk factor is unexpected. While we found an association between BMI and Dupuytren's disease, we have not shown definitive causation. Further work is required to determine the physiologic factors related to obesity, which may be protective against the development of Dupuytren's disease.

P134. Outcomes from a Registry Study of Complex Peripheral Nerve Injuries Reconstructed using Processed Nerves Allografts

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Introduction: Severe trauma to the upper extremities often results in complex traumatic injuries requiring extensive tissue reconstruction presenting a challenge to even the most skilled surgeon. A recent nerve repair option, processed nerve allograft (PNA), has seen increased utilization in the reconstruction of traumatic nerve injuries. As these injuries are difficult to study, prospective clinical research on treatment algorithms are limited. Here we report our findings from a registry study on the outcomes of complex peripheral nerve injuries reconstructed using processed nerves allografts.

Methods: The RANGER registry is designed to continuously monitor and incorporate injury, repair, safety and outcomes data into a centralized database. The database was queried to identify a subset of patients with multi-tissue, high energy and extensive reconstructions. Outcomes from repairs reporting a minimum of 6 months quantitative data were evaluated for meaningful recovery, defined by the MRCC scale at S3/M3 or greater for sensory and motor function.

Results: Thirty subjects with 37 nerve injuries (25 sensory, 12 mixed/motor nerves) were identified in the database as having complex nerve reconstructions. The mechanisms of injury included: amputation (5), avulsion (9), crush avulsion (3), blast (3), crush (9), and gunshot (8). Their mean \pm SD (minimum, maximum) age was 37 ± 19 (19, 70). The mean gap length was 24 ± 15 (8, 65) mm and the time-to-repair was 23 ± 75 (0,456), with median time of 1 day. Overall meaningful recovery was observed in 78% of all repairs with 80% in sensory and 75% in mixed/motor. Sensory outcomes reported 6 (S3), 9 (S3+), and 7 (S4) and motor outcomes reported 4 (M3), 2 (M4), and 1 (M4+). The mean static 2-PD was 9 ± 4 mm. There were no reported nerve adverse events. Outcomes were comparable to those reported in the historical literature.

Conclusion: We found processed nerve allografts performed well when utilized in complex reconstructions of the upper extremity. Quantitative data demonstrate meaningful recovery in 78% of these cases. The Ranger Registry remains ongoing. Additional data collected will allow for further data analysis.

P135. Characterizing Medical Malpractice and Expert Witness Qualifications in Carpal Tunnel Surgery Claims

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With the advent of expert witness testimonies in the 70's and the media sensationalization of "big money" ordered by the courts, the number of malpractice claims exploded in the last few decades. What used to be a therapeutic relationship between doctor and patient has shifted to a transaction between healthcare provider and consumer. Numerous physicians are now sued daily, often with faulty claims, forcing them to practice defensive medicine. Excessive litigation lowers worker productivity, diminishes population health status, causes patient distrust, and creates emotional distress for physicians. We aim to examine the characteristics of carpal tunnel surgery claims and the qualifications of the expert witnesses testifying for each side.

The legal database WestlawNext was accessed for jury verdict and settlement reports after 2004 through March 2015 using the terms "medical malpractice" and "hand surgery" OR "hand surgeon." Board certification and hand surgery certification information was obtained from licensing medical board websites. Surgeon's year of medical school graduation and academic position were obtained from hospital or personal websites. Academic productivity of expert witnesses was measured by using the h-index using the Scopus database (www.scopus.com). Data were collected in March 2015. Statistical analysis was performed with Mann-Whitney U-test and Student t-test. Power of significance was set at $p < 0.05$. STATA version 13.0 was used.

Of a total of 632 cases retrieved, 84 hand surgery litigations were identified. Among them, 26 (30.95%) cases involved carpal tunnel syndrome. Of the carpal tunnel syndrome cases, 18 out of 26 (69.23%) verdicts favored the defendant. The average age of plaintiff was 45.08 years old and the average amount awarded was \$546,884. Females made up 76.92% (20 out of 26) of the plaintiff. The most common type of alleged cause was due to median nerve damage (69.23%, 18 out of 26). Experts who testified on behalf of plaintiffs had significantly lower *h*-index compared to the experts testifying on behalf of defendants (2.44 vs. 11.84, $p < 0.05$). There was no significant difference in duration of practice, board certification, and practice setting (academic or nonacademic) between the experts.

The surgical treatment of carpal tunnel syndrome is the most frequent subject of litigation in hand surgery. Improving intra-operative skills to minimize surgical errors and providing thorough informed consent for patient understanding of risks and benefits may help minimize the number of future lawsuits. Meticulous documentation of medical records and hiring credible expert witnesses may lead to favorable verdict in legal courts.

P136. Treatment of Aggressive Digital Papillary Adenocarcinoma—Amputation Versus Digit Salvage

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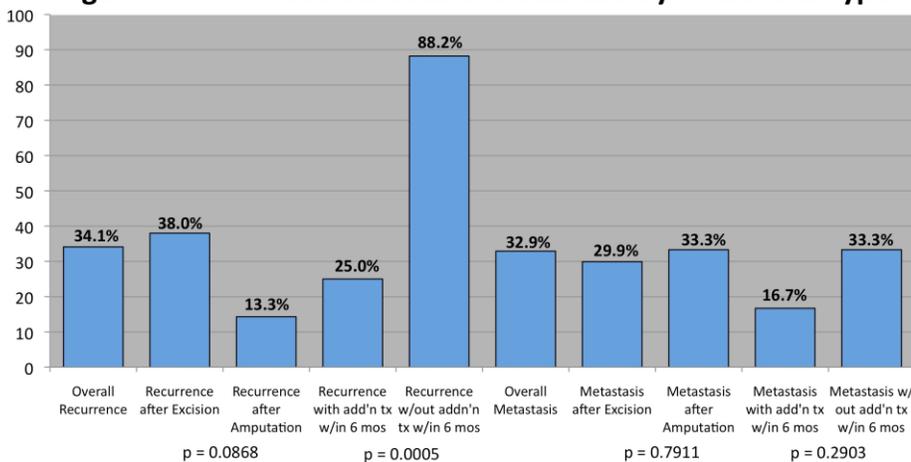
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Introduction: Aggressive digital papillary adenocarcinoma (ADPA) is a rare tumor of eccrine sweat gland origin with predilection for the hand. Because the rarity of this tumor, published data include only case reports or small case series, making it exceptionally difficult to define an appropriate treatment algorithm. The purpose of this study was to pool the current world literature in order to compare outcomes between amputation and digit salvage.

Methods: A Medline database search was performed to locate all ADPA cases reported in the world literature. Translations were performed as necessary. We included reports of individual variables and excluded reports without case-specific information. The data was compiled and a meta-analysis of treatment methods and outcomes was performed. Descriptive statistics and intergroup comparisons were performed with a p value of <0.05 considered significant.

Results: There were 217 cases were reported in the literature, 174 of which were included in this aggregate data analysis (including 3 of our own cases). Mean patient age was 47 and 82% were male. Average tumor size was 2 cm and 82% were on the upper extremity. Duration of lesion until diagnosis was 4.6 years and 5.2% had a history of trauma to the affected area. The majority were treated by excision (88% vs. 11% with amputation). The overall recurrence rate was 34%, and overall metastasis rate was 33%. Recurrence rate was higher for excision compared to amputation (38% vs. 13%, p=0.087), however metastatic rates were similar (30% vs. 33%, p=0.79). A delay in treatment after the initial diagnosis for > 6 months led to a higher recurrence and metastatic rate (Figure 1).

