Electronic Poster Abstracts

P1. PCLF as a Backbone for Chondrocyte Attachment and Proliferation Augmented by Platelet Lysate

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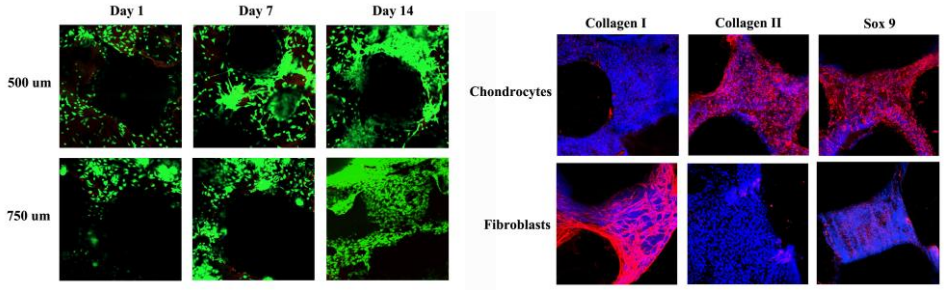
Purpose: Management of chondral injuries is a difficult problem. Our goals are to 1) create a biodegradable polymer scaffold with the capabilities of sustaining chondrocyte growth and proliferation, 2) enable cell-cell communication and tissue regeneration via large pores, 3) assess the biological augmentation of the scaffold capabilities using a cocktail of platelet secretion products known as platelet lysate.

Methods: We synthesized biodegradable polycaprolactone fumarate (PCLF) scaffolds to allow cell communication via large interconnected pores. Molds were printed on a SolidScape 3D printer and scaffolds synthesized via UV crosslinking. Chondrocytes were isolated from rabbits and cultured in DMEM and 10% FBS. The analysis compared this media to media composed of DMEM with 5% platelet lysate (PL), a mixture of platelet release products. Seeding of scaffolds occurred in a dynamic bioreactor. Assays included cellular proliferation (MTS), toxicity and viability (Live/Dead immunostaining), differentiation (GAG, ALP, and Total Collagen), and immunostaining for chondrogenic markers collagen II and Sox 9 (with collagen I as a negative control).

Results: The large interconnected pores (500 and 750 micrometers) enable cell-cell communication and cellular infiltration into the scaffolds. After dynamic cell seeding of the progenitor cells on the PCLF, the cells remained viable for 2 weeks cultured on *in vitro* culture plates, invading throughout the pores and body of scaffolds (**Figure 1**: GFP signal represents viable, healthy cells). Chondrocytes cultured in the presence of PL did have increased rates of proliferation when compared to FBS. The chondrogenic markers glycosaminoglycan (GAG) and total collagen contents increased over 2 weeks at each time point ($p<0.05$), while the osteogenic marker alkaline phosphatase (ALP) did not significantly change ($p<0.15$). Immunostaining at 2 and 4 weeks for the expression of chondrogenic markers Collagen II and Sox-9 was significantly increased when compared to control human fibroblasts (**Figure 2**: red represents ColI/Tenascin expression, blue represents DAPI nuclear staining).

Conclusion: Our results show that the PCLF polymer scaffold enables chondrocytes to attach, proliferate and retain their chondrogenic phenotypes. This novel scaffold and material has promise in chondrocyte engineering and cartilage regeneration.



P2. In-vitro Kinematics Of The Proximal Inter-phalangeal Joint in the Finger after Progressive Disruption of the Main Supporting Structures

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Introduction: PIP joint stability is dependent on osseous anatomy, soft tissue stabilizers and muscle activity. The relative contribution of the soft tissue stabilizers versus the bony anatomy remains controversial and has not been examined objectively in a physiologic model of joint motion. The purpose of this study was to determine the kinematics of the PIP joint following sequential sectioning of the ligamentous and bony stabilizers in an in-vitro cadaver model, using a 3-dimentional motion tracking system.

Materials and Methods: Ten cadaveric PIP joints underwent computer-controlled simulated motion, using physiologic loads. The experimental conditions tested in each specimen included intact specimen, sectioned collateral ligaments, sectioned volar plate, and progressive resection of the middle phalangeal volar base comprising 20%, 30% and 50% of the articular surface. PIP joint kinematics were measured in the intact specimen and after sequential sectioning of the stabilizing structures.

Results: Release of the collateral ligaments and the volar plate did not alter the joint kinematics significantly. With a 20% volar bony defect a small but significant maximum dorsal translation was observed ($3.8 \pm 8.6\%$, $p<0.05$), without joint subluxation. Significant alterations in several kinematic variables were observed after resection of at least 30% of the middle phalangeal volar base. No significant increment of the hysteresis of the kinematic variables was detected until 30% of joint disruption.

Conclusions: Sectioning the PIP joint soft tissue stabilizers in 2 planes did not produce significant joint instability and abnormal joint kinematics. Gross instability of the PIP joint occurred when disruption of the collateral ligaments and volar plate was accompanied by resection of at least 30% of bone at the base of the middle phalanx. It is the size of the volar base fragment itself, rather the remaining collateral attachment on the dorsal fragment that renders a joint stable.

P3. Reconstruction of Chronic Distal Biceps Ruptures Using Achilles Tendon Allograft

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Introduction: Chronic distal biceps ruptures are uncommon and their reconstruction is technically challenging. Proximal biceps muscle retraction, shortening of the musculo-tendinous unit and adhesion formation make direct reattachment to bone difficult and the results are considered inferior than acute ruptures. The aim of this study was to evaluate the results of anatomic reconstruction of the chronic distal biceps ruptures using an Achilles tendon allograft through a single anterior approach .

Materials & Methods: 14 males patients with chronic distal biceps ruptures were included in this study. The mean patient age was 38 years (range, 30-54). The mean period from injury to surgery was 32 weeks (range, 11-49 weeks). Reconstruction through a single anterior approach using the Achilles tendon allograft and 2 suture anchors was performed in all patients by a single surgeon. The Achilles tendon allograft was attached to the bicipital tuberosity by using suture anchors and then secured to the biceps stump with a pulvertaft weave technique. A posterior, long arm splint with the elbow in 90° of flexion was applied for 2 weeks and then replaced with a hinged elbow brace with an extension block. Gradual full extension in the brace was reached at 8 weeks. Then progressive strengthening was started until full loading is permitted at 6 months. All patients were evaluated with regard to satisfaction, pain, range of motion and strength.

Results: At a mean follow-up of 43 months all patients were pain free at rest. Mean elbow flexion was 143°, mean pronation was 85° and mean supination was 86°. One patient had an extension deficit of 10°, in the remaining patients extension was noted to be full. Manual testing revealed 5/5 strength in elbow flexion and supination. Mean supination strength was 88% of the contralateral healthy extremity using a BTE (Baltimore Therapeutic Equipment). Thirteen patients achieved an excellent and one a good rating in the Mayo elbow performance score. All patients were satisfied with the procedure and eventually were able to return to their pre-injury employment. No complications were encountered.

Conclusions: Late reconstruction of distal biceps rupture through a single anterior approach using Achilles tendon allograft is an effective and safe technique for this challenging problem. Although this technique is a demanding procedure and involves a prolonged rehabilitation period, it is an excellent alternative for patients with high functional demands in pronosupination in their occupational or athletic activities.

P4. Improved Symptom and Functional Status After Carpal Tunnel Release in Patients Over 80

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Introduction: Outcome following carpal tunnel release may be influenced by age, chronicity, and disease severity. Little data exists regarding outcomes in patients over 80. Patient-oriented outcomes are typically assessed by validated instruments such as the Brigham and Women's Carpal Tunnel Questionnaire (BWQ). Multiple studies have reported mixed results when investigated the relationship between age and improvement in BWQ; however, many have done so without controlling for confounders and using small cohorts of relatively younger patients. We hypothesize that patients over 80 benefit from carpal tunnel surgery based on the BWQ.

Methods: 201 carpal tunnel release (CTR) procedures between 2008 and 2013 were performed by 2 senior hand surgeons on individuals over 80. The BWQ was completed by each patient pre-operatively and then contacted by phone for post-operative results. Exclusion criteria included multiple CTR or missing questionnaire. The main outcome measurement is the difference in average BWQ score. Wilcoxon Signed-Rank test was used to verify differences in BWQ score. A standardized response mean was calculated for effect size. Covariates were chosen based on potential as confounders: body mass index, gender, surgeon, procedure type, hypothyroidism, ASA status, osteoarthritis, diabetes, peripheral neuropathy, systemic inflammatory processes, mood disorder, chronicity of symptoms, and thenar EMG findings (amplitude, velocity, latency). T-test or chi-squared test were used for univariate analysis. Logistical regression was used to predict the odds of a large improvement in BWQ vs. a small improvement in BWQ in a multivariate model. The model was assessed by ROC and Hosmer-Lemeshow tests. Statistical significance was based on a p-value less than 0.05.

Results: We found statistically significant improvement in symptom severity scores by 2.97 points, functional status scores by 1.52 points, and combined scores by 2.51 points. Age was not a significant predictor in a multivariate model to predict effect size; however, ASA status was found to have a statistically significant inverse relationship with a decrease in the odds of large improvement by 77%.

Conclusion: We found no association using age as a predictor of improvement for self-reported symptom and functional status using a regression model, analyzing one of the largest cohorts of patients over 80 who have undergone CTR. We conclude patients over 80 do benefit from CTR based on differences in BWQ score. While age is not associated with the size of this benefit, ASA status is, suggesting that other medical co-morbidities adversely affect outcomes after CTR in this elderly population.

P5. A Systematic Review of the Surgical Management of Carpal Boss

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Introduction: The carpal boss is a benign bony protuberance that often develops over the dorsal aspect of the index and middle carpo-metacarpal (CMC) joints bases. There is no clear consensus on the most effective surgical technique, however: simple excision or excision followed by CMC arthrodesis. The existing literature on the surgical management of carpal boss was systematically reviewed to identify the optimal surgical treatment method.

Methods: Two authors independently reviewed articles retrieved from MEDLINE using the search query "carpal boss AND ganglion cyst OR carpal boss" and applied limitations to include English language articles. Reports with less than 5 patients were excluded. Secondary selection required the studies to report data with at least 6 months of clinical follow up. Variables of interest included basic demographics, post-operative symptom recurrence, reoperations and complications. Fisher's exact test was used for statistical analysis.

Results: A total of 41 studies were identified. Following the application of inclusion and exclusion criteria, 8 studies remained: 1 level III, 7 level IV evidence. 206 patients were identified: 168 underwent simple excision, 38 underwent excision followed by arthrodesis. 86 females and 78 males were identified. 70/207 cases had a history of trauma, while 3/36 had an overlying ganglion cyst. Follow up ranged from 6months to 10 years. There were no significant differences in pain relief, reoperation rates, symptom recurrence or complication rates.

Discussion: Simple excision is a technically less demanding procedure and may result in outcomes similar to CMC arthrodesis. While persistent symptoms of pain are not uncommon following carpal boss excision, additional, more extensive debridement or CMC arthrodesis appears to result in satisfactory patient outcomes. The available literature on the surgical treatment of carpal boss is limited by a small number of studies with low levels of evidence. Higher quality studies would be useful in guiding treatment considerations.

P6. Skin Surface Pressure under Short Arm Casts – Comparing Plaster of Paris and Fiberglass Casts

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Introduction: There is limited data regarding how wrist size and cast material affect edema-induced pressure within a short arm cast (SAC) as well as pressure reduction during cast cutting. We sought to: (1) evaluate if wrist size and simulated peak pressure relate and (2) compare differences in peak pressure and pressure reduction in SACs made with plaster of Paris (PoP) and fiberglass (FG).

Materials and Methods: Nineteen healthy volunteers (13 male, 6 female, average age 24yrs) were evaluated; their distal palmar crease (DPC) and distal radial ulnar joint (DRUJ) circumferences were recorded.

Each wrist was casted in neutral position with PoP then FG using one roll of 2-inch webril, 4-inch PoP and 2-inch FG, for a total of 76 casts.

An empty 50mL IV bag, placed on the dorsum of the wrist, was incorporated into a SAC and connected to a pressure transducer. A syringe infused air to simulate swelling.

Pressures were recorded during low- and high-pressure casting and during cast cutting, which included paired ulnar- then radial-sided cutting, spreading, webril cutting, and ace wrapping.

Results: FG SACs had significantly higher pressures compared to PoP at initial pressure with 10cc of air (25.94mmHg vs. 13.75mmHg, $p<0.0001$), peak pressure with 50cc of air (149.68mmHg vs. 113.64mmHg, $p<0.0001$), and ace wrapped cut cast pressure with 50cc of air (31.41mmHg vs. 28.05mmHg, $p=0.004747$).

Linear regression demonstrated a significant inverse relationship between peak pressure and circumference for PoP (DPC: $\beta=-0.0657\pm0.0122$, $p<0.0001$; DRUJ: $\beta=-0.0419\pm0.0072$, $p<0.0001$) and FG SACs (DPC: $\beta=-0.0534\pm0.0068$, $p<0.0001$; DRUJ: $\beta=0.0320\pm0.0043$, $p<0.0001$).

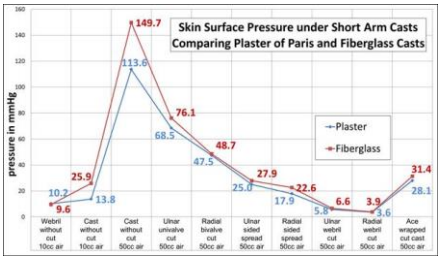
Pearson correlation demonstrated a moderate negative correlation for PoP SAC peak pressure and DPC ($r=-0.6777$) and DRUJ ($r=-0.7087$) as well as a strong negative correlation for FG SAC peak pressure and DPC ($r=-0.8028$) and DRUJ ($r=-0.7894$).

Discussion: FG SACs have higher pressure than PoP SACs – use FG with caution. PoP and FG SAC peak pressure were greater than the pressure threshold to occlude cutaneous microcirculation (60-75mmHg) and digital arterioles (32-60mmHg) – cast cutting is warranted.

Ace wrapped cut cast pressures were considerably less than the threshold to occlude cutaneous microcirculation, but marginally below that to occlude digital arterioles – apply ace wrap without stretching.

High peak pressures occur in patients with small DPCs and DRUJs – could this explain an association between complex regional pain syndrome and women with distal radius fractures?

Studies on cut location (ulnar-radial vs. dorsal-palmar) is necessary – can pressure reduction improve?



P7. Wrist Ganglion Treatment: Systematic Review and Meta-Analysis

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Introduction: There are many treatments for wrist ganglia. The objective of this study was to review the clinical outcomes of all ganglia treatment modalities and to generate a meta-analysis comparing the two most common options: open surgical excision and aspiration.

Materials & Methods: Review methodology was registered with PROSPERO. A systematic search of MEDLINE and EMBASE was performed for articles published between 1990 and 2013. Studies were included that reported adult wrist ganglia treatment outcomes; recurrent ganglia treated with the same modality were excluded. Two independent reviewers performed screening and data extraction. Risk of bias was evaluated with Cochrane's tool for randomized controlled trials (RCT) and the Newcastle-Ottawa Scale for cohort studies; GRADE methodology was used to evaluate quality of evidence.