Figure 1. ADPA Recurrence and Metastasis by Treatment Type



Conclusion: To our knowledge, the current report is the only meta-analysis of published ADPA cases and the largest series comparing outcomes of amputation vs. digit salvage. Recurrence rate was lower in patients who had amputations, although this did not reach significance. There was no difference in metastatic rates. Due to implications of amputation on form and function, wide local excision may offer similar benefits without the detriments of losing a digit. Furthermore, a definitive surgical procedure within 6 months of diagnosis was shown to significantly reduce recurrence. Early diagnosis and complete excision of ADPA will likely lead to improved outcomes that further promote digit salvage.

P137. Stabilizing Effect of Ulnar Shortening Procedure for DRUJ Instability

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Ulnar shortening is widely indicated for ulnocarpal abutment syndrome. It also stabilizes the distal radioulnar joint (DRUJ), as long as either the dorsal or palmar portion of the radioulnar ligament (RUL) attached to the ulnar fovea. We retrospectively analyzed our case series. Method: There were 663 wrists of 624 patients, who underwent ulnar shortening procedure done by single surgeon. Among them, 70 wrists of 68 patients indicated mild to severe DRUJ instability. There were 34 males and 34 females, with 36 right, 30 left, and 2 bilateral wrists. Age ranged 19-63, with an average of 34 years. Preoperative ulnar variance indicated 2.0 mm (range: 0-6.5). All wrists indicated pain, while there was no limitation of pronosupination range. Mild DRUJ instability, which indicated more instability compared to the intact contralateral side, was noted in 11 wrists, moderate instability indicating no endpoint either in dorsal or palmar direction in 41, severe DRUJ instability demonstrating instability without endpoints both in dorsal or palmar direction in 18. Arthroscopic examination including DRUJ exploration was done before shortening of the ulna. The ulna was shortened by average 2.4 mm (range: 2-6.5). If there was still DRUJ instability, additional open repair or reconstruction of the DRUJ using ECU half-slip tendon was performed. We evaluated arthroscopic findings, clinical results using our original DRUJ evaluation system. Results: There were Palmer 2A tear in 43, Palmer 2C tear in 3, and Palmer 1B tear in 8 wrists through radiocarpal arthroscopy. DRUJ arthroscopy reevaluated partial dorsal tear of the RUL in 9 and complete avulsion of the RUL at the fovea in 10 wrists. We added open TFCC repair in 7 wrists of complete avulsion of the RUL and 3 wrists needed reconstruction of the TFCC. Overall clinical results obtained were 59 excellent, 9 good, 1 fair and 1 poor. Eleven wrists with mild DRUJ instability all obtained excellent clinical results only with ulnar shortening. In 41 wrists with moderate DRUJ instability, ulnar shortening obtained 40 excellent and 1 poor clinical results. However, in severe DRUJ instability wrists, we obtained 8 excellent, 9 good and 1 fair clinical results even with additional procedure. Conclusion: Ulnar shortening obtained excellent clinical results in the wrists with mild to moderate DRUJ instability. When the RUL was avulsed from the ulnar fovea completely, ulnar shortening could no longer restabilize the DRUJ. In such case, repair or reconstruction of the RUL is necessary.

P138. Congenital Absence of the Lateral Ulnar Collateral Ligament and Instability Treated with a Novel Internal Joint Stabilizer for the Elbow

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Introduction: The lateral ulnar collateral ligament (LUCL) is the primary lateral elbow stabilizer and functions to resist posterolateral stress. Posterolateral rotatory instability, subluxation, and dislocation of the elbow can occur with injury to the LUCL. The most common etiologies of instability are posttraumatic, iatrogenic, and chronic mechanical overload. Little has been reported regarding congenital absence of the LUCL as a cause for elbow instability.

Materials and Methods: A 12-year-old otherwise healthy, active female presented with painful, atraumatic bilateral elbow instability of unknown origin. Exam was significant for bilateral varus and posterolateral instability elicited with minimal force. Bilateral elbow MRI was significant for damage to the ulnohumeral cartilage and wear of the coronoid. Upon presentation the patient had already failed an attempt at bilateral reduction and external fixation. The patient was indicated for bilateral staggered open reduction and internal fixation. Intraoperatively during both cases, the patient was noted to have a band of tissue that lay anterior to the normal site of the LUCL. The tissue appeared to be intact but did not stabilize the elbow. A novel internal joint stabilizer (NIJS) was created from a distal radius variable angle locking plate. It was bent and twisted such that the distal locking screws were fixed to the proximal ulna and a partially threaded screw was placed through the axis of ulnohumeral rotation via the most proximal plate screw hole, thus creating an 'internal, external fixator' that permitted full range of motion. Tendon autograft was used for reconstruction of the LUCL using the docking technique. Postoperatively, the patient was permitted immediate full range of motion.

Results: To our knowledge, this is the first report of a patient with bilateral congenital absent LUCLs. Her pre and postoperative Mayo Elbow Performance Score (MEPS) improved from 35 to 75 for the right elbow and from 35 to 65 for the left elbow. Her DASH score improved from 73 to 9. At her most recent follow up (7 and 11 months) she had a stable flexion arc of 140 degrees and 110 degrees to the right and left elbow, respectively.

Discussion and Conclusion: We describe a new finding of congenital, bilateral absence of the lateral ulnar collateral ligament resulting in severe elbow instability. Our novel method of internal fixation and reconstruction of the lateral ulnar collateral ligament allowed this patient to obtain adequate pain-free motion and stability of her elbow.

P139. Ulnar Shortening Osteotomy versus Corrective Radius Osteotomy after Distal Radius Malunion

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Introduction: Distal radius fractures are the most common fractures of the upper extremity representing up to 3% of all upper extremity injuries. Only few studies report on the functional outcomes after ulnar shortening procedures for treating distal radius malunions.

Methods: A retrospective review of 11 patients with extra-articular distal radius malunion treated with ulnar shortening osteotomy (USO) was performed with an average of 12.7±13.2 months was performed. An age matched group of 11 patients after distal radius osteotomy (DRO) was randomly selected and compared.

Results: The average age of patients undergoing USO was 52.3 and DRO 53.8. Average ulnar shortening was 4.9 mm (mean 4.3 mm ulnar positive variance preoperatively in USO group). Average preoperative flexion and extension had improved from 46.7° and 44.6° to 50.4° and 53.2° postoperatively for USO, respectively (p>0.05). Patients undergoing DRO had a statistically significant increase in flexion and extension from 41.9° to 51.2° and 41.1° to 53.4°, respectively (p<0.05). Pronation had worsened in USO group from an average of 66.0° to 57.0°, whereas supination improved from 45° to 52° (p>0.05). DRO group had an improvement in supination and pronation from 59.1° and 54.2° to 65.4° and 65.3°, respectively. Ulnar and radial deviations had increased from 25° to 28° and decreased from 17° to 15° for USO, respectively (p>0.05). In comparison, DRO group had an increase in both ulnar and radial deviations from 21° to 30° and 15.6° to 18.5°, respectively (p>0.05). The grip and pinch strengths had increased from 14.4 kg to 23.3 kg for USO and from 14.1 kg to 22.3 kg for DRO, respectively. The average VAS had improved from 5.1 and 5.4 to 2.0 and 1.95 for USO and DRO, respectively (p<0.05). The final ulnar variance after USO was -1.9 mm versus 0.8 mm for DRO. Two patient underwent USO after DRO for persistent impaction symptoms. The total tourniquet time was slightly lower in USO group (97.3 minutes) compared to DRO (116 minutes).

Conclusion: Significant improvement of motion, grip strength, and VAS for both groups occurred. Patients with matched age group, symptoms, and radiological findings with positive volar tilt and radial inclination more than 15° undergoing DRO had a greater improvement in grip strength and range of motion at wrist and forearm compared to USO after surgery. Nevertheless, USO being a simpler procedure with a shorter operative time can be an attractive alternative with acceptable outcomes to address distal radius malunions.

P140. Application of Perforator Flap Arterial Anatomy in the Design of Interposition Arterial Bypass Grafts in Hypothenar Hammer Syndrome

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Purpose: Hypothenar hammer syndrome is an uncommon vascular condition in which the ulnar artery undergoes repetitive trauma leading to eventual aneurysm and/or thrombosis. Interpositional vein grafts across the occluded segment have been the mainstay of treatment. Cardiac surgery literature demonstrates improved long-term patency rates in radial artery grafts compared to vein grafts. It could be extrapolated that arterial bypass grafts may provide a better alternative to vein grafts in hypothenar hammer syndrome. Arterial grafts have typically been taken from the radial artery; however, knowledge of perforator free flap anatomy has enabled the possibility to design various configurations for arterial grafts from other donor sites. The characteristics of these donor arterial vessels may provide additional advantages over vein grafts. Thus the purpose of this study is to determine whether arterial interposition bypass grafts harvested from commonly used perforator free flap sites, DIEP and ALT, offer an advantage over vein grafts in the treatment of hypothenar hammer syndrome.

Method: A retrospective review of all patients undergoing ulnar artery bypass grafting for hypothenar hammer syndrome since July 2008 was performed.

Results: Five patients presented with hypothenar hammer syndrome. All patients underwent ulnar artery bypass grafting with the use of an arterial bypass graft. A deep inferior epigastric artery was used in four patients and the descending branch of the circumflex femoral artery was used in one patient. All grafts were performed proximally to the distal ulnar artery and distally to common digital arteries. Minimum of two distal arterial anastomoses were performed. Two patients underwent additional anastomosis to the superficial palmar arch in addition to the common digital arteries. All arterial bypass grafts have remained patent to date with a mean follow-up of 14 months as demonstrated on Allen's testing and angiogram. All patients have had resolution of symptoms. All donor sites healed uneventfully with no symptoms of muscle weakness. One patient complains of persistent parasthesia around the donor site scar.

Conclusion: Arterial bypass grafts harvested from donor sites commonly used for free flaps provides an alternative to vein grafts with numerous advantages: better tissue handling, better size match at proximal and distal anastomosis sites, and increased branching patterns to allow for numerous end-to-end distal anastomoses. Improved long-term patency rates and decreased stenosis rates maybe due to the lack of intimal hyperplasia.

P141. Predictors of Radial Nerve Position on the Humerus: An MRI-based Anatomical Study

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The radial nerve traverses the posterior aspect of the humeral shaft as it moves distally on the upper extremity. Awareness of this anatomy is crucial to posterior surgical approaches to the humerus for trauma, and the nerve may also be injured in trauma, such as Holstein-Lewis fractures. Prior cadaveric studies noted the position of the radial nerve 14 cm and 20 cm from the lateral and medial condyles, respectively. In this study, 16 MRI studies of the arm were reviewed to identify the position of the radial nerve and possible predictor variables such as gender, height, humerus length and humerus intercondylar width.

The mean distance of the radial nerve to the distal trans-epicondylar humeral line both lateral and posterior to the humeral shaft was 11.1 cm (7.9-14.3 cm, 95% confidence interval) and 16.3 cm (11.9-20.8 cm, 95% CI). A positive linear correlation was observed for both patient height and humeral length, as well as radial nerve distance from the epicondyles. Males (mean height 1.72m) had greater humeral lengths, humeral widths and radial nerve distance than females (mean height 1.54m). Males showed a larger lateral and posterior humeral nerve distance of 12.3 and 17.3cm (12.9-21.9cm and 9.9-14.6cm, 95%CI) compared to 10.2 and 15.8cm (11.8-19.6cm and 5.4-14.9cm, 95%CI) in females, respectively. A small positive correlation was seen between humeral length and epicondylar humeral width.

The radial nerve distance from point of crossover medial to lateral within the spiral groove on the humeral shaft appears to increase with patient height, humeral length, and gender.

P142. Neurovascular Island Flap for Reconstruction of Wassel IV Thumb Duplication

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Introduction: A number of techniques are used for reconstruction of Wassel IV thumb duplications, with the aim of reconstruction to obtain a stable, mobile thumb of adequate size and shape. Techniques include preserving the ulnar thumb, reconstructing a contour defect with a radial neurovascular island flap and the Bilhaut Cloquet procedure. A persistent problem is the asymmetry between the reconstructed and normal contralateral thumb.

Materials and Methods: We describe our technique for reconstruction of Wassel IV thumb duplications. Either the radial or ulnar digit is preserved, depending on which digit is more functional. A neurovascular island flap is dissected out from the thumb to be removed. Specific modifications include the use of Bruner incisions dorsally (Fig. 1) and volarly (Fig. 2) to reduce scarring at the interphalangeal joint, resection of a wedge of skin dorsally for better final contour of the thumb, reconstruction of the nail fold with the flap and also complete mobilization of the island flap on its pedicle (Fig. 3) to allow easier inset (Fig. 4, 5). Nine patients in 8 children and had surgery for Wassel IV thumb duplication.

Results: All neurovascular island flaps survived with good contour, shape and symmetry compared to the contralateral thumb.

Conclusions: Reconstruction of Wassel IV thumb duplications with an island neurovascular flap allows for good symmetry in shape and size following reconstruction.

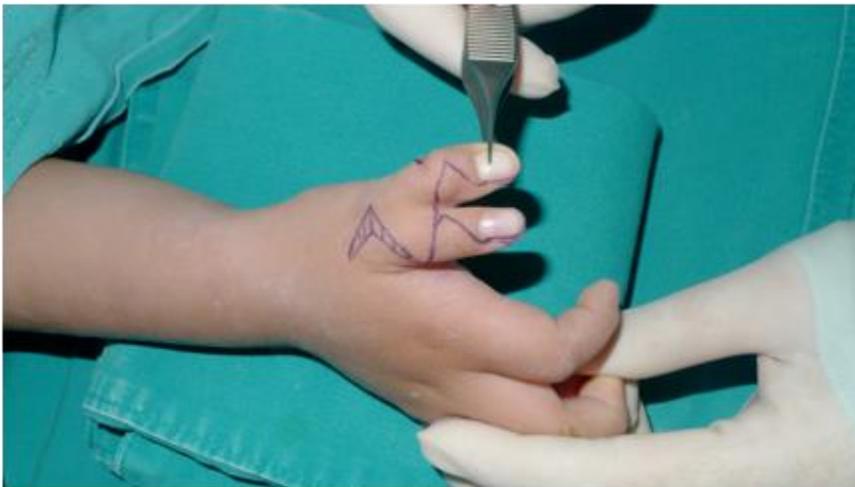


FIGURE 1. Dorsal markings



FIGURE 2. Volar markings

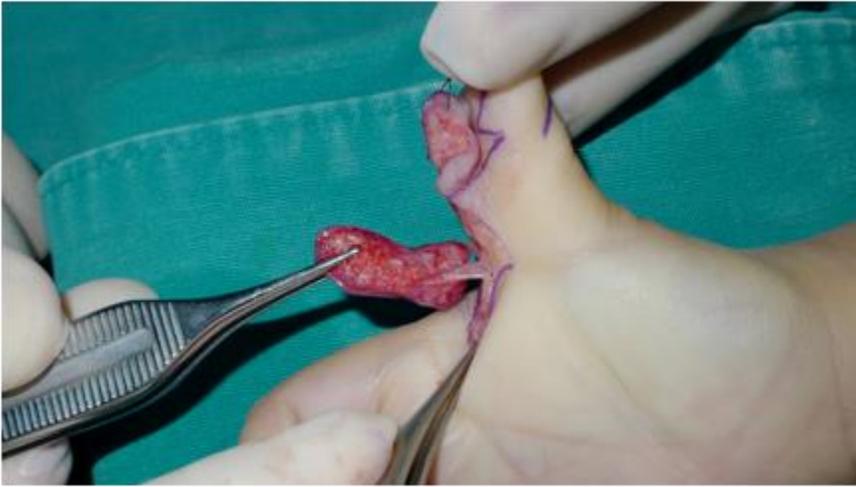


FIGURE 3. Neurovascular flap from ulnar duplicate (to be removed) is completely islanded on its pedicle