Results: A total of 753 abstracts were identified and screened, 112 full-text articles were reviewed and 35 studies (ganglia=2,239) met inclusion criteria for data extraction and qualitative synthesis; 6 studies met criteria for meta-analysis, including 2 RCTs and 4 cohort studies. In RCTs surgical excision was associated with a 76% reduction in recurrence compared with aspiration [RR=0.24; 95%CI=0.08-0.71; p=0.01; I^2=0%]; RCT quality was 'moderate' (GRADE). In cohort studies surgical excision was associated with a 58% reduction in recurrence compared with aspiration [RR=0.42; 95%CI=0.21-0.85; p=0.02; I^2=87%]; cohort study quality was 'very low' (GRADE). In cohort studies aspiration was not associated with a significant reduction in recurrence compared with reassurance [RR=0.99; 95%CI=0.77-1.28; p=0.96; I^2=0%]; cohort study quality was 'very low' (GRADE). Mean recurrence across all studies was 20.5% (SE=3.5%) with open surgical excision (studies=14, ganglia=809), 58.7% (SE=5.1%) with aspiration (studies=12, ganglia=489), and 5.6% (SE=1.8%) with arthroscopic excision (studies=11, ganglia=512); mean persistence was 52.5% (SE=5.5%) with observation (studies=2, ganglia=93). Mean complication rate was 14.4% (SE=5.6%) with open surgical excision (studies=6, ganglia=341), 2.6% (SE=1.5%) with aspiration (studies=3, ganglia=134), and 4.1% (SE=2.3%) with arthroscopic excision (studies=6, ganglia=221).

Conclusions: Open surgical excision offers a significantly lower chance of recurrence compared with aspiration in the treatment of adult wrist ganglia but carries an added risk of complications. Aspiration is a simple option with a low risk of complications but appears to provide no benefit compared with reassurance. Further RCTs are needed to increase confidence in the estimate of effect and to compare complications and recovery between treatments. Treatment selection should be guided by the potential outcomes and complications of each treatment option as well as the patient's symptoms and the natural history of the ganglia.

P8. Comparison of Early Outcomes between Injectable Collagenase Clostridium Histolyticum and Limited Fasciectomy in the Treatment of Dupuytren's contracture: A Multicenter Propensity Score-matched Study

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Purpose: To compare the real-world effectiveness of injectable collagenase clostridium histolyticum (CCH) with limited fasciectomy (LF) in patients with Dupuytren's contracture.

Methods: We identified 235 subjects undergoing CCH or LF for single-digit contractures affecting metacarpophalangeal (MP) and/or proximal interphalangeal (PIP) joints at 7 practice sites using a prospective database. Propensity score (PS) matching was applied to minimize treatment selection bias. PS's were estimated using 11 baseline characteristics (including demographics, disease-characteristics and contracture severity) and applied to individually match CCH subjects to LF subjects. We were able to create 74 matched-pairs (N=148) with similar characteristics.

Primary endpoint was residual joint contracture assessed between 6 and 12 weeks after treatment. Secondary endpoints included the Michigan Hand Questionnaire (MHQ) and adverse events/complications.

Results: Assessed at an average of 8 weeks after treatment, residual MP joint contracture after CCH (12°SD[13°]) was significantly worse than after LF (6°SD[7°])(Fig.1A). Residual PIP joint contracture was also significantly worse after CCH (24°SD[16°]) than after LF (14°SD[10°])(Fig.1B).

However, total MHQ score and subscores (satisfaction with hand function and work performance) showed significantly larger increases from baseline in the CCH group than in the LF group (p's>0.005). Complications that required an intervention or were non-transient occurred more frequently in the LF group: tenosynovitis (3% vs 0%), infection (1% vs 0%) and nerve injury (3% vs 0%)(p=0.043).

Approximately one-third of subjects in the matched groups received treatment for recurrent disease (p=0.600). Exploratory analysis of this subgroup showed that residual MP joint contracture after CCH (15°SD[19°]) was worse than after LF (6°SD[7°]), although this difference was not significant (p=0.197). Residual PIP joint contracture was significantly worse after CCH (31°SD[18°]) than after LF (18°SD[11°])(p=0.008).

Conclusion: Compared with LF, injectable CCH was less effective at reducing MP and PIP joint contractures. However, the CCH group showed superior self-reported outcome in the MHQ satisfaction and work performance subdomains at short-term follow-up. Injectable CCH may offer an attractive alternative to LF for subjects who are willing to trade less contracture reduction for faster functional recovery and lower risk of serious complications.

This study highlights the importance of minimizing selection bias through propensity score matching when comparing interventions for Dupuytren's disease.

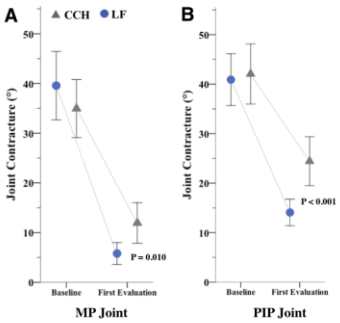

Figure 1. Joint contracture for affected MP (Panel A) and PIP (Panel B) joints in the collagenase clostridium histolyticum injection (CCH) group and the limited fasciectomy (LF) group at baseline and first evaluation time-point. Means and 95% confidence intervals are plotted. P values indicate the comparison of mean residual joint contracture between treatment groups.

P9. Safe-Zones for Surgical Intervention in the Lunate: a Micro-CT Study

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Purpose: The etiology of Kienböck's disease remains unknown. Traumatic and non-traumatic causes for avascular osteonecrosis of the lunate are described in literature. The lunate is the most frequently carpal bone to experience global avascular necrosis. Avascular necrosis of the lunate after surgery has been reported. The primary scope of this micro-CT study is to assess the intraosseous vascularity of the lunate. We have designed an anatomical study with use of micro-CT for the assessment of intraosseous vascularity and to identify "safe-zones" for surgical interventions e.g. drill hole and screw placement.

Methods: 14 lunates were collected from fresh frozen cadavers. Prior to harvest the wrists were injected through the radial and ulnar artery with a lead-based contrast agent (Microfil MV-117, Flow Tech, Carver, MA, USA) under a physiologic pressure of 140 mmHg monitored by a pressure monitor. The lunates were then scanned at 20µm/voxel. The intraosseous vascularity was assessed and incorporated into a 3D rendering (fig 1). The vessel diameters were measured and analyzed.

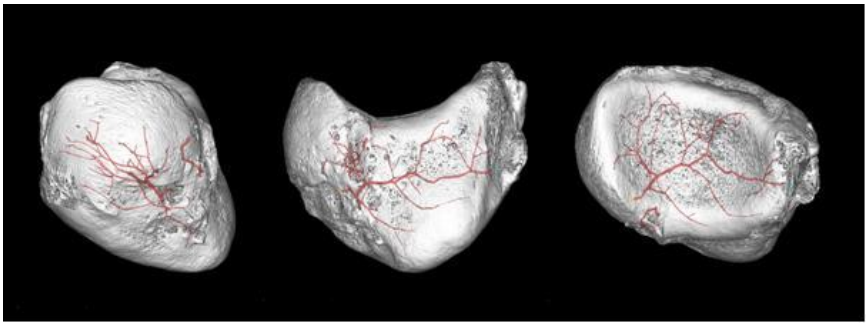

Fig. 1; Micro-CT of the lunate injected with Microfil

Results: Eleven specimens had consistent nutrient vessels entering from dorsal and volar; one specimen had no volar nutrient vessels; two specimens had no dorsal nutrient vessel. The connecting pattern between volar and dorsal intraosseous blood vessels could consistently be classified following the X-, Y- and I-pattern as described by Gelberman et al. Average number and diameter of nutrient vessels entering the lunate was 2.0 and 123.1 µm (volar) and 1.3 and 137.6 µm (dorsal). Total average diameter of nutrient vessels entering the lunate was 246.2 µm (volar) and 180 µm (dorsal).

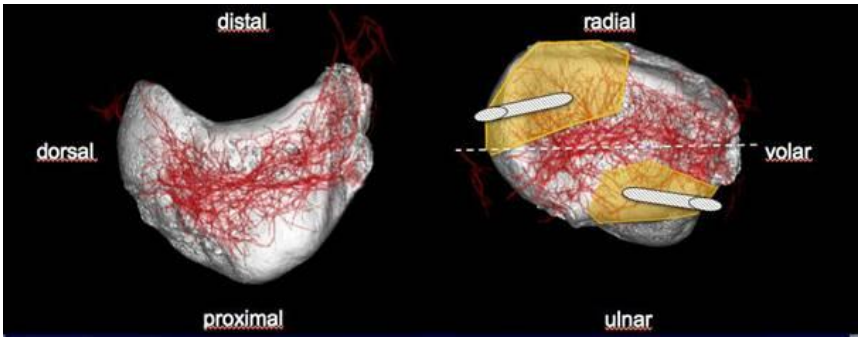

Fig. 2; Stacked image of all scans with two safe-zones for surgical intervention

P10. A British District General Hospitals' Experience of Paediatric Hand and Wrist Fractures

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Introduction: Understanding paediatric fracture patterns is essential to optimise service provisions, target procedural training of junior othopaedic surgeons and to develop clinical guidelines. The purpose was to determine the incidence of paediatric wrist fractures, the associated activities and our management of these fractures.

Method: All paediatric orthopaedic emergency admissions between January 2011 and December 2013 were reviewed retrospectively. Data collected for patients with hand or wrist fractures including the distal third of the radius, included: age, fracture nature, mechanism of injury and management. In addition, all Emergency Department (ED) radiographs performed in under 17 year olds between January 1st 2012 and February 29th 2012 were interpreted.

Results: Over 3 years, there were 242 paediatric hand and wrist fractures admissions, accounting for 42.3% of emergency orthopaedic admissions. Fractures of the hand accounted for 13.6%, while 86.4% of admissions were associated with wrist fractures. Phalyngeal and metacarpal fractures were represented equally. Hand and wrist fractures represented 12.4% of all radiographs performed in the ED for children presenting following an injury, whilst in 78.5% there was no fracture identified. A fractured distal radius was confirmed in 60.5% of children presenting with suspicion of a fracture following a wrist injury.

The commonest activities associated with wrist fractures were ballgames, climbing frames and cycling/skateboarding; accounting for 21.3%,14.7% and 14% of fractures respectively. The average age of acquisition of distal radius fracture was 10.9 years. The average age of distal radius fracture varied between activities, as low as 8.1 years in association with horse-riding, and over 13 years with acrobatic or athletic activities.

84.9 % of hand and wrist fractures were managed conservatively as outpatients in fracture clinic, without any delayed interventions, 80.5% of these were torus in nature. Of admitted wrist fractures, 80.9% were dorsally angulated. Manipulation under anaesthesia was performed in 65.5% of wrist fracture admissions, 12.9% closed reduction internal fixation with K-wires, and 19.1% open reduction and internal fixation.

Conclusion: Nearly half of all emergency paediatric orthopaedic admissions were as a result of hand or wrist fractures. There should be a high clinical suspicion of distal radius fracture in children presenting with wrist trauma, however the overall fracture incidence in this population is low.

Most Paediatric wrist fractures were managed in outpatients without interventions. New guidelines were introduced to our ED to reflect our findings; encouraging community follow-up of torus distal radius fractures, preventing undue educational disruption by attending non-essential clinic appointments.

P11. Release of Hand Contractures with the Percutaneous Aponeurotomy & Lipo-Filling (PALF) Procedure: An Incisionless Regenerative Alternative to the FLAP

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Introduction: Needle pricks selectively cut the tightest fibrous bands. Using this observation, we have developed a percutaneous technique that selectively mesh-expands the taut contracted tissues while sparing the looser neurovascular structures. We then seed the meshed interspaces with regenerative fat grafts.

Methods: We performed 186 percutaneous aponeurotomy & lipo-filling (PALF) procedures (152 Dupuytren, 34 scar contractures) on 140 patients (38 bilateral & 8 twice). The procedure consists of placing the contractures under strong tension, and with multiple percutaneous 1.25-mm needle pricks, generating a pattern of staggered slits that mesh-expands the contracture like a meshed skin graft to create a recipient scaffold for the interposed fat grafts. We then diffusely inject though multiple needle puncture sites a gravity-sedimented, syringe-harvested, lipoaspirate as tiny droplets in multiple planes (10 ml/digital ray). The hand is then immobilized in extension for 5-7 days before returning to gentle activities as tolerated.

Results: No incisions and no sutures were required, and patients had a quick recovery with 90% returning to gentle hand use within 8 days. PALF treatment of the Dupuytren contractures yielded 110% and 57% correction at MPJ and PIPJ at 12-months; a result comparable to open fasciectomy and flap. The area treated with PALF resulted in a 30% tissue gain, allowing us to successfully release scar contractures that would have otherwise required a flap transfer without the risks and morbidity of flap surgery. There was no nerve injury. Complications were infrequent and minimal.

Conclusions: Needle pricks in the 1-mm range leave no scar; the cumulation of these staggered slits can expand the overall meshed area by 20-30%. Fat grafting the tiny interspaces prevents re-scarring by filling the gaps with near normal tissue, thus regenerating the tissue deficiency without scar or donor defect. Though limited, our experience shows that PALF is an incisionless, regenerative alternative to conventional flap transfers.

Figure 1. Left) Multi-digit Dupuytren Contracture placed under tension intraoperatively. Right) One year following a single incisionless PALF release.

Figure 2. Left) Recurrent first web space contracture under tension intraoperatively. Right) Six months following a single incisionless PALF release.

P12. Prefixed and Postfixed Brachial Plexus: Is it Clinically Relevant?

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Hypothesis: A prefixed brachial plexus has been described as having a contribution to the plexus from C4 without a significant contribution from T1, while a postfixed brachial plexus has been described as having a T2 contribution without a significant contribution from C5. The reported incidence of a prefixed plexus ranges from 25% to 48%, whereas the incidence of a postfixed plexus has been reported to be 2% to 5%. The purpose of this study was to assess the contributions from C4 and T2 and when present, to determine its clinical relevance.

Methods: The 66 brachial plexus' (33 cadavers) were carefully dissected down to the root level in order to determine the presence of a C4 or T2 contribution. If a contribution was present, the significance of the contribution was assessed for clinical relevance. Sex, age and ethnicity of the cadavers were all also recorded to document any variation.

Results: 11 of 66 plexuses (20%) were found to have a prefixed brachial plexus with a contribution from the C4 nerve root. 80% of subjects with prefixed plexuses were female, and all were white. The majority (60%) of prefixed plexuses occurred on the right side, and a single cadaver exhibited bilateral contributions from C4. 9 of 66 plexuses (14%) were postfixed and found to have a contribution from the T2 nerve root. 75% of subjects with a postfixed plexus were female, and 75% were white. 4 of 8 (50%) subjects with a postfixed plexus exhibited a left-sided variant, while a single cadaver exhibited bilateral T2 contribution. The majority of C4 and T2 contributions that were found were single fascicle neural connections. 11 of 11 prefixed plexuses (100%) had single fascicle C4 contributions, and 7 of 9 postfixed plexuses (78%) had single fascicle T2 contributions. The total C2 or T4 contributions that were single fascicle connections was 18 of 20 (90%).