FIGURE 4. Final result (dorsal view)



FIGURE 5. Final result (volar view)

P143. Management of Acute Postoperative Pain in Hand Surgery

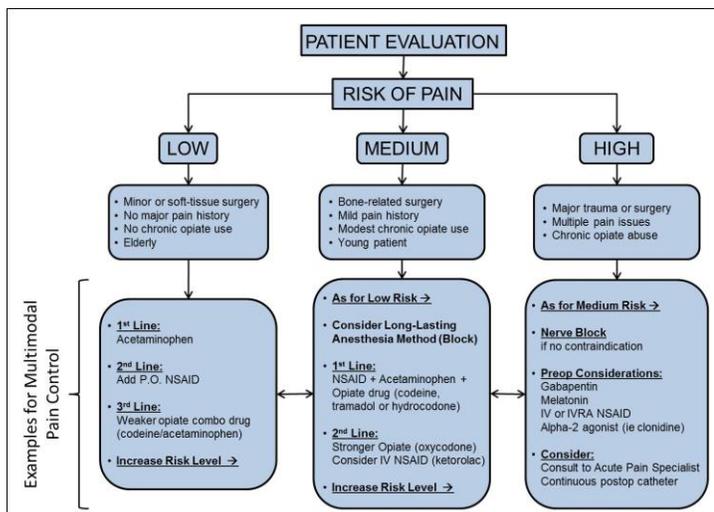
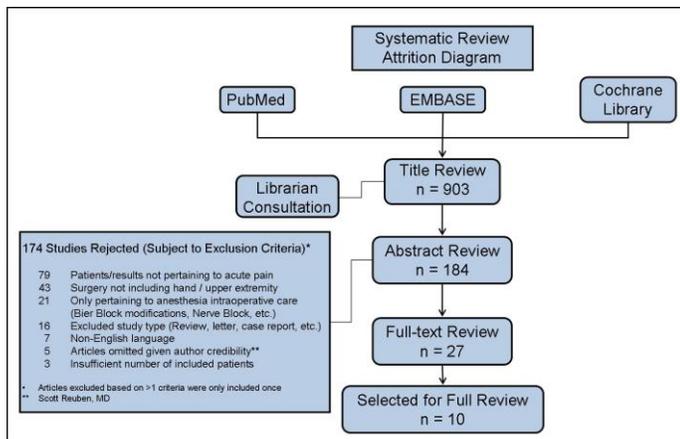
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Introduction: Acute postoperative pain is a major concern for patients undergoing surgery. However, pain control can be difficult and a multimodal approach is often necessary. There is currently no consensus regarding the best practices for pain control after hand surgery. Furthermore, scrutiny of physician prescribing habits of analgesics is increasing in medical, federal, and public forums. We conducted a systematic review to guide hand surgeons in an evidenced-based approach in managing postoperative pain.

Materials & Methods: A literature review was performed using Medline (PubMed), EMBASE, and the Cochrane Collaboration Library for primary research articles on postoperative pain control in hand surgery patients. Inclusion criteria were primary journal articles examining treatment of acute postoperative based on any modality. Data related to pain assessment, postoperative recovery, and total postoperative analgesic consumption were extracted.

Results: A total of 903 publications were reviewed; 184 publications underwent abstract review. After applying inclusion and exclusion criteria, 10 primary articles were selected for inclusion in this review. Data were noted to be heterogeneous and findings was compiled. The results were divided into groups evaluating either postoperative pain medications or pain infusion catheters.

Conclusions: There has been little research in the area of pain control for acute postoperative pain in hand surgery patients. Though this review does not demonstrate a “best practices” model for postoperative pain management, it does provide evidence for alternative medications and treatment strategies. The evidence available suggests that postoperative pain control should begin before surgery and that combining multiple strategies for pain treatment is beneficial. Given the increasing attention paid to narcotic prescriptions and the potential for abuse, surgeons should begin to adopt evidence-based pain management practices. We provided an example algorithm for pain treatment in hand surgery based on available data and the authors' experience.



P144. Intramedullary Scaffold Fixation of Distal Radius Fractures Compared to Volar Locking Plate

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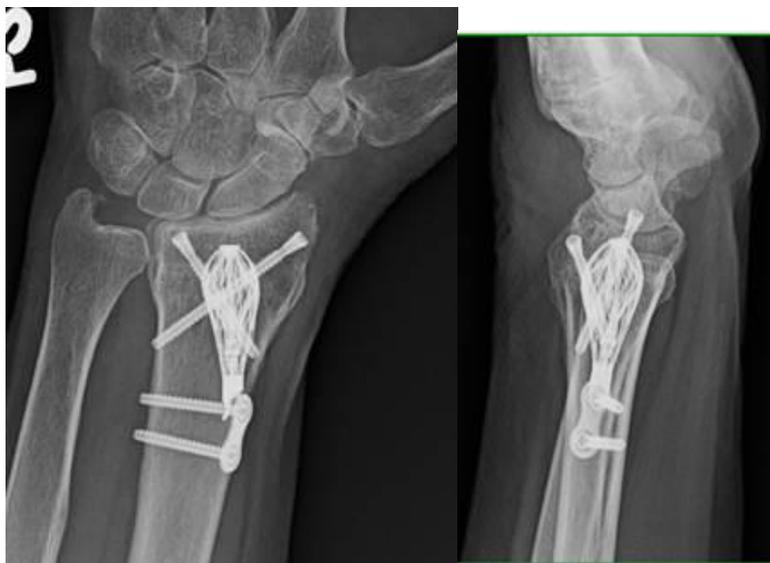
Introduction: The Conventus DRS system (Conventus Orthopaedics, Maple Grove MN) is a nickel-titanium intraosseous device that allows for stabilization of distal radius fractures with an intramedullary scaffold (IMS) and percutaneous cannulated screws (Figure). The purpose of this study is to report our early results with the Conventus implant compared to volar locking plate fixation of distal radius fractures.

Methods: Two groups of 11 patients each were retrospectively identified: patients treated with the IMS device for isolated distal radius fractures from 2014-2015, and patients treated with volar locking plate fixation (Acumed, Beaverton OR) who were matched to the IMS patients based on AO fracture classification and age. Measurements were obtained from postoperative and 4-week radiographs. Subjective outcomes were measured by reviewing Disabilities of the Arm, Shoulder, and Hand (DASH) scores calculated at the first postoperative visit, 4 weeks and 8-12 weeks. Total active motion (TAM) was measured at 4 weeks and again at 8-12 weeks. Variables were compared between the two groups using independent T-tests.

Results: Mean operative time was slightly increased in the IMS group (112 min \pm 38) compared to the volar plate group (98 min \pm 37, $p=0.39$). Volar plated fractures achieved better volar inclination on postop radiographs ($7.6^\circ \pm 5.2$) compared to the IMS group ($3.0^\circ \pm 7.8$, $p=0.12$) and maintained volar inclination at 4 weeks compared to the IMS group, which lost on average 1.6° of volar tilt, however this was not statistically significant ($p=0.2$). Mean DASH scores were lower for the volar plate group compared to the IMS group at initial postop (66 vs 75), 4 week (43 vs 55), and 8-12 week visits (24 vs 30), however this difference was not statistically significant. TAM was similar between the volar plate and IMS groups at 4-week (63° vs 59°) and 8-12 week visits (106° vs 101°). Two patients experienced EPL tendon rupture – one in each group.

Conclusions: IMS fixation provides a less-invasive method of distal radius fracture stabilization. This study found no statistically significant difference between IMS compared to standard volar locking plate fixation with respect to radiographic parameters, postoperative DASH scores, or total range of motion. This study is limited by small sample size, and larger prospective studies are needed to prove equivalence between the two fixation systems.