Summary Points:

-A significant amount of variation in brachial plexus anatomy exists.
-The percentage of plexus' described previously as prefixed may be overestimated, whereas the percentage of postfixed plexus' may be underestimated.
-Despite the presence of a pre- or postfixed plexus, the size of the C4 or T2 contribution may be of such diminutive diameter that the clinical relevance is questionable.

Figure 1: Prefixed brachial plexus with a C4 contribution

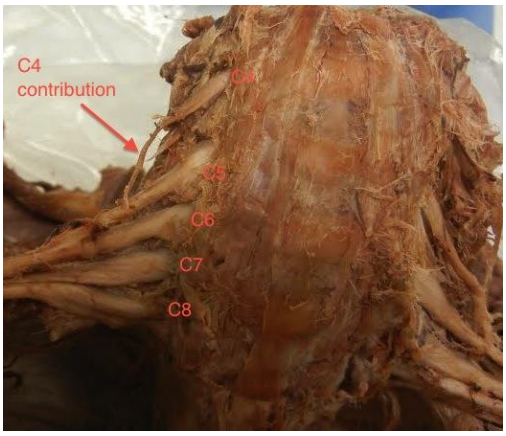
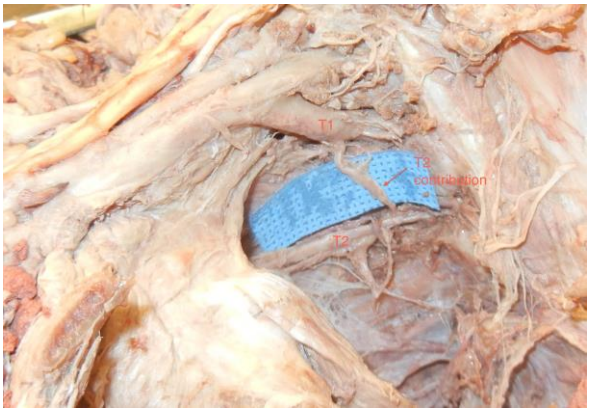


Figure 2a: Postfixed brachial plexus with a T2 contribution

Figure 2b: Postfixed brachial plexus with a T2 contribution



P13. Evaluation of Ultrasound-Guided Radial Tunnel Injection in a Cadaver Model

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Purpose: To evaluate an ultrasound-guided technique for radial tunnel injection in a cadaver model.

Methods: Eighteen fresh-frozen trans-humeral amputation specimens without evidence of previous elbow injury were positioned in maximum pronation and 135¡ elbow flexion. The lateral epicondyle, radiocapitellar joint, and radial head were palpated and marked for reference. An e-saote Musculoskeletal Ultrasound unit with a 18MHz ultrasound transducer was used. The transducer was oriented perpendicular to the long axis of the radius at the radiocapitellar joint.Ê Under ultrasound guidance, the probe was advanced distally until the posterior interosseous nerve (PIN) was identified emerging deep to the distal margin of the supinator muscle approximately 5cm distal to the lateral epicondyle. Using ultrasound visualization, a 25-guage needle was inserted with the tip positioned immediately adjacent to the PIN and 1 ml of India Ink was injected. Dissection was performed to evaluate injection accuracy.

Results: 18/18 PIN were successfully colored with dye and no nerve penetration injuries were observed. Conclusion: We describe a safe, reliable technique for radial tunnel injection using ultrasound guidance.

Clinical Significance: Traditional management of radial tunnel syndrome (RTS), or compressive neuropathy of the PIN may include RT injection and a decision to proceed with surgical nerve decompression may depend on the outcomes of RT injection. Typically, RT injection relies on clinical palpation and an estimation associated with subjective localization of symptoms; previously described techniques involve injection at the site of maximal tenderness or approximately 3 cm from the radiocapitellar joint. Risks of inaccurate injection include misinformed treatment decision-making, nerve injury, incomplete treatment. Underpowered, retrospective clinical studies report a poor response to injection but do not use a standardized technique. A safe, reliable injection for RTS using ultrasound guidance for nerve localization may improve injection accuracy and clinical outcomes and may reduce risks of incomplete treatment or nerve injury.

P14. Experience of Bleomycin Sclerotherapy Treatment of Upper Limb Vascular Malformations

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Background: Treatment of vascular anomalies of the upper limb, especially lymphatic and venous malformations remains challenging. Surgical excision risks damage to vital structures and can disappointingly be followed by recurrence. We have utilized bleomycin sclerotherapy successfully in both microcystic lymphatic and complex venous malformations with no neural injury and minimal recurrence. Bleomycin acts as a highly selective sclerosant with minimal tissue reaction.

Methods: Data is collected as a prospective observational study. Colour photographs are taken before and after treatment. Injection is performed percutaneously with ultrasound guidance under a short general anaesthetic or Remifentanil sedation as a day case procedure.

Results: 45 patients received treatment, 30 females and 15 males with an age range of 0-79 years and median of 26.5 years. 39 venous malformations, 3 haemangiomas, 2 lymphatic malformations and 1 other vascular malformation were treated with a 100% response rate. 66.7% of patients achieved complete resolution, 26.6% significant improvement and 6.7% presented with mild to moderate improvement. 28 patients were referred from other centres in the UK. 47% of patients with previous unsuccessful treatments performed elsewhere were salvaged successfully. An average dose of 0.305 mg/kg was used in an average of 3.1 sessions. Minimal complications occurred; swelling & bruising n=1 (2.2%), ulceration n=1 (2.2%), and infection n=1 (2.2%), No patient presented with lung complications. After 6 years, no recurrence had occured.

Conclusions: A high success rate, very low recurrence and minimal complication rate makes bleomycin a powerful and attractive non-surgical treatment choice for upper limb vascular anomalies.

P15. The Effect of Granulocyte Stimulating Factor Therapy on Post-traumatic Avascular Necrosis

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Introduction: Avascular necrosis (AVN) of the lunate (Kienbšck's disease) is a problem for which there is no universally effective solution. The purpose of this study was to determine whether a pharmacological agent known to mobilize stem cells into the peripheral blood (granulocyte-colony stimulating factor (G-CSF)) can be used to impede progression of post-traumatic AVN such as that observed in Kienbšck's disease.

Materials & Methods: Phase I. An animal model of surgically-induced AVN was confirmed by disrupting the blood supply to the femoral heads of 6 mature Sprague-Dawley rats. Bone and soft tissue changes were assessed two weeks following vascular disruption using µCT. **Phase II.** Two weeks following surgical induction of femoral head AVN, 27 rats were randomized to three treatment groups (Control (C), Low Dose (LD), and High Dose (HD)). Each rat received a daily subcutaneous injection for five days of either normal saline (C), 10 µg/kg G-CSF (LD), or 100 µg/kg of G-CSF (HD). Rats were euthanized 2 weeks after the first injection. Femoral head aspect ratio and volume were quantified by µCT. Subchondral cyst formation, femoral head bony remodeling, glycosaminoglycan (GAG) content, cartilage congruity, and physeal disruption were graded on Movat's pentachrome-stained slides. Immunostaining of Von Willebrand Factor (vWF) was used to quantify neovascularization.

Results: Phase I. Significant change in aspect ratio (P=0.004) and volume (P<0.001) occurred in devascularized femoral heads compared to healthy contralateral heads. Histologically, subchondral cyst formation and remodeling of subchondral bone were observed, as were neck shortening and thinning. **Phase II.** HD rats exhibited less cyst formation (P=0.047) and superior congruity/sphericity cartilage grade (P=0.001) compared to C rats (Figure 1); however, HD rats showed significantly less physis congruity grade (P=0.01) than controls. There were no differences in GAG staining in subchondral bone (P=0.42), vWF staining (P=0.69), femoral head aspect ratio (P=0.70), or femoral head volume (P=0.41).

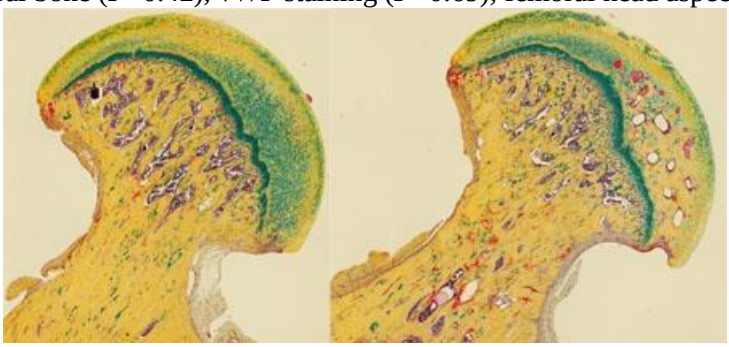

Figure 1. High dose G-CSF femoral heads (left) exhibited less cyst formation than control femoral heads (right).

Conclusions: Surgically-induced AVN in a rat model was associated with characteristic morphologic and tomographic changes. Although geometric properties by µCT were similar, G-CSF treated rats exhibited distinct histologic differences from non-treated controls. G-CSF treatment may be efficacious in mitigating progression of AVN.

P16. Restoring Joint Function in the Contracted Burned Hand: The Benefit of the Soft Tissue to Skeletal Ratio

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Introduction: Long-standing burn contractures of the hand produce marked soft tissue deficits across mobile joint surfaces. Optimum functional reconstruction requires attention to the ratio of soft tissue contracture to skeletal length. Maturation of the burn scar and anticipated growth in children also play a role in selection of procedures that will maximize function and range.

Methods: Burn scar contractures of the hands show functional loss of motion by flexion or extension deformities of the fingers and wrist. An analysis of quality and depth of soft tissue shortening (contraction), measured against existing skeletal length was used to customize procedures to restore maximum function. Twenty six patients, aged 3 to 57 years underwent post burn reconstructive procedures to maximize hand function. Each procedure selected was based on the ratio of existing soft tissue to skeletal length.

Results: The hand permits flexion and extension at all joints by a balanced glide of soft tissue over the existing bone defining a 1:1 ratio between soft tissue and skeletal length. Burn scar contracture shortens soft tissue and subsequently motion over joints. An objective ratio was applied to each joint contracture. Evaluation of soft tissue quality and potential for further skeletal growth was used to determine prognosis for maximum outcome.
Abnormalities included six post burn boutonniere deformities, two basal joint contractures, two wrist flexion deformities, six MP hyperextension, and ten digital flexion contractures. The more severe the hypertrophy and induration, the worse the ratio. Eight patients with a ratio of 0.4:1 or less required bone shortening in the form of either joint arthrodesis, trapeziectomy, or wrist fusion. Twelve patients with a ratio of 0.7:1 or better were managed with skin grafts and tissue resurfacing. In the remaining group, four patients underwent composite soft tissue and tendon expansion restoring length of all soft tissue to bony length precluding the need for flap reconstruction and tendon grafting. Two patients underwent bone shortening with prosthetic joint replacement. All patients were restored to a 0.8:1 ratio or better optimizing the position of joints for motion. No secondary procedures were required for deterioration of function at two years.

Conclusions: A balanced soft tissue to skeletal ratio principle, with knowledge of critical bone length is essential in restoring proper function to the burned hand. Based on the degree of soft tissue shortening and anticipation of bone growth (children), the optimum procedure can be designed to maximize functional hand outcome.

P17. WITHDRAWN

P18. Randomized Clinical Trial: Plaster vs. Thermoplastic Splint for a Pediatric Boxer's Fracture

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Introduction: This is the first comparative study of boxer's fracture immobilization methods, for pediatric patients, to our knowledge. An ulnar gutter plaster splint is the gold standard method of immobilization for boxer's fractures and is typically worn 24 hours a day for 3 to 4 weeks. In our experience, up to 20% of pediatric patients prematurely discard their splints. When patients are compliant in wearing their splint at all times, they often have some extent of joint stiffness.

Methods: This study was a blinded randomized clinical trial, registered at ClinicalTrials.gov. Pediatric patients with a boxer's fracture were seen within one week of their injury and inclusion/exclusion criteria assessed. A closed reduction was performed for angulation > 45 degrees, or any rotation. Subjects were randomized to either an ulnar gutter plaster splint or a thermoplastic hand-based splint. Patients recorded average daily pain and were to wear the splint continuously for three weeks.

At 3 and 12 weeks, patients had blinded clinical assessments. The PODCI validated questionnaire (assessing pediatric general health, upper extremity function and happiness) was completed at 3, 6, and 12 weeks. Subjects had blinded range of motion (ROM) and grip strength assessments at 3, 6, and 12 weeks. Repeat radiographs were taken at 12 weeks and compared with the initial films.

Results: Forty patients were enrolled in the trial, with equal randomization. Patient demographics were similar between groups. There was a significant difference in the mean ROM deficit between groups at 3 weeks, $p = 0.0478$. At 6 weeks, all patients had normal ROM, except for three ulnar gutter splint patients; all patients had full ROM at 12 weeks. Splint compliance was 75% and 59% for the ulnar gutter and thermoplastic groups, respectively ($p = 0.46$).

There was decreased grip strength (injured vs. non-injured hands) at 3 and 6 weeks among ulnar gutter splint patients. Grip strength was equivalent for both hands at all time points for thermoplastic splint patients. Reported pain scores and the time to being completely pain-free was similar between groups ($p = 0.13$ and $p = 0.98$). PODCI scores were similar between groups at each interval.

All patients had full recovery at 12 weeks, with nearly perfect PODCI scores, no functional deficits and there were no cases of malunion or nonunion.

Conclusion: Thermoplastic splints resulted in improved early ROM and grip strength, with no increased pain or complications, despite a lack of strict compliance.

P19. Fluoroscopic Radiation Exposure : Are we Protecting Ourselves Adequately?

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Introduction: While traditional intraoperative fluoroscopy protection relies on thyroid shields and aprons, recent data suggest that eyes and hands receive more exposure than previously appreciated. We examined which part of the surgeon is most at risk during distal radius fracture surgery, a common procedure requiring fluoroscopy, to determine how much personal shielding equipment can decrease exposure and how does exposure vary with fluoroscopy unit size.

Methods: An anthropomorphic model was fit with radiation-attenuating glasses, a thyroid shield, an apron and gloves. "Exposed"thermoluminescent dosimeters overlaid protective equipment at the eyes, thyroid, chest, groin and index finger while "Shielded" dosimeters were placed beneath the protective equipment. The model was positioned at a hand table with its hands flanking a volar plated distal radiussawbone. Fluoroscopy position and settings were standardized. Mini c-arm mAs were fixed based on kVp selection. Three mini and three standard c-arms scanned the wrist for 15 continuous minutes each. Ten dosimeter exposures were recorded for each c-arm.

Results: Hand exposure averaged 3.1 mrem/min (range 2.2-4.8), 14.9 times more than other recorded exposures. Eye exposure averaged 0.4 mrem/min, 1.7 times more than mean thyroid, chest and groin exposure. Gloves reduced hand exposure 69.4%. Glasses decreased eye exposure 65.6%. There was not a difference between mini and standard fluoroscopy exposures.