Figure



P145. High-Frequency Ultrasound Imaging of the Hand: A Pilot Study

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Background: Ultrasonography is a cost-effective, non-invasive, and expedient imaging modality with wide clinical applications. Conventional ultrasound uses transducers with frequencies that range from 5-12 MHz. These relatively low frequencies allow for penetration deep into the body to visualize target internal structures. High-frequency ultrasound (HFUS) is capable of producing frequencies up to 70 MHz. Such high frequency provides superior imaging of superficial anatomical structures with tissue resolution up to 30 microns. Our investigation focuses on the imaging capabilities of HFUS for the superficial structures of the hand including nerves, tendons, arteries, and veins. To date, only a single human study has been published on the use of HFUS imaging of the hand at frequencies greater than 20 MHz.

Methods: The Vevo® 2100 (VisualSonics, Toronto, Canada) imaging system was used to perform all ultrasound exams. Four unique linear array transducers were employed. They include the following: MS250 at 13-24 MHz, MS400 at 18-38 MHz, MS550S at 32-56 MHz, and MS550D at 22-55 MHz. All studies were performed by the authors who have no formal training in ultrasound techniques. Additionally, all studies were performed on healthy volunteers under IRB approval.

Results: A series of static images and dynamic, real-time videos were obtained at various locations within the hand. Structures as large as tendons and as small as individual fascicles of the digital nerves were successfully identified. Examples of findings include, but are not limited to, the following: 1) the median nerve and its individual fascicles at the proximal wrist and carpal tunnel, 2) the insertion of FDP onto the distal phalanx (Figure 1), 3) the flexor tendons, phalanx, digital artery and nerve in finger cross-section views (Figure 2), 4) real-time motion capture showing the movement of the slips of FDS moving dorsolateral to FDP with finger flexion, 5) the extensor tendons and dorsal extensor compartments of the wrist, and 6) the intimal layer of the radial artery (Figure 3).

Conclusions: HFUS is both a feasible and clinically significant imaging modality for hand surgeons. Our investigation shows that HFUS exhibits diagnostic promise for multiple hand pathologies including neural, vascular, and tendinous injuries in both acute and chronic settings. Further study is needed to better define the capabilities of HFUS and its clinical potential for the hand.

Figure 1



Figure 2



Figure 3



P146. A Cost Comparison of Introducing a Soft Splint Pathway for Management of Distal Radius Buckle Fractures

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Introduction: Distal radius buckle fractures are stable injuries that are manageable in soft casts rather than traditional Plaster of Paris (POP). Soft casts can be removed at home by the parent(s), avoiding unnecessary follow-up appointments. Therefore a soft cast treatment pathway would involve application of the removable soft cast at first appointment and discharge with cast care, removal and mobilisation advice.

Aim: We examine our current departmental practice and present a cost comparison of using the proposed soft cast pathway rather than POP.

Methods: We examined the radiographs and notes of all children presenting with distal radial buckle fractures over a 3 month period. Costings were assimilated through plaster room purchasing and the clinical coding department.

Results: All 107 children (61M; 46F), of average age 8.4 years, were placed in POP in the Emergency Department (ED). Approximately 61% of children were managed in POP and 25.2% had unnecessary additional radiographs. Only 33% were discharged at the first clinic appointment. Approximately 85% were reviewed in a dedicated Paediatric fracture clinic, where patients are twice as likely to be discharged at first contact. Only 32% of children were managed in soft cast and discharged at first appointment. Net hospital earnings treating this cohort amounted to £20,146. Treating this cohort with the proposed removable soft cast pathway would earn £24,097 (19.6% increase) and would save plaster room time by 34.7%.

Conclusion: Soft casts are a cost-effective way of managing buckle fractures. Reducing inappropriate fracture clinic follow-ups can increase new patient output and improve service efficiency. Based on these findings, a new treatment algorithm using soft casts has been introduced in our department.

P147. Persistent Central Carpal Row Ossicle in Sporadic Holt Oram Syndrome

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Introduction-Background: Holt Oram syndrome is an autosomal dominant disorder that is characterized by a combination of congenital cardiac septal defects, conduction anomalies and upper limb deformities, linked to mutations affecting the transcription factor TBX5 that is located at gene locus 12q24.1. Associated upper limb defects vary greatly from isolated involvement of the thumb or other digits to radial longitudinal deficiency and bilateral phocomelia.

Patient-Case presentation: A 20-year-old female with no significant family history diagnosed with asymptomatic congenital ventral septal defect and a conduction anomaly requiring dual chamber pacing, was referred to clinic complaining of a 2 month history of wrist pain. On exam she was found to have pain on supination, radial deviation and axial wrist loading. Imaging studies revealed a supernumerary radial carpal bone between the scaphoid and trapezium as well as a persistent central ossicle proximal to the capitate, articulating with the scaphoid and lunate. On surgical exploration, the scapholunate ligament appeared to be intact as well as the articular surfaces of the scaphoid, lunate and capitate. The persistent central ossicle was excised with complete resolution of patient symptoms at follow up.

Discussion: Although the degree of limb involvement in patients with Holt Oram syndrome varies greatly, the majority of affected patients are reported to fall under the spectrum of radial longitudinal deficiency or present with thumb anomalies. Although carpal anomalies are more specific than the thumb changes for the diagnosis of Holt Oram syndrome, they are far less described in the literature as asymptomatic cases can only be diagnosed with imaging studies. Furthermore, there is even less published data on the appropriate management of patients presenting with carpal pain or instability as a result of supernumerary carpal bones in this setting. This is the first report of a sporadic case of Holt Oram syndrome presenting with a supernumerary carpal bone between the scaphoid and trapezium as well as a concurrent persistent central ossicle. The persistent central ossicle is a remnant of the primitive hand central carpal row that normally appears during embryonic development only to be fused with the scaphoid by the eighth week of gestation. In this case, patient symptoms resolved upon excision of the central ossicle. As the management of symptomatic cases of Holt Oram syndrome is currently decided on a case-by-case basis, more studies are needed to help in the categorization of associated deformities and guide management.

P148. Submuscular Versus Subcutaneous Ulnar Nerve Transposition: A Cadaveric Study Evaluating Their Utility in Ulnar Nerve Repair at the Elbow

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Introduction: This study investigated the length gained from subcutaneous and submuscular transposition of the ulnar nerve at the elbow. The information was used to define potential nerve length gains from techniques commonly utilized in attempted primary ulnar neurohaphy at the elbow.

Materials and Methods: Eleven cadaveric complete upper extremity specimens were utilized. The glenohumeral joints and scapulae were fixed with Steinmann Pins. Standard approach for *in situ* decompression and mobilization of the ulnar nerve at the elbow was performed. A laceration 2cm distal to the medial epicondyle was created. The nerves were marked 5mm proximal and distal to the laceration site to simulate clinical nerve end preparation during repair. Nerve ends were attached to spring gauges set at 100g of tension (strain <10%) with 5.0 nylon suture (Figure 1). Measurements of nerve overlap were obtained in varying degrees of wrist and elbow flexion using an electronic caliper. Measurements were performed after *in situ* decompression/mobilization and repeated after both subcutaneous and submuscular transposition. Two and one way RMANOVA analyses were performed to compare overlap means.

Results: Ulnar nerve transposition was found to significantly increase nerve overlap past a threshold of 30 degrees of elbow flexion (Figure 2). No significant difference was seen between subcutaneous and submuscular transpositions at all wrist and elbow positions. Nerve length gained from wrist flexion was significant in all groups independent of elbow flexion and transposition. *In situ* decompression/mobilization alone with application of 100g tension provided an average of 3.5 cm of maximal length gain, whereas transposition in conjunction with clinically reasonable wrist and elbow flexion (30 and 60 degrees respectively) provided 5.2cm. Controlling for mobilization and with the wrist and elbow placed in clinically acceptable flexion positions a statistically significant increase in overlap of approximately 2cm was gained from transposition.

Conclusions: Subcutaneous and submuscular transposition along with clinically reasonable elbow and wrist flexion afforded a statistically significant length gain of approximately 2cm when compared to *in situ* decompression/mobilization. However, transposition length gain was only significant at elbow flexion greater than 30 degrees and there was no statistically significant difference between transposition techniques.



Figure 1: Photograph of the Experimentation Methodology. Note spring gauge attachment to either nerve end and marking sutures placed 5mm proximal to the laceration site. Glenohumeral joints and scapulae were secured with Steinmann pins, overlap was measured with an electronic caliper, and elbow flexion was measured with a goniometer (top right). Wrist flexion positions were held with prefabricated thermoplastic splints with built in flexion of 0, 30, and 60 degrees.

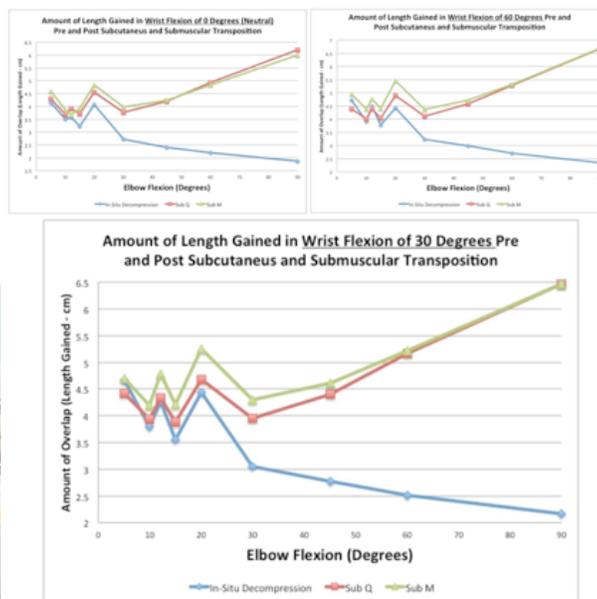


Figure 2: Average nerve overlap within our study's three subgroups (*In Situ* Decompression, Post Subcutaneous Transposition, and Post Submuscular Transposition) based on elbow flexion angle and with fixed wrist flexion angles of 0, 30, and 60 degrees.

P149. Achieving the Optimal Epinephrine Effect in Wide Awake Hand Surgery Using Local Anesthesia Without a Tourniquet

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Background: In our experience, for all surgeries in the hand, the optimal epinephrine effect from local anesthesia - producing maximal vasoconstriction and visualization - is achieved by waiting significantly longer than the traditionally quoted 7 minutes from the time of injection.

Methods: In this prospective comparative study, healthy patients undergoing unilateral carpal tunnel surgery waited either 7 minutes or roughly 30 minutes - between the time of injection of 1% lidocaine with 1:100,000 epinephrine, and the time of incision. A standardized incision was made through dermis and into the subcutaneous tissue followed by exactly 60 seconds of measuring the quantity of blood loss using sterile micropipettes.

Results: There was a statistically significant reduction in the mean quantity of bleeding in the group that waited roughly 30 minutes after injection and before incision compared to the group that waited only 7 minutes (95% Confidence intervals of 0.06 +- 0.03 ml/cm of incision, compared to 0.17 +- 0.08 ml/cm respectively) (P=0.03).

Conclusions: Waiting roughly 30 minutes after injection of local anesthesia with epinephrine is required to achieve the optimal epinephrine effect and vasoconstriction. In the hand, this will result in roughly a threefold reduction in bleeding - making wide awake local anesthesia without tourniquet (WALANT) possible. This knowledge has allowed our team to expand the hand procedures that we can offer using WALANT. The benefits of WALANT hand surgery include: reduced cost and waste, improved patient safety, and the ability to perform active intraoperative movement examinations.

P150. Angulation and Shortening in Communitied Metacarpal Fractures Treated with Intermedullary Nailing: Report of 55. Patients and their Outcomes

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Introduction: To evaluate clinical and radiographic outcomes in a case series of unstable metacarpal fractures treated with flexible intramedullary nail (IMN) fixation.

Materials & Methods: 55 patients with unstable metacarpal fractures between 2003 and 2010 were treated with IMN fixation and followed for a minimum of 1 year. The outcomes were assessed via radiological study of longitudinal and angular collapse, Disabilities of the Arm, Shoulder, And Hand (DASH) score, total active range of motion (AROM) of the digit, and grip and pinch strength testing.

Results: In the 55 patients, metacarpal fractures were healed by clinical and radiographic assessment at an average of 12.7 weeks. IMN were removed in all cases at an average of 13.9 weeks. Patients regained full finger range of motion at final follow-up and were capable of 72.4% of motion at two weeks post operatively. 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.

Conclusion: We found that this technique allowed for stabilization of fractures, early range of motion and resumption of usual activities, reduced immobilization, and minimal complications. A removable orthosis, instead of a cast, allowed for mobilization of the PIP joint.

P151. Video Tutorial for Teaching Medical Students Hand Surgery Technical Skills: Perception Does Not Equal Reality

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Introduction: Surgical proficiency depends on a high degree of technical skill. To gain these skills, medical students have been traditionally taught with the apprenticeship model. Increased concerns for patient safety, combined with work hour restrictions, have led to new approaches to teach and assess surgical skills. While various methods for garnering surgical skills are available, evaluation of the effectiveness of surgical skills training is limited. We sought to determine the effectiveness of a video tutorial in the acquisition of surgical skills utilizing a flexor tendon repair model; which is both objectively testable and economically favorable.

Methods: Medical students (n=12) interested in pursuing a surgical specialty were recruited in this IRB approved study. Subjects independently viewed a video tutorial reviewing zone II flexor tendon injury and repair. Using surgical simulation with a cadaveric flexor tendon, they then performed a flexor tendon repair with the technique just practiced. Subjects filled out a post-tutorial questionnaire reviewing the quality and usefulness of the content in the video tutorial. Post-tutorial repairs were tested for 2-mm gap and ultimate breaking strength on an MTS machine (MTS Systems Corp., Eden Prairie, MN).

Results: Post-tutorial flexor tendon repairs on average required 19.7 ± 9.1 N of force to create a 2-mm gap. The mean force required for repair failure by suture pullout or rupture was 23.0 ± 10.9 N. 16.7% of post-tutorial repairs were clinically significant with a load to failure ≥ 35 N (Figure 1). 75% students thought the video tutorial was an effective method of learning zone II flexor tendon repair technique and 90% stated surgical simulation videos would be a valuable asset to their future education in surgical residency.

Conclusions: Although 75% of medical students thought the video tutorial was an effective teaching tool for learning zone II flexor tendon repair technique, only 16.7% produced clinically significant repairs. Video tutorials may be insufficient to teach medical students advanced surgical skills, especially for technically challenging procedures. This model may be better suited for use in resident education. Despite the misperception of the medical students ability to perform a clinically significant repair, the majority felt surgical simulation videos would be a valuable asset to their future surgical residency curriculum. With limited time during residency, effective and reliable teaching tools for technical skills, which are level appropriate, must be available.