Conclusion: Surgeons' hands receive the most radiation exposure during distal radius plating. Radiation-attenuating gloves substantially reduced exposure. Eyes are exposed also, but to a lesser extent. Radiation-attenuating glasses substantially reduced exposure. Thyroid, chest and groin exposure was the lowest. The mean exposure for standard fluoroscope exposure was greater than mini fluoroscope exposure, but some standard units had lower exposure than some mini units. Based on these findings, we recommend routine protective equipment to mitigate exposure to the surgeons' hands and eyes, in addition to the thyroid, chest and groin, during fluoroscopy procedures.

P20. Accuracy of Ultrasound-Guided DeQuervain Injection and Anatomic Considerations in a Cadaver Model

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Introduction: DeQuervain stenosing tenosynovitis is a common tendinopathy involving the first extensor compartment (1EC) at the wrist, most likely involving the extensor pollicis brevis (EPB) primarily. Previous studies have demonstrated improved clinical outcomes with corticosteroid injection of the tendon compartment, although complications such as subcutaneous atrophy and skin depigmentation may be caused by inaccurate injection. Correct identification of the pertinent anatomy and accurate needle placement for injection may facilitate improved patient outcomes and limit the complications of treatment. The purpose of this study was to evaluate: (1) the accuracy of ultrasound-guided injection of the 1EC, with priority for the EPB subcompartment where feasible; and (2) the accuracy of ultrasound assessment of the pertinent anatomy of the 1EC at the wrist.

Methods: The senior author performed anatomic assessment and ultrasound-guided 1EC injection in 50 fresh-frozen upper limb amputation specimens. Ultrasound evaluation of the 1EC using a 18MHz transducer (MyLabOne Musculoskeletal: Esoate North America; Indianapolis, IN) was done to determine the presence or absence of an EPB subcompartment, and to determine whether the subcompartment extended the length of the extensor retinaculum (complete) or was incomplete (contained). Initial needle placement replicated a non-imaging aided, clinical injection; this clinical needle placement was evaluated with ultrasound. Then, the needle was guided by ultrasound visualization, attempting to inject 1cc of India Ink into the compartment containing the EPB tendon. Open evaluation confirmed findings for each of the anatomy and injection portions of the study, including possible complications of injection considered to be positive where India Ink was located outside of the 1EC.

Results: A subcompartment of the 1EC was identified in 27/50 (54%) of the wrists, with 18/27 being complete and 9/27 contained, for which ultrasound was 94% accurate. Clinical needle placement into the 1EC was accurate in 26/50 specimens, but only 2/27 (7%) were correctly located within the EPB subcompartment. Ultrasound-guided injection facilitated 100% accuracy (50/50) for the 1EC and was 26/27 (96%) accurate for EPB injection when 2 compartments were present. Minimal extravasation (slight staining of the deep subcutaneous tissue) was identified in 6/50, or 12%.

Conclusion: Ultrasound-guided DeQuervain injection potentially improves injection accuracy through the delineation of compartmental anatomy and the visualization of needle placement, and may minimize complications compared to ÒblindÓ or clinical injection methods. Keywords: DeQuervain, injection, ultrasound

P21. A Genetic Basis for Adult and Pediatric Trigger Finger

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Introduction: The underlying etiology of trigger digit is unclear in both pediatric and adult presentations. A genetic basis has been suggested, but broad evidence for inheritable predisposition for trigger digit has not been demonstrated.

Materials and Methods: The Utah Population Database (UPDB) is a unique resource that contains the genealogy records from over two million Utah founders and their descendants. This database has been merged with the University of Utah Heath Sciences Center data warehouse, which maintains medical records dating back to 1994. This merger has created a unique resource that has allowed for the investigation of the genetic basis of a wide variety of diseases and conditions. This study was approved by the IRB at our institution.

Patients who did not have at least 3 generations of data available for analysis were excluded from the study. Matched control individuals were selected from the database. The UPDB was queried using the ICD9 for trigger digit and CPT code for trigger digit release, and the relative risk of developing trigger digit in first, second, and third degree relatives as compared to the control group was calculated.

Results: Patients with incomplete medical and/or genealogical data were excluded from our analyses. We identified 395 individuals by using the CPT code for trigger digit release (26055). The relative risk (RR) of developing trigger digit was 5.91 (95% CI 2.83-10.87, $p < 0.001$) in a first-degree relative and was 3.08 (95%CI 1.88-4.75, $p<0.001$) in a third degree relative.

We identified 1051 cases by using the ICD9 code (727.03) for the analysis. There was an increased relative risk for trigger digit in first (RR=4.22), second (RR=1.82), and third degree relatives (RR=1.4), ($p<0.05$).

In addition, analysis of pediatric trigger digit (age < 10) data revealed an increased relative risk in first (RR=27.38, 95%CI 11.82-53.95, $p < 0.001$) and third (RR=2.75, 95%CI 1.32-5.05, $p=0.004$) degree relatives of all ages.

Conclusions: The study demonstrates evidence for an inherited predisposition in the risk for development of adult trigger digit. Additionally, we report evidence for a genetic link between the development of pediatric and adult trigger digit.

P22. Pediatric Upper Extremity Emergency Room Transfers: Are They Warranted?

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Introduction: Emergency room transfers to a higher level of care are 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) of pediatric orthopedic emergency room transfers were cases related to the upper extremity, all of which were fractures and/or partial amputations. 30% (14/46) of the transfers occurred on the weekend and 24% (11/46) of the transfers involved patients with Medicaid.

63% (29/46) of cases required a procedure in the operating room, while 33% (15/46) had a closed reduction procedure performed in the emergency room. 24% (11/46) of patients had conscious sedation provided in the emergency room. Only 6.5% (3/46) of transfers did not require any of these three factors. These patients included one scapular body fracture, one proximal humerus fracture, and one minimally displaced forearm fracture.

Conclusions: The vast majority of pediatric upper extremity transfers are warranted requiring operative intervention, a closed reduction maneuver, or conscious sedation in the emergency department. 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.

P23. Anatomy of Terminal Branches in Targeted Muscle Reinnervation of the Brachium

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Purpose: Targeted muscle reinnervation (TMR) offers enhanced prosthetic use by harnessing additional neural control from unused nerves from the amputated limb. The purpose of this study was to document the location and number of motor end-plates to each muscle commonly used in TMR in the brachium, relative to a proximally-based bony landmark.

Methods: 18 matched arms (9 fresh-frozen cadavers) were dissected. The locations of each of the terminal branches into the medial biceps and brachialis were measured with a standard tape measure relative to the anterolateral tip of the acromion. The terminal branches to the lateral triceps were measured relative to the posterolateral tip of the acromion. Both the number of branches and their locations were documented. Common descriptive statistics were used to describe the data.

Results: There were a median of 2 branches to the medial biceps located at 19.6 cm from the anterolateral tip of the acromion (range 15-25 cm). There were a median of 3.5 branches to the brachialis located at 24.2 cm from the anterolateral tip of the acromion (range 19-27.5 cm). There were a median of 2.5 branches to the lateral triceps located at 21.6 cm from the posterolateral tip of the acromion (range 11-29 cm). The mean distances to the main branch of the motor innervation to each muscle and the number of smaller branches were not significantly different when compared by sex or side.

Conclusions: TMR in the brachium requires localization of the major terminal branches to the target muscles, as well as denervation of any remaining branches. The data obtained from this study will assist the TMR surgeon in localizing the motor end-plates for the commonly used muscles in the TMR of the brachium.

P24. Plate Fixation Versus Percutaneous Pinning For Unstable Metacarpal Fractures: a Meta-analysis

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Introduction: Whether percutaneous pinning or plate fixation is more appropriate for metacarpal fractures is still often debated. Our study purpose was to determine the optimal treatment modality for metacarpal fractures on the basis of functional outcomes, radiographic outcome, and rates of complications.

Materials and Methods: We selected PubMed, Cochrane Library, EMBASE, and the relevant English orthopedic journals and pooled data from eligible trials including four eligible comparative studies and one retrospective review. Three reviewers extracted data independently from eligible studies using a data collection form. Overall, the studies contained 222 patients with 231 fractures, 143 treated with pinning and 88 treated with plates and screws. Mean follow up was 7.5 months (4-12 months). Data were and the fixed effects are assumed for meta-analysis.

Results: The results show that patients undergoing pinning for metacarpal fractures have higher motion scores when compared to ORIF with plate and screws. Pooled risk ratio of good proportion of total active motion of pinning compared to plating is significantly greater than one (RR 1.15, 95% CI: 1.03, 1.29, p-value = 0.017), as well as the mean of motion (%) is 12 percent (0.12) greater in pinning than plate (95% CI: 0.06, 0.17, p-value < 0.001). The mean difference of functional score, grip strength, radiographic parameters, time to radiographic union and the rate of complications were found to be not significantly different between the two treatment groups.

Conclusion: The results show that there is some evidence supporting the use of pinning over ORIF with plate and screws in the treatment of metacarpal fractures. This may also have practical advantages by allowing a technically easier insertion, requiring minimal dissection, and being universally available. Limitations in this study remain, including the small number of eligible studies, lack of reporting of standard deviation values, and lack of universal DASH-score assessments at all follow-up evaluations. Further RCT's with larger patient numbers, longer follow-up, and improved reporting are required to substantiate superiority of one fixation method over another.

P25. Elevated Hemoglobin A1C Levels Correlated With Blood Glucose Elevation In Diabetics After Cortisone Injection

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Introduction: Locally administered corticosteroids are known to elevate serum glucose levels in diabetic patients. Hemoglobin A1C (HA1C) is a form of glycated hemoglobin which is the mainstay measure of plasma glucose control over time in diabetics. The purpose of this study is to test the hypothesis that HA1C levels are directly correlated to the degree of the hyperglycemic response to corticosteroid injections in diabetics.

Methods: We prospectively investigated diabetic patients presenting with disorders of the hand or wrist requiring an injection of corticosteroid. Patients who refused participation in the study or those who required more than one injection at the time of the visit were excluded. Twenty one patients (twelve women, nine men) with an average age of 63 years formed the study group. Ten patients were insulin dependent diabetics, while eleven were non-insulin dependent diabetics. An injection of 1 mL containing 10 mg triamcinolone acetonide was given for the diagnoses of trigger finger (n=13), DeQuervain's tenosynovitis (n=3), carpal tunnel syndrome (n=2), osteoarthritis of the thumb basal joint (n=2), and wrist tendonitis (n=1). The most recent HA1C level and the normal fasting blood glucose levels were obtained for each patient. Daily follow-up interviews to record post-injection glucose levels were performed.

Results: The average HA1C level was 6.8 mmol/mol (range 5.6 – 10.0). The average normal blood glucose level was 116 mg/dL (range 90-160) prior to injection, and increased to 208 mg/dL (range 123-385) at 24 hours post-injection. The majority of patients (62%) had the highest hyperglycemic levels within 24 hrs of the injection, and the average duration of hyperglycemia was 2.3 days (range 1-8). Insulin dependent diabetics had significantly higher post-injection blood glucose levels than non-insulin dependent diabetics ($p=0.003$). There was a significant positive correlation (Pearson correlation coefficient) between high baseline HA1C levels and the extent to which glucose levels increased post-injection ($r=0.76$, $p=0.0006$). There was no significant correlation between the HA1C levels and the duration of the hyperglycemic event ($r=0.32$, $p=0.13$).

Discussion/Conclusion: The hyperglycemic response in diabetics following the administration of injected corticosteroids in the hand has long been recognized, but there are no known risk factors identified to predict the intensity of this response. Based on the results of this study, it appears that baseline HA1C levels correlate strongly with the degree of blood glucose elevation following local administration of corticosteroids in the hand, and may represent an important tool for patient education in this common clinical scenario.

P26. Barbed Sutures and Tendon Repair - A Review

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Introduction: Traumatic tendon lacerations are a common problem encountered by hand surgeons worldwide. Although the use of barbed suture to repair tendon lacerations has gained theoretical popularity in recent years, there is little information available regarding the safety, efficacy, longevity, or complications encountered when used in tenorraphy. In this study, we review the available literature on the use of barbed suture in tendon repair.

Methods: Studies conducted between 1980 and 2014 were identified using several databases, including EMBASE, SCOPUS, MEDLINE, and Web of Science. Keywords used to search for appropriate studies included: barbed, v loc, quill, tendon, tendon injuries, suture, tenorraphy, injury, and laceration, in various combinations.

Results: Our initial literature search identified 47 articles, and 8 were deemed appropriate for review after applying our exclusion criteria,

The data from each of the articles is reviewed for the following major categories:

1. Maximum Load to Failure
2. Mode of Failure
3. Load to 2 mm Gap
4. Change in Cross Sectional Area
5. Type of Repair

Conclusions: Barbed suture tenorraphy has a myriad of theoretical advantages, supported by varying ex-vivo studies, as compared to traditional techniques. However, due to the non-uniformity in current studies, and the lack of available data in a live model, we are unable to argue for or against barbed suture tenorraphy. We believe our review provides the most in-depth analysis of barbed suture tenorraphy to date, illuminates the potential advantages of using barbed sutures, and highlights the need for further investigation into this technique.

Load to Failure

Publication	Year		Groups	Load to Failure (N)	P value
McClellan et al.	2011		A = Modified Kessler 3-0 Ethibond	32.03±5.36	p<0.05: knotless and Savage had significantly greater ultimate strength than Kessler
			B = Savage 3-0 Ethibond	69.18±8.96	
			C = Knotless Repair 0 Quill	72.39±15.16	
Parikh et al.	2009		2-0 Quill 6 strand	88±4	b3str vs ub, p=0.32; b6str vs ub, p<0.001; b3str vs b6str, p<0.001
			2-0 Quill 3 strand	36±7	
			4-0 Prolene (polypropylene)	29±7	
			4-0 Ethibond (braided polyester)	30±8	
			4-0 Fiberwire	40±11	
Lin et al.	2013		A = Modified 4 strand Kirchmayr-Kessler 3-0 Ethibond	42.3±12.7	p=0.01
			B = Knotless 4 strand repair 0 Vloc	52.3±12.5	
Zeplin et al.	2011	2-strand	3-0 Polydioxane Knot (A)	94±10.5	2str knot vs knotless, p<0.001; 4str vs 2str, p<0.001; 4str knot vs knotless, p=0.0737
			3-0 Glycolic-carbonate Knotless (B)	38±6.1	
		4-strand	3-0 Polydioxane Knot C	149.5±7.0	
			3-0 Glycolic-carbonate Knotless (D)	145.6±16.1	
Marrero-Amadeo et al.	2011		A = Tajima w/ Horiz Mattress 4 strand 4-0 surgilon	48±12	p=0.48
			B = Mod Kirsch Kess 4 strand with 3 tranverse passes 2-0 Quill	50±14	
Joyce et al.	2013		A = Traditional 4 strand Adelaide Repair 3-0 Prolene	52.0±11.3	p > 0.05
			B = Knotless 4 strand Adelaide Repair 2-0 Vloc	55.5±4.7	
Peltz et al.	2013		A = 4 strand Adelaide 3-0 Ticron	48.6±5.9	barb vs Ade, p=0.002; barb vs conv sutur, p<0.001; Ade vs Conv, p=0.623
			B = V Loc 3D repair	61.5±9.3	
			C = 3-0 Ticron 3D repair	47.2±6.3	
Trocchia et al.	2009		A = 3-0 Ethibond Kessler	34.7±5.4	p=0.001
			B = 2-0 Quill Kessler-Bunnel	29.6±3.6	

Mode to Failure

Publication	Year	Groups	Mode of Failure								P value
			Suture Breakage		Knot Rupture		Pullout		Suture adjacent to Knot		
			Frequency	Load (N)	Frequency	Load (N)	Frequency	Load (N)	Frequency	Load (N)	
Parikh et al.	2009	2-0 Quill 6 strand	6/6 (100%)	Not reported	N/A	Not reported	0/6	Not reported			b vs ub, p<0.001
		2-0 Quill 3 strand	7/8 (88%)		N/A		1/8 (12%)				
		4-0 Prolene (polypropylene)	0/8		5/8 (63%)		3/8 (37%)				
		4-0 Ethibond (braided polyester)	0/8		7/8 (88%)		1/8 (12%)				
		4-0 Fiberwire	0/8		6/8 (75%)		2/8 (25%)				
Marrero-Amadeo et al.	2011	A = Tajima w/ Horiz Mattress 4 strand 4-0 surgilon	13/20 (65%)	52±13	7/20 (35%)	43±11	N/A	N/A			max load & sutur rup - trad vs. barb, p=0.90
		B = Mod Kirsch Kess 4 strand with 3 tranverse passes 2-0 Quill	7/21 (33%)	63±16	N/A	N/A	14/21 (67%)	43±8			
Peltz et al.	2013	A = 4 strand Adelaide 3-0 Ticron	14/29 (48%)	Not reported	13/29 (45%)	Not reported	1/29 (3%)	Not reported	1/29 (3%)	Not reported	Not reported
		B = V Loc 3D repair	10/15 (67%)		N/A		5/15 (33%)		N/A		
		C = 3-0 Ticron 3D repair	0/10		6/10 (60%)		4/10 (40%)		0/10		
Trocchia et al.	2009	A = 3-0 Ethibond Kessler		Not reported	18/20 (90%)	Not reported	2/20 (10%)	Not reported			
		B = 2-0 Quill Kessler-Bunnel			0/20		20/20 (100%)				

Change in Cross Sectional Area

Publication	Year	Groups	Cross Sectional Area (mm2)	Change in Cross-Sectional Area	Cross-Sectional Area Ratio	P Value
McClellan et al.	2011	A = Modified Kessler 3-0 Ethibond	32.3*	+14.3±5.55	Not Reported	*p<0.01
		B = Savage 3-0 Ethibond	31.9*	+13.6±3.35		
		C = Knotless Repair 0 Quill	24.4*	+7.10±4.58		
Joyce et al.	2013	A = Traditional 4 strand Adelaide Repair 3-0 Prolene		+7.7±6.7%		p<0.001
		B = Knotless 4 strand Adelaide Repair 2-0 Vloc		+2.8±0.4%		
Parikh et al.	2009	2-0 Quill 6 strand			1.2±0.1	b3str vs ub, p=0.009;b6str vs ub, p=0.005, b3str vs b6str, p=0.62
		2-0 Quill 3 strand			1.2±0.2	
		4-0 Prolene			1.6±0.2	
		4-0 Ethibond			1.3±0.3	
		4-0 Fiberwire			1.2±0.2	

Load to 2 mm Gap

Publication	Year		Groups	Load to 2mm Gap	P Value
McClellan et al.	2011		A = Modified Kessler 3-0 Ethibond	23.45±5.32	p<0.05: knotless & Savage had significantly greater 2mm-gap formation force than Kessler
			B = Savage 3-0 Ethibond	59.22±15.12	
			C = Knotless Repair 0 Quill	62.84±17.30	
Lin et al.	2013		A = Modified 4 strand Kirchmayr-Kessler 3-0 Ethibond	11.7±4.5	p=0.62
			B = Knotless 4 strand repair 0 Vloc	10.9±3.8	
Marrero-Amadeo et al.	2011		A = Tajima w/ Horiz Mattress 4 strand 4-0 surgilon	42±12	p=0.90
			B = Mod Kirsch Kess 4 strand with 3 tranverse passes 2-0 Quill	32±9	
Joyce et al.	2013		A = Traditional 4 strand Adelaide Repair 3-0 Prolene	41.5±10.9	p<0.05
			B = Knotless 4 strand Adelaide Repair 2-0 Vloc	46.5±5.5	
Trocchia et al.	2009		A = 3-0 Ethibond Kessler	22.8±6.3	p=0.723
			B = 2-0 Quill Kessler-Bunnel	22.2±4.0	

Type of Repair

Publication	Year		Groups	Uni or Bi Directional?	# of Throws if Knots	Epitendinous?	Technique for Knotless Repair
McClellan et al.	2011		A = Modified Kessler 3-0 Ethibond	BI	6	NO	Novel
			B = Savage 3-0 Ethibond		6		
			C = Knotless Repair 0 Quill		N/A		
Parikh et al.	2009		2-0 Quill 6 strand	BI	NOT DIVULGED	NO	Novel
			2-0 Quill 3 strand				
			4-0 Prolene (polypropylene)				
			4-0 Ethibond (braided polyester)				
			4-0 Fiberwire				
Lin et al.	2013		A = Modified 4 strand Kirchmayr-Kessler 3-0 Ethibond	Uni	4	NO	Modified 4 strand Kirchmayr-Kessler
			B = Knotless 4 strand repair 0 Vloc				
Zeplin et al.	2011	2-strand	3-0 Polydioxane Knot (A)	Uni	Not Divulged	NO	Modified 4 strand Kirchmayr-Kessler
			3-0 Glycolic-carbonate Knotless (B)				
		4-strand	3-0 Polydioxane Knot C				
			3-0 Glycolic-carbonate Knotless (D)				
Marrero-Amadeo et al.	2011		A = Tajima w/ Horiz Mattress 4 strand 4-0 surgilon	BI	5	YES 6-0 Ethilon Locking	Modified 4 strand Kirchmayr-Kessler
			B = Mod Kirsch Kess 4 strand with 3 tranverse passes 2-0 Quill			For only the Traditional	With extra suture passes at end
Joyce et al.	2013		A = Traditional 4 strand Adelaide Repair 3-0 Prolene	BI	Not Divulged	NO	Novel Adelaide
			B = Knotless 4 strand Adelaide Repair 2-0 Vloc				
Peltz et al.	2013		A = 4 strand Adelaide 3-0 Ticron	BI	5	NO	3D method
			B = V Loc 3D repair				
			C = 3-0 Ticron 3D repair				
Trocchia et al.	2009		A = 3-0 Ethibond Kessler	UNI	Not Divulged	No	Kessler - Bunnell
			B = 2-0 Quill Kessler-Bunnel				

P27. Validation of a Patient-Specific Visual Analogue Survey for Dupuytren's Contracture

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Hypothesis: The Patient-Specific Visual Analogue Survey (PSV) will be more responsive than a traditional upper extremity questionnaire in assessing improvement after treatment for Dupuytren's Contracture (DC).

Introduction: Patient reported outcomes are recognized by the FDA and valued by the clinical community as a tool to measure the impact and value of treatment. Traditional questionnaires measuring upper extremity function and quality of life do not address patient-specific concerns surrounding disease and treatment. Building on previous research developing patient-specific questionnaires for knee, spine, and chronic pain, we developed an electronic patient-specific instrument for DC that allows patients to identify and assess activity limitations due to their condition.

Methods: Prospective evaluation of test-retest and responsiveness cohorts of patients undergoing treatment with collagenase clostridium histolyticum (CCH) for DC was conducted to evaluate the reliability (ICC, Kappa), internal consistency (Chronbach's alpha), content validity (Spearman's Correlation), and responsiveness (Effect Size) of the newly-developed PSV. Patients completed a tablet-based PSV consisting of pairs of visual analog scales that allow patients to list the importance and difficulty of activities affected by their contracture. The test-retest cohort (n = 28) completed the PSV at two time points without any intermediate intervention for their Dupuytren's contracture (time between administrations: 11 ± 8 days). The responsiveness cohort (n = 120) completed the PSV and QuickDASH pre- and 30-days post-injection with CCH. Whereas the test-retest cohort indicated different activities at each administration, post-injection, the responsiveness cohort was provided with their pre-injection activities and importance and were asked to re-rate their difficulty with each activity.

Results: In the test-retest cohort, 90% of patients listed 3 or fewer activities on the PSV and agreement between the numbers of activities listed at each administration was moderate (K 0.46, 95%-CI 0.21–0.72). The ICC between test and retest was 0.18 (95%-CI -0.15-0.48). Internal consistency was good (Chronbach's alpha 0.74-0.80). Correlation between the PSV and QuickDASH were 0.31 for pre- and 0.71 for post-injection. PSV was substantially more responsive than QuickDASH (effect size 0.55 versus 0.28).

Summary Points:

- Test-retest reliability of the PSV is lower than traditional questionnaires because patients were allowed to list different activities at test and retest.
- The PSV assesses patient-specific activities affected by contractures and is more responsive to changes in DC and treatment than more traditional outcome measures.
- Due to the superior responsiveness of the PSV, studies using this outcome measure will have lower sample size demands than was previously possible with traditional upper extremity questionnaires.

P28. The Impact of Multiple Diagnoses on Treatment Decisions

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Introduction: Multiple simultaneous diagnoses in the upper extremity are clinically observed, but there is a paucity of research as to the prevalence of multiple diagnoses and their impact on disease management decisions. We hypothesize that treatment decisions for specific conditions are influenced by the presence of multiple diagnoses.

Materials & Methods: We reviewed the records of all consecutive patients presenting to an orthopedic hand clinic at a level one academic medical center from February 2004 to February 2005. Data collected included age, sex, race, occupation, medications, comorbidities, diagnosis, and treatment. Each diagnosis was assigned a unique case. Conditions persisting in a patient during the same time period were considered multiple diagnoses. The incidence of multiple diagnoses was analyzed overall, and correlations with gender, age, occupation, and diagnostic categories were analyzed using Fisher's exact test. Surgical rates of multiple and single diagnosis patients were compared using Fisher's exact test. Two-tailed $p < 0.05$ was considered statistically significant.

Results: 668 patients with 1127 unique diagnoses were included in the study. 32.8% (N=219) of patients had multiple diagnoses. Women had a higher incidence of multiple diagnoses than men (39.1% compared with 23.0%, respectively; p<.001). Older patients had significantly higher rates of multiple diagnoses; patients aged 18-35 had only a 21.4% incidence of multiple diagnoses, compared with 35.7% among patients 36-54 and 37.9% for patients 55 and above (p<.001). Patients with multiple diagnoses were more likely to undergo surgical treatment; 46.6% of patients with multiple diagnoses had surgery, compared with 29.6% of patients with one diagnosis (p<.0001, z=4.31). Among the 107 patients with Carpal Tunnel Syndrome, 82.2% (88 patients) had multiple diagnoses. Patients with CTS and one or more additional diagnoses had a higher rate of carpal tunnel release than patients with a single diagnosis of CTS only (51.1% compared with 26.3%, respectively; p=.0488, z=1.97).

Conclusions: The incidence of multiple diagnoses in the upper extremity is higher in women and older patients. Patients with multiple diagnoses are more likely to opt for surgical treatment. CTS patients are more likely to be treated surgically for CTS if they have additional conditions.

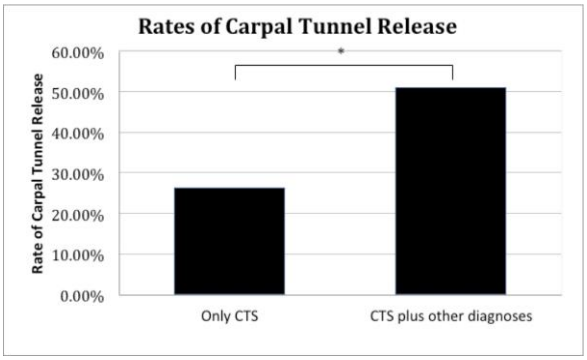

Figure 1. Significant correlation between multiple diagnoses and rate of Carpal Tunnel Release procedure. 51.1% of patients with CTS together with one or more additional diagnoses underwent a Carpal Tunnel Release, compared with 26.3% of patients with only a single diagnosis of CTS (p=.0488, z=1.97).

P29. Single Incision Distal Biceps Repair with Hemi-Krackow Suture Technique: Surgical Technique and Early Outcomes

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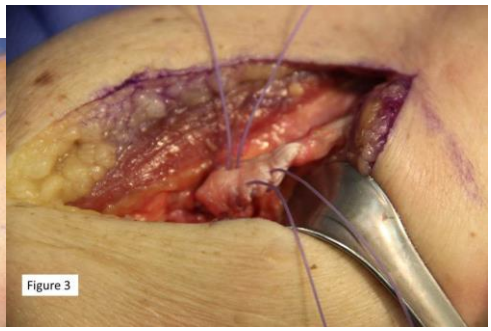
Hypothesis: Suture anchor fixation for acute distal biceps repairs has been well described, however quite variable in actual technique. We present the early outcomes of a series of distal biceps repairs using a single anterior incision and two suture anchors that allows appropriate tensioning with maintenance of the tendon bone interface using a hemi-Krackow locking stitch.

Methods: A retrospective chart review was performed of patients who underwent primary distal biceps repair using a single anterior incision with two suture anchors utilizing a hemi-Krackow stitch (fig 1). With this repair, one strand from each anchor was passed up and down the edge of the tendon in a running locking technique (fig 2). The other suture limbs were then passed through the central aspect of the tendon and advanced to tension the repair (fig 3) and tied on top of the tendon to its respective hemi-Krackow limb, allowing the tendon to insert directly onto bone (fig 4). Patients with revision surgery and the use of allograft were excluded. Clinical outcomes measured included elbow range of motion and grip strength compared to the contralateral arm. All patients completed a Quick Disabilities of the Arm Shoulder and Hand (DASH) questionnaire at most recent follow up. Secondary outcomes including patient satisfaction, pain level, and reported complications, were recorded.

Results: Fourteen patients with an average age of 51.3 (range: 27.8 to 66.4 years) were included in the study. The dominant arm was injured in 9 cases. At an average of 16.4 months follow-up (range: 6.8 to 34.3 months), all patients had elbow range of motion of 0 to >130°, and grip strength was 101.5% of the uninjured arm (range: 70.6 to 121.4%). Average QuickDASH score was 6.5 (range: 0 to 36.5). Patients rated their pain as 0.3 on a scale of 0 to 10 (range: 0 to 2.5) and one patient reported infrequent and self-limited tingling in the distribution lateral antebrachial cutaneous nerve. No patient required further surgery on their arm, and all patients were satisfied with the overall surgical result. One patient was not satisfied with his arm's cosmetic appearance.

Conclusion: Single incision biceps repair with suture anchor fixation and hemi-Krackow stitch provided satisfactory functional outcomes in both acute and chronic injury at early follow-up. This technique allows excellent tensioning of the tendon, even in chronic tears, without the risks associated with two incisions or suture button techniques.