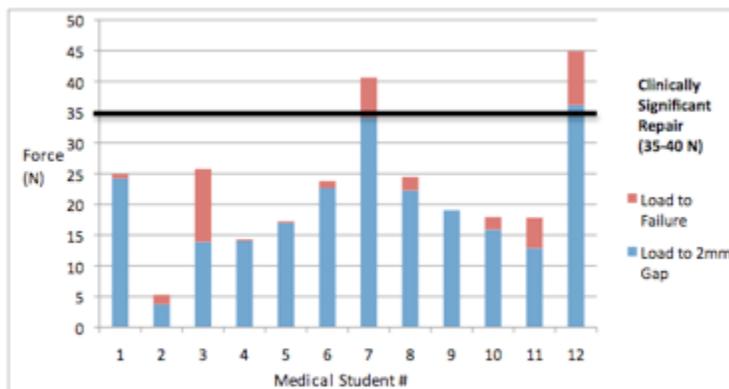


Figure 1: Load to failure and 2mm gapping of pilot study post-tutorial repairs

P152. WITHDRAWN

P153. 1. Versus 2. Tendon Transfer in Treatment of Brachial Plexus Birth Palsy

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Introduction: Tendon transfers (TT) are a common procedure utilized for brachial plexus birth palsy (BPBP) patients to improve shoulder function, specifically abduction and external rotation. The traditional use of two tendons in C5-7 patients may result in loss of midline function. Therefore, we assessed the outcomes of transferring a single tendon (1TT) versus the traditional method (2TT) for patients with C5-7 injuries.

Materials & Methods: A retrospective review of all BPBP patients that underwent tendon transfers over a 4 year period was performed at 2 institutions. All patients who had tendon transfer surgery and were C5-7 injuries were included. Outcomes were assessed utilizing the Modified Mallet (MM) scores and shoulder abduction range of motion.

Results: A retrospective review over a 4 year period identified 22 C5-7 patients, including 11 patients in both the 1TT and 2TT groups. The average age at surgery was 3.6 (1-5.4) years in the 1TT and 4.1(2.1-12.7) years in the 2TT group.

Pre-operative total MM score for the 1TT group was 14.6 and 15.1 for the 2TT group. The average MM internal rotation score was 3.55 for the 1TT group and 3.82 for 2TT group pre-operatively ($p=0.19$) and 2.73 and 2.64, respectively, post-operatively ($p = 0.27$).

When comparing pre and post-operative MM categories, there were significant improvements in both the 1TT and 2TT groups for global abduction ($p<.05$ and $p<.01$) and external rotation ($p<0.00001$ for both). MM hand to neck was significantly improved in the 2TT group ($p<.05$) but not in the 1TT group ($p=.053$). Internal rotation significantly decreased in both groups ($p<0.001$).

Final follow-up MM scores were 17.1 and 16.9 for the 1TT and 2TT groups, respectively ($p=0.83$). Both were significantly increased from the pre-operative MM values ($P<0.01$).

Conclusions: 1TT and 2TT procedures result in substantial gains in upper extremity functions for patients as measured by the MM score, specifically within the global abduction and external rotation subcategories, however a significant loss occurs in internal rotation for both groups. 1TT and 2TT procedures have similar outcomes however hand to neck was significantly improved only in the 2TT group and therefore one should balance the risks of multiple tendon transfers versus functional benefits.

P154. Practicability and Reliability Of A New Locking Plate For Scaphoid Reconstruction In Difficult Pathologies

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Hypothesis: Headless compressions screws are usually the most implanted devices for scaphoid nonunions or difficult fractures. For special circumstances when screw osteosynthesis is not possible because of instability of the fragments or failed healing, a special locking plate has been developed. The purpose of this study was to evaluate the practicability and reliability of this new device for difficult scaphoid pathologies.

Methods: Between March 2010 and December 2013, 18 patients (aged between 18 and 56 years) were treated by scaphoid locking plate osteosynthesis. Two patients were operated at least once on the scaphoid. The indication for using the plate was in 16 cases scaphoid nonunion or delayed union and in 2 cases a multifragmentary fracture of the scaphoid. The fracture was located in 5 cases in the proximal third of the scaphoid, in 4 cases in the proximal-middle third, in 6 cases in the middle third, in one case in the middle-distal and in 2 cases in the distal third. In 15 cases the locking plate fixation was used as primary option.

Results: 17 of 18 scaphoids demonstrated bony union 4 months postop on average (CT scan). 9 of the 18 plates have been removed. Reasons for hardware removal were mechanically disorders of wrist flexion due to impaction of the plate or protrusion of the screws. One patient will be re-operated in terms of delayed union.

Summary: This new locking device for scaphoid reconstruction is a useful tool and reliable backup option in the treatment of difficult nonunions or multifragmentary scaphoid fractures. However hardware removal should be performed due to intraarticular impaction in most patients. The practicability is excellent and satisfying fusion rates can be accomplished. We use this plate now as a rescue option in situations when a very stable osteosynthesis is necessary for healing and screw fixation has already failed or may be not practicable.

P155. Hand Therapist Led Follow-up for Paediatric Hand Injuries

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Introduction: Most hand injuries in children can be managed non-operatively and are associated with excellent outcomes. Whilst the majority of our patients are discharged to the care of hand therapists there is no literature to support this protocol. Our aim was to ensure this is safe and effective practice.

Materials & Methods: We conducted a retrospective analysis of all patients referred to our paediatric hand trauma clinic for closed injuries over a 4 month period between December 2014-March 2015. Data related to demographics, injury pattern and clinical outcomes was recorded and analysed. A telephone interview with a patient satisfaction questionnaire was attempted with all patients discharged to the care of hand therapists.

Results: 139 patients were seen in the study period, including 90 males and 49 females. Phalangeal fractures (39%), volar plate injuries (19%) and metacarpal fractures (16%) were the commonest causes of hand trauma. The majority of patients (88%) were managed non-operatively. 98 patients were discharged to hand therapy follow-up and 51 patients completed a patient satisfaction questionnaire. 100% of the parents were happy with the care, 96% were not disappointed they did not see a doctor and 96% denied any complications.

Conclusion: Hand therapy led follow-up is appropriate for a selected group of paediatric hand injuries. It is safe and associated with high patient satisfaction.

P156. Pediatric Upper Extremity Emergency Room Transfers: Are They Warranted?

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Introduction: Emergency room transfers to a higher level of care is a vital component of modern healthcare in order to permit the optimal care of patients by providing access to specialized personnel and facilities. However, literature has shown that transfers to a higher level of care facility for an adult hand injury are frequently unnecessary. Furthermore, adult hand emergency room transfers have been shown to be higher during “off-hours” and weekends, and are frequently based on insurance status. The purpose of this study was to evaluate the appropriateness of pediatric upper extremity transfers to a tertiary care center and the factors surrounding them.

Materials & Methods: A retrospective review was performed of all pediatric emergency room transfers to our tertiary care facility over a 1 year period. All cases that involved the upper extremity were reviewed to assess patient demographics, the time of the request for transfer, the day of the week of the transfer, insurance status, whether or not the patient went to the operating room, whether or not a closed reduction maneuver was performed in the emergency department, and whether or not conscious sedation was provided in the emergency department. Simple statistical analysis was performed.

Results: 61% (46/75) pediatric orthopedic emergency room transfers were cases related to the upper extremity, all of which were fractures. 30% (14/46) transfers occurred on the weekend. 24% (11/46) transfers involved patients with Medicaid.

63% (29/46) of cases required a procedure in the operating room, and 33% (15/46) had a closed reduction procedure performed in the emergency room. 24% (11/46) had conscious sedation provided in the emergency room. Only 6.5% (3/46) of transfers did not require any of these three factors.

Conclusion: The vast majority of pediatric upper extremity transfers are warranted requiring either operative intervention, a closed reduction maneuver, or conscious sedation. Unlike adult hand transfers, the majority of pediatric upper extremity transfers do not seem to be influenced by time of day/week or insurance status. While transfer of a patient to a tertiary care facility does increase healthcare costs, pediatric upper extremity transfers are an appropriate use of resources.

P157. Long Term Outcome Of Surgical Treatment Of Radial Tunnel Syndrome in 223. Patients

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Purpose: Radial tunnel syndrome (RTS) is a pain syndrome due to entrapment of the posterior interosseous nerve (PIN) at the proximal forearm. In this study we analyze the long term outcome of its surgical treatment in 223 patients.