P30. When Can I Drive Doc? Addressing Driving Concerns with Elective Upper Extremity Surgery

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Introduction: Patients inquire about driving after elective upper extremity (UE) surgery but the orthopaedic literature has been sparse, leaving UE surgeons with little supporting data to guide their patients. The purpose of this study is to improve our field's literature by surveying UE surgeons. A secondary objective is to determine how driving limitations after surgery impact a patient's decision in selecting a surgical treatment and to provide guidance on how surgeons should structure the discussion of driving safety.

Methods: Two surveys were constructed to obtain data on how surgeons address the topic of driving after surgery, routine protocols they use in the decision making process to allow driving after surgery, and time frames established in each of their practices for allowing patients to drive after specific UE surgeries. The surveys were distributed via the listserv to UE surgeons who had completed US-accredited hand and UE fellowships.

A third survey was constructed and distributed to new patients in our clinics to obtain data on commuting habits, driving styles, and factors that determine when patients will choose to drive after surgery.

Results: Seventy-six surgeons completed the logistics of driving survey and 58 surgeons completed the survey that focused on obtaining return to driving timelines among common elective UE surgeries. Sixty-three percent of surgeons inform their patients about postoperative driving restrictions prior to scheduling the patient for surgery. Interestingly, 20% never address driving restrictions after surgery, either because of concerns for legal ramifications (14%) or they forget (7%). The ability to make a composite fist (72%) and pain visual analog score of <5 (41%) are the two most common objective measures used by surgeons to facilitate the recommendation for surgical patients to resume driving.

Only 37% of the 80 patients completing the survey would consider their driving limitations after surgery before electing to have surgery, demonstrating that the majority of patients do not weigh their treatment options (nonsurgical versus surgical) based on driving restrictions after surgery. Only 19% of patients stated that an emergency was the strongest factor for not following their surgeon's driving restrictions. The remainder of patients would not adhere to driving restrictions because of work (26%) or lack of discomfort (24%).

Conclusion: UE surgeons recommend driving once patients are able to make a composite fist and have ceased narcotic use. Timeline trends for driving after specific surgeries were not successfully established.

P31. Assessment of Differences Regarding the Management of Pediatric Supracondylar Fractures Between Hand and Pediatric Orthopaedic Surgeons

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Introduction: Supracondylar humerus (SCH) fractures are the most common elbow fracture among children and are commonly treated by both hand and pediatric orthopaedic fellowship trained surgeons. The purpose of this study is to assess whether or not there are differences in the management and outcomes of pediatric supracondylar humerus fractures treated by adult hand and pediatric orthopaedic fellowship trained surgeons.

Materials & Methods: A blinded retrospective review was performed to assess the management and outcomes of pediatric SCH fractures treated by hand and pediatric orthopaedic fellowship trained surgeons over a 4-year period. Data reviewed included patient demographics, the Gartland classification, the time from injury until operative intervention, operative technique, post-operative treatment, and complications. Simple statistical analysis and Student's t-test were performed.

Results: 65 cases were reviewed including 23 patients in the hand fellowship trained surgeon group and 42 patients in the pediatric orthopaedic fellowship trained group. 22% (5/23) of patients had a medial pin placed in the hand group while only 2% (1/42) had one placed in the pediatric group. 65% (15/23) of cases in the hand group were performed within 12 hours of the injury, while only 48% (20/42) were performed within 12 hours in the pediatric group. 31% (4/13) of Gartland type III fractures underwent an open reduction in the hand surgeon group, with none performed (0/26) in the pediatric group. The average operative time was 47 minutes in the hand group versus 26 minutes in the pediatric group ($p<0.005$).

Removal of hardware occurred at 4.3 weeks in the hand group, including 26% (6/23) performed in the OR. The average time of ROH in the pediatric group was 3.3 weeks, with none performed in the OR. 39% (9/23) of patients in the hand group were referred to PT while only 7% (3/42) were referred in the pediatric group. No complications occurred in either group.

Conclusions: Adult hand and pediatric orthopedic surgeons treating pediatric supracondylar humerus fractures have similar patient outcomes and low complication rates. However, differences exist regarding the management of these patients including the potential for substantially higher health care costs when these fractures are treated by hand surgeons due to the increased use of open reduction techniques, the longer operative times, the more common referrals to physical therapy, and the return to the operating room for removal of hardware.

P32. Photography-Based Goniometric Method for Measuring Wrist Range of Motion: Feasibility Study

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Hypothesis: The primary aim of this study was to test the reliability of wrist range of motion (ROM) measurements based on digital photographs taken by subjects at home. We hypothesized that photography-based wrist ROM measurements would be as reliable as traditional physician-performed goniometry.

Methods: Six healthy volunteers with no prior wrist pathology were examined. Active and passive radial/ulnar deviation, wrist flexion/extension, pronation and supination were measured with a 1-degree resolution manual goniometer. Subjects were then provided an instruction sheet detailing how to take digital pictures of the extremity in various positions required for ROM measurements. Photographs were e-mailed to an IRB-approved research account. At a later date in a blinded fashion, photograph-based ROM measurements were performed. Reliability analysis was evaluated using the intraclass correlation coefficient (ICC). "Good" agreement was defined as 0.70 to 0.79 and "Excellent" as 0.80 to 0.99.

Results: Photograph-based measurements for radial/ulnar deviation and active wrist flexion/extension were accurate and had 8 or less degrees difference compared to clinical measurements (Figure 1). Passive wrist flexion/extension measurements displayed slightly greater variability. Photograph-based pronation and supination measurements poorly correlated with clinical measurements. ICC demonstrated "Good" and "Excellent" agreement for all measurements except pronation and supination (Figure 2). Statistically significant agreement ($p < 0.05$) was achieved for ulnar deviation and active/ passive wrist flexion, whereas trend towards significance (p 0.05 to 0.10) was achieved for radial deviation and active/passive wrist extension.

Conclusions: This feasibility study is the first to assess goniometry based on photographs taken by subjects at home as a potential alternative to clinical goniometry, as well as the first to assess photography-based goniometry of a joint with multiple planes of motion (versus prior studies in the knee and elbow). This study demonstrates that patient performed photography-based goniometry is accurate and reliable for measuring active and passive wrist radial/ulnar deviation and flexion/extension. Pronation and supination were not accurately measured. Our study validates a protocol allowing accurate and reliable ROM measurements without direct physician contact. Statistical analysis is limited by the small number of subjects. However, given potential cost and convenience implications, an IRB-approved study is underway in a cohort of pre- and post-operative patients to further validate this method.

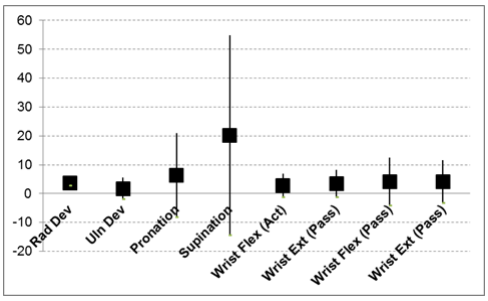

Figure 1. Mean of absolute value differences between traditional clinical and photograph-based ROM measurements ± two standard deviations.

Measurement	ICC	95% CI Lower	95% CI Upper	p-value
Radial Deviation	0.790	-0.497	0.971	0.056
Ulnar Deviation	0.956	0.686	0.994	0.002*
Pronation	0.460	-2.861	0.924	0.258
Photo Supination	0.278	-4.162	0.899	0.365
Wrist Flexion (active)	0.911	0.367	0.988	0.009*
Wrist Extension (active)	0.763	-0.696	0.967	0.070
Wrist flexion (passive)	0.930	0.498	0.990	0.006*
Wrist extension (passive)	0.724	-0.969	0.961	0.092

Figure 2. Reliability analysis between clinical and photograph-based ROM measurements. Statistically significant values ($p < 0.05$) denoted by *.

P33. Efficacy and Safety of Collagenase Clostridium Histolyticum (CCH) in the Treatment of Proximal Interphalangeal Joints in Dupuytren Contracture: Combined Analysis of Four Phase 3 Clinical Trials

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Introduction: Analysis was undertaken to determine the efficacy and safety of collagenase clostridium histolyticum (CCH) injections in the treatment of Dupuytren contracture (DC) of the proximal interphalangeal (PIP) joint.

Methods: This retrospective analysis examined DC of 644 PIP joints in 506 subjects (404 male, 102 female, mean age 62 years) enrolled in CORD I/II and JOINT I/II clinical trials to determine the % of subjects who achieved clinical success (0º–5º extension), clinical improvement (greater than or equal to 50% of baseline contracture), and improvement in range of motion (ROM) at 30 days after the first injection and the last injection of CCH. Per protocol, a maximum of 3 injections/cord was allowed.

Results: A total of 1,165 CCH injections were administered to cords affecting 644 PIP joints. Clinical success and clinical improvement was seen in 27% (174/644) and 49.0% (316/644) of PIP joints after 1 injection, and in 34% (218/644) and 58% (374/644) after the last injection, respectively. 60% of PIP joints received 1 injection, 24% received 2 injections, 15% received 3 injections, and 1% received 4 injections. Mean change in ROM increased from 51.0º at baseline to 71.2º after the first injection and to 75.4º after the last injection. Clinical success and clinical improvement were highest in the index finger compared to the other fingers. Improvement in ROM was generally comparable among the fingers and slightly higher after the last injection. Clinical success and clinical improvement were markedly better in the subgroup with low (less than or equal to 40°) baseline severity than high baseline severity after the first and last injection. The most common adverse events included: edema (58.3%), contusion (38.0%), injection site hemorrhage (23.0%), pain in extremity (22.4%), injection site pain (20.9%), and swelling (16.2%). Three flexor tendon ruptures of the small finger were reported. No further tendon ruptures occurred after changing the injection method.

Conclusions:

• CCH was effective for DC of PIP joints of both low and high baseline severity and by finger.
• Outcomes after CCH injection were better in the low baseline severity subgroup, suggesting earlier intervention to achieve better outcomes.
• Clinical success and clinical improvement were most improved in the index finger and least improved in the small finger after the first and last injection in subjects with high baseline severity.
• AEs in PIP joints were similar across fingers and to those previously observed in metacarpophalangeal joints.

P34. Salvage Palmar Fasciectomy Following Initial Treatment with Collagenase Clostridium Histolyticum

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Background: Collagenase clostridium histolyticum (CCH) was approved for clinical use in 2010 and has become an accepted treatment modality for Dupuytren's contracture. Because longitudinal experience with injectable collagenase remains limited, the effect of treatment on future surgery is unknown. Anecdotal experience indicated that salvage fasciectomy following CCH injection is technically more difficult than primary fasciectomy given the disruption of normal tissue architecture.

Materials and Methods: A retrospective review of the senior author's practice from February 2010 to March 2014 was performed. Eleven patients were identified undergoing salvage fasciectomy for Dupuytren's disease following at least one prior CCH injection. Cases were reviewed for functional outcomes and operative difficulty.

Results: A total of 7 MCP joints and 12 PIP joints in 11 patients were treated with palmar fasciectomy following prior CCH injection. Nine of the 11 patients were referred to the senior author following CCH injections by other hand surgeons; 2 patients had previous injections by the senior author. The average interval between most recent CCH injection and salvage fasciectomy was 12 months (see Table 1). Intraoperative findings demonstrated severe disruption in tissue architecture after prior CCH injection (see Figure 1). There was one tendon rupture post-CCH injection. Mean preoperative/post-injection joint contracture for MCP and PIP joints was 42 and 60 degrees, respectively; following surgery joint contractures were 0 and 21 degrees, respectively ($p<0.01$). Signficant increases in postoperative range of motion were seen for both MCP joints and PIP joints following salvage fasciectomy (see Figure 2 and 3).

Conclusions: Despite the increased technical difficulty of salvage fasciectomy, results comparable to primary fasciectomy can be achieved even in the setting of recurrent or progressive disease.

Table 1: Patient Characteristics:

Table 1: Patient Characteristics and Treatment History	
Patient Characteristic	**Number**
Number of Patients	11
Mean Age (range)	69 (52-76 years)
Gender	6 males, 5 females
Affected Hand Treated with Salvage Fasciectomy	
Left Only	0
Right Only	3
Bilateral	8
Joints Treated with Salvage Fasciectomy	19
Number of MCP Joints	7
Number of PIP Joints	12
Total Treated Joints/Patient (range)	1.7 (1-4)
Treated PIP Joints/Patient (range)	1.1 (1-2)
Treated MCP Joints/Patient (range)	0.64 (0-2)
Prior Treatments for Dupuytren's Contracture	
CCH Injection	11 patients
Mean Number of CCH Injections/Patient Before Fasciectomy (range)	1.5 (1-3)
Mean Time Interval between CCH Injection and Fasciectomy (range)*	12 months (6-24)

*Time provided is interval between most recent prior CCH injection and salvage fascectomy for joints having more than one injection

Figure 1: Disruption of Tissue Architecture post-CCH injection

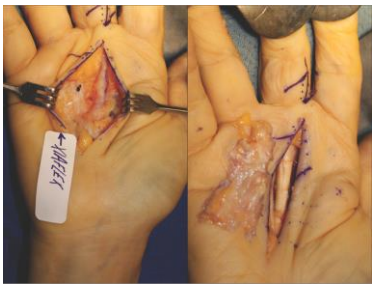


Figure 2: Pre- and Post-operative MCP and PIP contracture

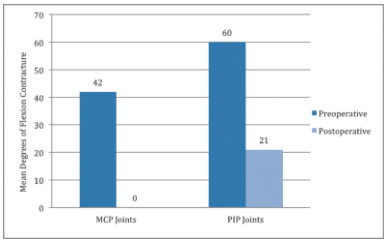
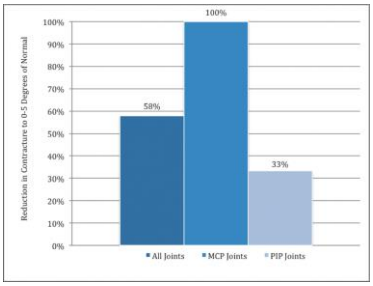


Figure 3: Reduction in contracture within 5 degrees of normal



P35. The Utility of Ultrasound in Diagnosing Purulent Infections of the Upper Extremity

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Hypothesis: Cellulitis or simple infections of the upper extremity can be difficult to differentiate from purulent infections, requiring laboratory and physical exam data in addition to imaging to confirm the diagnosis. When differentiating simple cellulitis from a drainable infection, we hypothesize that ultrasound as a stand-alone modality has a low sensitivity for ruling out abscess.

Methods: We completed a retrospective cohort study of patients who had formal ultrasounds at Yale-New Haven Hospital for the indication of rule out upper extremity abscess. Patients were eligible if they had an ultrasound performed between July 2010 and July 2013. Exclusion criteria included repeat ultrasound examinations, fistula examinations, or ultrasound studies that were not primarily performed to evaluate the upper extremity. We then completed chart abstractions for all eligible patients and collected information on age, ultrasound result, vital signs, clinical examination, laboratory findings, cultures, aspiration results, other imaging, comorbidities, and antibiotic therapy. We used presence of pus as the gold standard for diagnosis of abscess. We calculated the sensitivity and specificity of ultrasound for the diagnosis of abscess.

Results: We identified 512 patients who had ultrasound examinations in our study period. Of these, 178 met enrollment criteria and 105 were read as negative, 37 (20.1%) were read as positive, and 36 were ambiguous. Forty-four patients had a final diagnosis of abscess, and eight patients were identified as having negative or ambiguous ultrasounds with the final diagnosis of abscess. Of the 37 patients with positive ultrasounds, one patient had a final diagnosis of cellulitis rather than abscess. The sensitivity of ultrasound for the diagnosis of abscess was 81.8%. The specificity was 74.6%.

Summary Points:

-Ultrasound examination has a sensitivity of 81.8% and as a stand-alone modality cannot reliably rule out abscess in the upper extremity

-Ultrasound has a moderately low specificity of 74.6%

-Ultrasound may be a low-yield diagnostic modality if used in every patient with a suspected infection, as we found it was positive in only 20.1% of patients

-Other clinical and laboratory factors should be taken into consideration, in addition to ultrasound, in making the diagnosis of upper extremity abscess

P36. Radiation Exposure to the Eye with Mini C-Arm Use During Hand Surgery

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Introduction: Fluoroscopic radiation exposure is a potential occupational health risk to the Hand Surgeon, given operator proximity and the relative lack of eye shielding. At present, the amount of radiation exposure to the eye, associated with the routine use of mini C-arm fluoroscopy is unknown. The association of eye radiation exposure and the early development of cataracts have been previously reported. The purpose of this study is to test that eye radiation exposure, sustained during routine mini C-arm use, does not exceed that of previously reported critical radiation dosages to the eye.

Methods: Over a four month period, eye radiation exposure was measured in four Board-Certified Hand Surgeons utilizing mini C-arm fluoroscopy during routine surgical procedures. Eye dosimeters were secured to surgical loupes at the level of the orbit. Accumulated radiation dosage was analyzed and compared to control badges on a monthly basis, and background exposure was eliminated. For each procedure, mini C-arm radiation output was logged, including the dose rate, total accumulated dosage, and total exposure time.

Results: Average monthly eye dosimetry values included the following: dose rate was 0.50±0.03 mGy/sec, total accumulated dosage was 32.16±7.88 mGy, and total exposure time was 75.72±16.36 sec. Average monthly eye radiation exposure values were less than 30 mrem (previously reported maximum eye dosage is 1,250 mrem per month). 46 procedures were performed over the collection period. The most commonly performed procedures included ORIF distal radius fractures (14), metacarpal and phalangeal surgery (9), and basilar thumb arthritis surgery (7). ORIF of the distal radius fracture was associated with higher average exposure time (93.57 sec) and average accumulated dosage (51.73 mGy).

Conclusion: Our study suggests that eye radiation exposure, from routine mini C-arm fluoroscopy use, on an average monthly basis, does not approach previously reported critical eye radiation loads associated with cataracts.

P37. Comparison of Systemic Heparinization Protocols for Zones 1 and 2 Artery-only Replantations

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Introduction: We compared the clinical results of intermittent versus continuous systemic heparinization in patients undergoing single-digit replantation with single artery-only anastomosis.

Materials & Methods: This study included 61 institute patients who underwent artery-only anastomosis for the replantation of zones 1 or 2 single-digit amputation from January 2004 to October 2011. Patients with concomitant injuries, degloving hand injuries, venorrhaphy, revisional operation 24 hours postoperatively, the first 5 cases of each operator, and patients younger than 10 years of age were excluded.

Protocol 1 (27 patients) consisted of aspirin, prostaglandin E1, heparin-soaked gauze on fish-mouth incision, and intermittent intravenous bolus heparin injections (25,000 U). In protocol 2 (34 patients), after a loading dose of 12,500 U of heparin, the heparin fluid (12,500 U in 500 ml of 5% dextrose) was infused continuously at a rate of 20 ml/hr. The infusion rate was regularly adjusted to maintain a target aPTT level of 51-70 seconds.

Cases showing viable replant on discharge without secondary revision during follow-up were deemed a success. Blood loss (a 15% drop in hemoglobin), transfusion, and thrombocytopenia were also assessed.

Results: Heparin-induced thrombocytopenia was not observed. Blood loss (p=0.125) and transfusion rates (p=0.092) did not differ statistically. Protocol 2 (91.9%) showed a statistically significant higher success rate than protocol 1 (59.3%, p=0.0051).

Conclusions: In cases of replantation with single artery-only anastomosis for zones 1 or 2 single digit amputation, continuous systemic heparinization can improve the surgical outcome without increasing bleeding risk or transfusion rate, compared to intermittent systemic heparinization.

P38. The Use of Donor Activation as the Guiding Rehabilitation Strategy Following Nerve Transfer Surgery for AIN Palsy: A Case Report

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Introduction: There is a paucity of information in the literature on motor re-education protocols for patients undergoing nerve transfer surgery. The donor activation focused rehabilitation approach has not been well described. Nerve transfer surgery effectively changes the efferent source for the paralyzed (recipient) muscle. Using this approach, cortical control is transferred to the donor muscle efferents. A program focused on donor activation establishes a new motor pattern to achieve cortical remapping following a nerve transfer. In the following we present a case to illustrate the use of this therapeutic approach.

Methods: A 50 year-old female presented with an isolated anterior interosseous nerve (AIN) palsy. Eight months post onset, with no sign of recovery by electrodiagnostic exam, she underwent a flexor digitorum superficialis (FDS) to AIN nerve transfer surgery. A profundus tenodesis was also performed. Donor activation exercises were initiated at two months and included passive range of motion (ROM), active/active-resisted FDS exercises; and combined resisted "donor" muscle contractions with passive "recipient" muscle exercises. At three months, 1+/5 recipient muscle grade function was noted and resisted donor muscle activation with assisted active ROM of the recipient muscle, including "place and hold" exercises, were added. As the strength of recipient muscles improved, the program was advanced accordingly.

Results: At 12 months, the patient demonstrated the ability to actively flex the thumb IP joint 30 degrees with simultaneous donor activation. At fifteen months, the patient demonstrated a 3+/5 flexor pollicis longus (FPL) and 4-/5 flexor digitorum profundus (FDP) of the index and long fingers. By 17 months post-op a lateral pinch of 4 pounds was achieved without hyperextension of the thumb IP joint. Her grip strength advanced to 44 pounds or 79% of her dominant side. She demonstrated improved ability to use the left hand for fine motor tasks.

Conclusion: Donor activation rehabilitation strategy successfully restored function for a patient after nerve transfer for AIN palsy. This strategy can be the guiding model for motor re-education following a nerve transfer. This case clearly illustrates a therapeutic approach that can be successful even in a challenging clinical example.

P39. Volar Extended Harvest of Dorsal Metacarpal Perforator Flaps for Primary Coverage of Complex Distal Digital Defects: Anatomical Basis and Clinical Application

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Introduction: The coverage of very distal (beyond the PIP joint) digit defects that cannot be allowed to heal by secondary intention, skin grafting or reimplantation is a difficult problem.

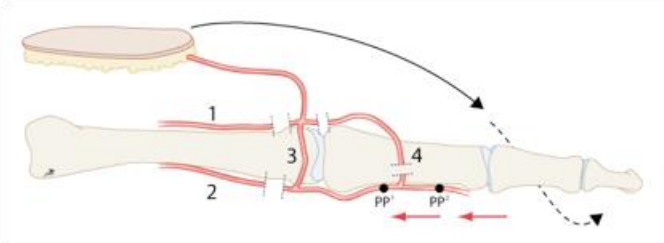
Using the concept of perforator flaps in the hand, we hypothesized that a dorsal metacarpal island perforator flap based on the palmar digital artery to dorsal metacarpal artery perforator vessel could be designed. It would be fed by reverse flow in the PDA (more dominant circulation than DMA terminal branches), allowing a pivot at the proximal or even the distal portion of the proximal phalanx. This will allow coverage of defects too large to be treated by a reverse flow homodigital island flap, including large combined volar and dorsal defects of the thumb and digits.

Materials and Methods: Cadaver dissections were performed in 5 hands. Dorsal metacarpal perforators were identified in each intermetacarpal space and the most distal pivot point after dissection to the volar circulation was determined for each perforator. The results were applied to a patient with a bilateral thumb total pulp defect which was closed in a single stage using first dorsal metacarpal island perforator flaps with pivot points at the proximal portion of the proximal phalanx and neurotisation to the ulnar digital nerves, followed by primary donor site closure.

Results: Dorsal metacarpal perforators were found in each intermetacarpal space, also when a dorsal metacarpal artery was absent. Perforators were followed to the volar circulation and originated from just proximal to or at the level of the digital arterial commissure, never from a palmar digital artery. Division of specific branches of the dorsal arterial system and communications with the volar system allowed the extension of the pivot points to the distal level of the middle phalanx in fingers and that of the proximal phalanx in thumbs.

In our patient, the flaps showed uneventful primary healing, with return to full manual labour after four weeks. A distal edge necrosis on the left thumb was removed after 3 months, and the left hand first web space required secondary deepening after 10 months. Sensory recovery on both flaps has returned to 2PD of 1cm after 3 years.

Conclusions: The reverse flow dorsal metacarpal artery perforator flap is a versatile flap allowing primary closure of very distal volar and dorsal digital defects, possibility for neurotisation as well as primary donor site closure with excellent cosmesis.



P40. Tendon Rupture Following Distal Radius Volar Plating

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Purpose: There has been a recent trend in the surgical treatment of unstable or displaced distal radius fractures to apply internal fixation with a volar plate construct. Rare complications of this technique include irritation and rupture of the local tendons. Systematic approaches to identification, prevention, evaluation and management of tendon injuries associated with volar plating are neither well described nor standardized. The present study aimed to assess the hand surgeons' experience with these injuries, to elucidate current practices, and to highlight an important topic that merits further investigation.

Methods: 3022 members of the American Society for Surgery of the Hand (ASSH) were emailed a link to an online questionnaire regarding their experience with tendon injuries associated with volar plating of distal radius fractures. Respondents were asked to provide their familiarity with tendon injury after volar plating, associated methods of assessing plate placement, and provided treatment.

Results: Of the 595 (19.7%) respondents, 199 (33%) surgeons reported encountering at least one flexor tendon injury after volar plating for a distal radius fracture over the past year. The Flexor Pollicis Longus (FPL) was the most commonly reported tendon injury (254, 75%). A majority of plates removed for tendon irritation were located distal to the watershed line (355, 44%); with 141 (45%) described as Grade 1 and 122 (39%) as Grade 2 according to the Soong classification system. Tendon transfer was used most often for intervention of flexor injuries (114, 39%). Respondents also reported 324 extensor tendon ruptures after volar plating of distal radius fractures over the past year, with tendon transfer (315, 88%) also being the preferred treatment option.

Conclusions: Both flexor and extensor tendon ruptures following volar plating of distal radius fractures may be more common than previously described in the literature. The FPL was the most frequently reported flexor tendon ruptured and tendon transfer was the most frequently described intervention for tendon rupture after volar plating. Surgeons should be aware of these complications. Critical assessment of plate position at the time of index procedure and during follow-up is recommended. Long-term studies are needed to standardize approaches to identifying at-risk patients and to managing tendon rupture following volar plating of distal radius fractures.

P41. Endoscopic Carpal Tunnel Release Simulation: A Single Center Validation Amongst Hand Surgery Trainees

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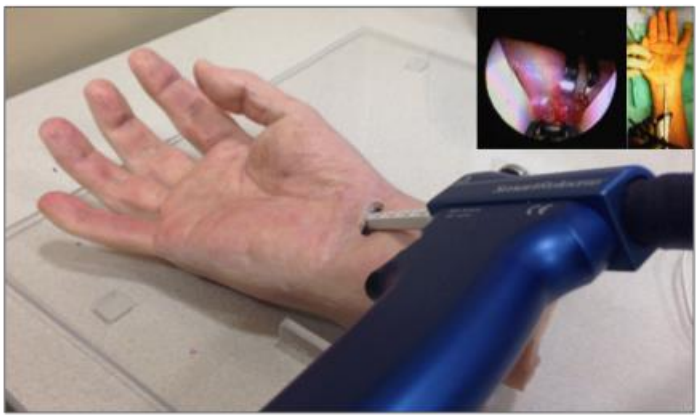
Introduction: We hypothesize that use of an endoscopic carpal tunnel release (ECTR) simulator as an adjunct to surgical training will significantly improve knowledge of surgical indications and anatomy and shorten the course of progress toward procedural competency.

Materials and Methods: An ECTR simulator was developed at the University of Wisconsin and IRB approved for beta testing (Figure 1). Resident subjects in surgical subspecialties that routinely perform carpal tunnel surgery were enrolled and randomized to simulation and non-simulation groups. Subjects were told that they would be the primary surgeons performing an ECTR case. Subject age, PGY level, and number of prior ECTR surgeries were obtained. Pre and post-tests were administered before and after simulation or independent case preparation. Subjects were then evaluated in a real-time ECTR case by the senior author (NS) who was blinded to study group. Operative skills were objectively measured using a 5-point scoring system including operation set-up, anesthesia, tourniquet, procedure, and dressing application. Statistical analysis was performed using a student T test.

Results: Twenty-two subjects are enrolled to date (12 simulation; 10 non-simulation). There were no differences in pre-preparation test scores between groups (p=0.481). Post-preparation test scores following use of the simulator were significantly higher compared to the non-simulation group (p=0.0001). The average operation performance score for the simulation group and non-simulation group were 96% and 78% respectively (p=0.002). The simulation group performed significantly better on all operative steps except for dressing application (p=0.052). Simulation subjects without prior ECTR experience (n=5) had operative scores significantly higher than non-simulation subjects with no experience (n=5) (97% vs. 69%, p=0.006). Simulation subjects without experience also performed better than non-simulation subjects who had performed at least 1 prior case (n=5) (97% vs. 87%, p=0.035), where there was a significant difference in operation set-up (p=0.0053) and no difference in procedure execution (p=0.1). All simulation subjects commented that the simulator was helpful.

Conclusions: Early implementation of an endoscopic carpal tunnel release simulator demonstrates a distinct and significant knowledge and operative performance benefit in inexperienced ECTR subjects. When compared to non-simulation subjects with ECTR experience, inexperienced ECTR subjects demonstrated better familiarity with the equipment and equivalent performance of the procedure following simulation. Ongoing enrollment will help determine maximal simulation training benefits in residency and early clinical practice.

FIGURE 1:



P42. Comparison of Crossed Screws Versus Plate Fixation for Radial Head Fractures

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Purpose: Internal fixation is the treatment of choice for displaced radial neck fractures, in attempt to preserve the radial head. Fixation can be achieved with a plate and screw construct or with two obliquely-oriented screws if there is no comminution. The purpose of this study was to investigate the mechanical properties, specifically the stiffness and load to failure, of these two fixation strategies in a cadaver model.

Methods: Ten matched-pair radii were removed from fresh cadaver arms. X-ray and visual inspection were performed to ensure absence of preexisting trauma. DEXA scans were obtained to measure bone density. A transverse osteotomy was created at the neck of each radius, which was subsequently fixed. All right-sided radii were fixed with two oblique headless compression screws across the fracture site and all left-sided radii were fixed with a radial neck plate and screws. The distal aspect of each radius was potted in a urethane casting resin, with approximately 60mm of proximal radius exposed. The radial head was loaded in cantilever bending in 4 different planes, 90 degrees apart and orthogonal to the radial shaft using an Instron machine. Stiffness and load to failure were recorded for each specimen.