Materials and Methods: Between 1990 and 2012, 269 patients were surgically treated for RTS. 223 patients were available for review. There were 94 males and 129 females, with an average age of 43 years (23-72 years). Symptoms lasted an average of 9 months. (2-30 months). The dominant hand was involved in 159 patients. History of trauma was present in 67 patients. 162 patients were worker's compensation patients.

Electrodiagnostic studies were obtained in all patients. The studies were positive for entrapment of the PIN in 36 patients (16%). Associated conditions were present in 37% of patients.

Patients were treated conservatively for an average of 3½ months (6 weeks - 13 months). Surgery was performed using a dorsal approach under regional block anesthesia. The PIN was exposed between the extensor carpi radialis brevis and the extensor digitorum communis. The anterior approach was used in 3 recurrent cases.

Postoperative follow-up averaged 9 years (2-22 years).

Results: At the last follow-up, 162 patients had no pain (73%). 36 had minimal pain (16%), 18 had moderate of pain (8%) and seven had persistent pain (3%).

Of the seven patients who had persistent pain, five underwent re-exploration of the PIN; three through the anterior approach and 2 through the dorsal approach. Eventually three patients had complete improvement of the pain, but two patients continued to have persistent pain. The grip and pinch strength averaged 98% and 99% of the contralateral side respectively. Of the 162 worker's compensation patients, 157 returned to their regular work activities, four returned to modified work activities, and one changed his job. All non-worker's compensation patients resumed their normal daily activities.

Subjectively, patients classified their outcome as excellent in 78%, good 11%, fair 8% and poor 3%.

There was no statistical difference in the outcome according to age, gender, duration of symptoms or any other associated condition except lateral epicondylitis (p<0.05).

Discussion and Conclusion: Proper diagnosis and management of patients with RTS are associated with good functional outcome. Worker's compensation patients had slightly less favorable results, but not to a significant degree. Associated Lateral epicondylitis had a negative effect on long term outcome.

P158. Short-to Intermediate term Outcomes Following Interosseous Membrane Reconstruction Using Tightrope Suture-Button Suspensionplasty System

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Introduction: Forearm instability, such as that seen in Essex-Lopresti injuries, can have significantly debilitating clinical consequences when uncorrected. The purpose of this study is to describe our institution's experience with forearm Interosseous Membrane (IOM) Reconstruction using Tightrope suture-button suspensionplasty device.

Methods: We retrospectively reviewed the charts of all patients who underwent IOM reconstruction using the Tightrope (*Arthrex, Inc., Naples, FL*) by one of two senior, fellowship-trained hand surgeons from 2011 through 2014.

Demographic data, injury history, prior treatment(s) and clinical exam values were recorded. Bivariate statistical analysis with independent t-test was utilized for comparison of pre- and post-operative wrist and forearm range of motion and grip strength. Secondary outcomes of complications and/or need for revision surgery were also recorded.

Results: Ten (7 female, 3 male) patients satisfied inclusion in this study. Average age of all patients included was 45.3 years (range 22-59). Five surgeries were performed on each, the dominant and non-dominant extremity. One patient was treated for her Madelung's deformity; another patient was treated for instability resulting from failed lateral elbow reconstruction while the remaining eight patients were treated for post-traumatic sequelae of Essex-Lopresti type injuries (7 radial head/neck fractures, one Monteggia-type fracture-dislocation). All ten surgeries were performed in conjunction with an ulnar shortening osteotomy (USO) and arthroscopic triangular fibrocartilage complex (TFCC) repair. Eight Tightrope (TR) devices were used primarily, while two were used in revisions of prior failed surgeries. The mean interval from initial injury to IOM reconstruction surgery with the TR and to final follow-up were 25.7 +/- 17.5, and 14.7 +/- 12.7 months, respectively. All ten patients reported subjective satisfaction with improvements in pain and function. Significant improvement was seen in elbow flexion/extension arc (97.0 +/- 23.9 deg pre-operatively vs. 119.5 +/- 18.0 deg post-operatively; $p = 0.03$). No significant difference was observed between pre- and post-operative forearm rotation or grip strength as measured by dynamometer. Four patients required additional surgery after IOM reconstruction: two required revision USO for recurrent abutment symptoms, one patient required elbow capsulectomy with excision of heterotopic ossification (HO) due to stiffness and one patient required open reduction and internal fixation (ORIF) of the radial shaft of her operative extremity after sustaining a fracture from a fall.

Conclusions: IOM Reconstruction using TR device an effective treatment option to treat forearm instability from post-traumatic or congenital deformities, and may also be useful for revision of prior failed treatments.

P159. The Death of Open Surgery? Trends in Dupuytren's Treatment After Collagenase Introduction at the VA
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Introduction: Dupuytren's contracture is a debilitating disease caused by abnormal thickening of the palmar fascia resulting in pits, nodules and cords. This can lead to contracture of the digits preventing full hand motion. With the FDA approval of collagenase clostridium histolyticum in 2010, it was predicted that there would be an increase of use of collagenase with an associated decrease in palmar fasciectomy and fasciotomy in the VA system.

Materials & Methods: The VHA Services Support Center database was used to examine the past 8 fiscal years. CPT codes related to collagenase injection (20527 collagenase injection), fasciotomy (26040 fasciotomy closed, 26045 fasciotomy open) and fasciectomy (26121 palmar fasciectomy, 26123 fasciectomy single digit, 26125 fasciectomy additional digit) were identified. Data analysis was carried out using SPSS 22 (IBM).

Results: The total number of Dupuytren's cases treated in the VA system increased over time (1133 in 2007, 1976 in 2014). The VA system began to use injectable collagenase in fiscal year (FY) 2012. Please see table 1 for annual volumes of each procedure. The percentage of total cases treated with fasciotomy (open or closed) decreased from 29.4% in 2007 to 18.1% in 2014 and open fasciectomies decreased from 70.6% in 2007 to 54.6% in 2014. Injectable collagenase comprised 7.5% of treatments in 2012 and rapidly increased to 27.1% in 2014. Please see figure 1 for FY 2007 through 2014.

Conclusions: The introduction of injectable collagenase for the treatment of Dupuytren's contracture has increased in use in the VA system since its introduction in 2012. There has been an associated decrease in surgical interventions performed, both minimally invasive fasciotomies and open fasciotomy and fasciectomy. To the authors' best knowledge, this is the first study to show an increased use of injectable collagenase, while other methods of treatment are decreasing in the VA.

Figure 1. Percentage of total Dupuytren's contracture treatments by modality.

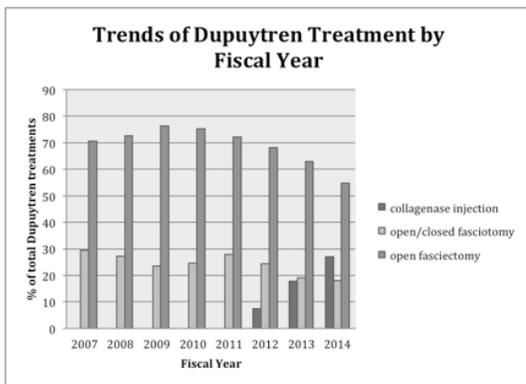


Table 1. Annual volumes of procedures for Dupuytren's in the VA system.

	2007	2008	2009	2010	2011	2012	2013	2014
Collagenase injection						131	328	536
Fasciotomy closed	94	117	156	169	258	218	166	171
Fasciotomy open	239	277	198	228	188	206	188	187
Palmar fasciectomy	93	85	106	136	146	128	164	159
Fasciectomy single digit	504	700	753	772	744	754	703	681
Fasciectomy additional digit	203	265	291	300	266	306	295	242
Total Cases	1133	1444	1504	1605	1602	1743	1844	1976