Results: The stiffness of both constructs was similar in all planes except for loading from medial to lateral (opposite of the plate) where the screw construct was 1.8 times stiffer. Ultimate failure occurred at 229N for the plate and 206N for the screws. Failure mode for the plate was plate bending while the screws failed by pullout and fracture.

Conclusion: The two strategies for internal fixation of radial neck fractures provide similar strength and stiffness to transverse, noncomminuted fractures. While plate-and-screw constructs are more appropriate when there is bone loss or comminution, this study supports the utilization of two oblique screws in simple transverse neck fractures, especially since screw fixation requires less exposure and the hardware is buried and unobtrusive.

P43. The Effectiveness of Surgical and Nonsurgical Management of Radial Tunnel Syndrome

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Hypothesis: This study compared the effectiveness of surgical and nonsurgical treatment for RTS and identified predictors of treatment success. We hypothesized that RTS could be treated non-surgically, and if non-surgical treatments failed, surgical intervention would be successful.

Methods: We reviewed medical records of patients (>18 years) diagnosed with RTS at a single academic institution from 2004-2010. RTS was defined as focal pain and tenderness in the radial tunnel area on palpation, with no weakness, and pain affecting daily activities. Pain levels were reported by patients before treatment, after conservative treatment (final visit before surgery), and after surgery. We adopted pain levels to Roles and Maudsley's criteria of four levels[1]: zero (no pain/activity limitations), mild (occasional pain/no activity limitations), moderate (pain with prolonged activity/limited activity), and severe (pain with minimal activity/limited activity). Our primary outcome was pain relief in the radial tunnel area that no longer affected patients' activities. Univariate analysis was performed between the 12 surgically-treated arms (9 patients) and the 70 conservatively-treated arms (55 patients) to assess differences. We determined an adjusted odds ratio (OR) for rate of treatment success.

Results: We identified 64 patients (mean age 43 years, 70% female, 69% white) with 82 arms diagnosed with RTS that limited their activity. Initial pain level was severe in 35 arms (43%) and moderate in 47 (57%). 37 of 82 arms (45%) were successfully managed nonsurgically (Figure 1). Of the remaining 45 (55%) failures, 12 underwent surgery, and 9 of 12 (75%) were successfully treated. Univariate analysis of the 35 arms with severe initial pain demonstrated treatment success was associated with surgery (P=0.011) (Figure 2). Controlling for occupation and comorbid lateral epicondylitis, multivariable analysis of all 82 arms with moderate or severe pain demonstrated significantly higher success rates with surgery (OR=13.5; P<0.001), moderate initial pain (OR=7.5; P=0.003), and female gender (OR=4.8; P=0.019).

Conclusions: Nonsurgical treatments of RTS that limited activity are successful in nearly half of patients, and surgical intervention in those patients who failed conservative treatments may be successful in three-quarters of patients. Prospective, randomized controlled studies are needed to compare nonsurgical and surgical interventions for RTS.

Figure 1: Pain Level in Arms Treated Conservatively for Radial Tunnel Syndrome

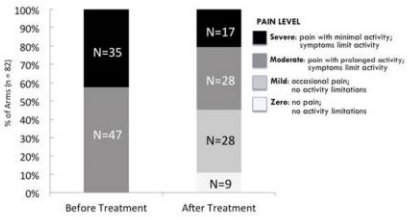

Figure 1: Clinical progression of conservative treatment of 82 arms (64 patients) from initial pain level to final pain level. Before treatment, pain level was severe in 35 arms (43%), while pain level was moderate in 47 arms (57%). After conservative treatment, pain level was severe in 17 arms (21%), pain level was moderate in 28 arms (34%), pain level was mild in 28 arms (34%), and pain level was zero in 9 arms (11%). Treatment was successful (mild or zero pain level) in 45% of the arms.

Figure 2: Treatment success of Operative versus Conservative Management

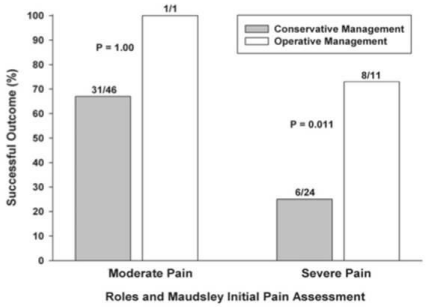

Figure 2: Success of conservative treatment versus operative treatment by initial pain assessment of moderate or severe. Bivariate subgroup analysis revealed no association between treatment success and operative versus conservative management in the 47 arms with moderate initial pain (P = 1.00, chi-square test). However, subgroup analysis demonstrated a significant difference in treatment success rate based on management strategy in the 35 arms with severe initial pain—8 of 11 arms (73%) with severe initial pain were successfully treated with surgery, while only 6 of 24 arms (25%) with severe initial pain were successfully treated with conservative management alone (P = 0.011, chi-square test).

P44. Can History and Physical Detect Loss of Reduction after Operative Repair of Distal Radius Fractures?

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Introduction: There is a growing body of literature that suggests routine postoperative imaging after common orthopaedic procedures has low clinical utility, and that clinical assessment (history and physical) should be used in its place, particularly at the initial follow-up visit. The purpose of this study is to determine the reliability of clinical assessment for detecting loss of reduction at the initial follow-up visit after operative repair of distal radius fractures.

Materials & Methods: Patients undergoing operative repair of distal radius fractures by our academic practice during 2007-2011 were identified. Clinical notes and radiographic series were reviewed to determine the accuracy of clinical assessment for detecting loss of reduction at the initial postoperative visit.

Results: 102 patients were included. Of these, at the initial postoperative visit, 11 patients had more than normal postoperative pain, 0 had visible deformity, 0 had crepitus with gentle motion, and 0 had instability at the fracture site. These 11 patients (10.8%) were considered to have positive clinical assessments. On radiographic series taken at the initial postoperative visit, none of these 11 patients had loss of reduction (positive predictive value of clinical assessment = 0%). Among all patients, there were 3 cases (2.9%) of loss of reduction visible on radiographic series taken at the initial postoperative visit. All of these occurred in patients who had negative clinical assessments (sensitivity of clinical assessment = 0%). There were no additional radiographic losses of reduction between the series taken at the initial postoperative visit and series taken at later postoperative visits.

Conclusion: There is a growing body of literature that suggests routine postoperative imaging after common orthopaedic procedures has low clinical utility. In particular, evidence suggests that there is little utility to obtaining radiography at the initial visit following operative repair of a wide variety of fracture types. This study presents evidence to the contrary with respect to repair of distal radius fractures. In our series, three losses of reduction occurred before the initial postoperative visit, but they were all subclinical (detectable only by radiograph). There were no subsequent losses of reduction between the first postoperative visit and later postoperative visits. Based on these findings, we propose a simple, cost-effective imaging algorithm as follows: Radiographic assessment at the initial postoperative visit for all patients, clinical assessment only at subsequent visits, and radiographs at final follow-up (if desired) to confirm and document fracture healing.

P45. Functional Outcomes after Primary Repair of Acute and Chronic Thumb Ulnar Collateral Ligament Injuries

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Introduction: Injuries to the ulnar collateral ligament (UCL) of the thumb metacarpophalangeal joint can occur in both the acute and chronic setting. The outcomes of primary repair for chronic injuries have been infrequently reported in the literature and the results have been unsatisfactory. The purpose of this study is to investigate the functional outcomes and patient satisfaction scores for primary ligament repair with suture anchors for acute and chronic UCL injuries. We hypothesize that primary repair of the UCL in both acute and chronic cases results in good functional outcomes, pain relief, and high patient satisfaction.

Materials and Methods: All patients age 18 years and older who underwent surgical repair of an isolated UCL injury from 2006-2012 were included. Patients whose time from injury to surgery was greater than 8 weeks were classified as having a chronic injury. All patients were treated by 1 hand fellowship-trained surgeon. Patients with less than 12 months of follow-up were excluded. A retrospective chart review was conducted for all patients who met inclusion criteria. Patients were contacted to obtain functional outcome and patient satisfaction scores.

Results: There were 19 patients in the acute group and 17 in the chronic group. Average follow-up was 42.5 months in the acute group and 38.1 months in the chronic group. 84% of patients in the acute group and 82% of patients in the chronic group completed functional outcome measures and patient satisfaction scores. The mean post-operative QuickDASH score was 3.18 in the acute group and 3.57 in the chronic group (P=0.4219). We found no statistically significant difference with respect to post-operative VAS pain scores, patient satisfaction and return to work or sports status. All patients were either “very satisfied” or “satisfied” with their outcome. There was no statistically significant difference for complication rates between the two groups (P=0.5323). There was one major complication (repair failure) in the chronic group. 4 patients in the acute group had a postoperative neuropraxic injury to the ulnar digital nerve which resolved by 6 weeks postoperatively in all cases. There were no infections and no patient underwent re-operation.

Conclusions: Patients with both acute and chronic injures to the thumb UCL have similarly good functional outcomes, postoperative pain relief and patient satisfaction after treatment with primary ligament repair with suture anchors. We propose that this technique is a safe and acceptable treatment option for patients with acute or chronic UCL injuries.

P46. Microsurgical Simulation Exercise for Surgical Training

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Hypothesis: Microsurgical skills require extensive training to master the technique. We hypothesized that implementing a turkey wing model for resident training, their comfort level with microsurgical skills and skill level would increase.

Methods: Residents were given a survey on their comfort level with microsurgery, a pretest on techniques and then a lecture on the subject. A surgical dissection of the turkey wing and the repair of the vessels and nerve were observed. They then performed the same dissection and repairs. A posttest was given once they completed. The results of the pretest, posttest, eight specific microsurgical assessments for each repair, and a combined surgical score for each repair (sum of all eight specific outcomes) were compared between two groups, Juniors (PGY 2 and 3) and Seniors (PGY 4 and 5). In addition, the pretest and posttest scores were pooled for all residents to assess the effect of training independent of training level. Differences between groups were assessed by performing Independent-Samples Mann-Whitney U Tests using SPSS (SAS Institute, Cary, NY) at the alpha level of 0.05.

Results: The survey results pre and post presentation, demonstration and completion of the anastomoses showed the majority of residents became more comfortable with microsurgical technique and identifying structures after the exercise. The lecture and training significantly increased knowledge of microsurgical techniques with an increase of over 40% seen between the pretest and posttest assessments of all residents. In addition to the survey and tests, each resident's wing with his/her anastomoses were evaluated. Several significant differences were observed. Specifically, Seniors outperformed Juniors by 72% for nerve end approximation, 35% for artery bunching, and 44% for artery suture placement. In addition, the combined surgical scores were significantly higher for Seniors than Juniors as evidenced by 21% and 27% higher scores for artery and nerve repair, respectively.

Summary:

- The turkey wing model for anastomoses of the artery, nerve and vein represents a realistic simulation of a digital artery, nerve and vein.
- This is a practical training method for residents in an orthopaedic surgery program or any other program that requires microsurgical skills.
- ACGME requirements have now mandated surgical skills training to be effective July 2013.
- Laboratories are a crucial learning tool for developing proficiency.
- The method is easy, convenient, inexpensive and simple to set up and complete.
- This allows for a comprehensive training environment that allows one to gain adequate microsurgical technique.

P47. Minimal Changes in Wrist Motions After Simulated Scapholunate Arthrodesis

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Introduction: Scapholunate (SL) instability presents a relatively common, yet challenging, problem for the hand surgeon. A high incidence of nonunion and relatively poor outcomes with prior fixation techniques have precluded the widespread acceptance of SL arthrodesis for the management of acute or chronic instability of the SL joint. The purpose of this cadaveric study was to determine how SL fusion, if able to be achieved more reliably with modern fixation techniques, would affect wrist motion.

Methods: Ten cadaveric wrists were tested using a wrist joint range of motion simulator. Manual and fluoroscopic examination of all wrists were performed prior to ensure an absence of underlying gross carpal pathology. Flexor and extensor tendons were exposed and sutured to standard five-pound weights to simulate wrist range of motion at maximum extension (ECRL/ECRB/ECU), flexion (FCR/FCU), radial deviation (ECRL/FCR), ulnar deviation (ECU/FCU), dart thrower's extension (ECRL/ECRB), and dart thrower's flexion (FCU). A dorsal-radial incision was created to permit insertion of two 3.0 mm headless compression screws across the SL joint to simulate fusion. Goniometric measurements and fluoroscopic images were obtained for each range of motion both before and after simulated SL fusion. The paired *t-test* was used to compare wrist motion before and after arthrodesis.

Results: Appropriately positioned and rigid simulated SL fusion was verified under fluoroscope and a consistent SL angle (47°±6° vs. 46° ± 4°, p=0.37; pre and post fusion, respectively) was ensured. The SL angle did not change throughout range of motion testing after screw insertion, confirming simulation of rigid SL fusion. The only statistically significant decreases in wrist range of motion following simulated SL fusion occurred during maximum flexion, dart thrower's extension, and dart thrower's flexion. Wrist flexion decreased 9° on average following SL fusion. Additionally, dart thrower's extension and flexion decreased an average of 9° and 6°, respectively, compared to the non-fused wrist.

Conclusion: We have established in a cadaveric model the effect of simulated SL fusion on radiocarpal and midcarpal motion, which compares favorably to reported range of motion outcomes for previous SL repair or reconstruction procedures. The statistically significant decreases in wrist flexion and dart thrower's extension and flexion following simulated SL fusion are of questionable clinical significance given the relatively small effect size. Figure 1A) Wrist joint motion stimulator. 1B) Lateral views of pre and post scapholunate arthrodesis.

Wrist Position	Intact Wrist	After SL Arthrodesis	*P –value*	95% CI
Maximum Flexion	80 (5)	72 (6)	**0.0001**	**5.61-11.39**
Maximum Extension	59 (8)	54 (14)	0.22	-3.27-12.47
Maximum Radial Deviation	52 (9)	51 (13)	0.89	-8.54-9.74
Maximum Ulnar Deviation	45 (15)	45 (7)	0.90	-11.29-1.09
Maximum Dart Thrower's Extension	57 (9)	48 (8)	**0.0001**	**6.11-10.89**
Maximum Dart Thrower's Flexion	76 (11)	70 (11)	**0.0003**	**3.78-8.82**

Table 1: Wrist Extremes of Motion (degrees [SD])

P48. Modified Merritt Splint in Proximal Zone IV and Zone V Extensor Tendon Injuries: Nine Years Rehabilitation Experience In A Single Center

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Introduction: Post-operative extensor tendon repair morbidity remains a significant problem despite newer splinting methods. The purpose of our study was to assess outcome of patients treated with a "Modified" Merritt Splint (exclusion of the wrist from immobilization) in proximal zone IV and Zone V extensor tendon injuries.

Methods: Patients aged 18-65 who underwent primary tendon repair for uncomplicated single digit (thumb excluded) Zone IV or Zone V extensor tendon injuries were provided with the modified Merritt Splint. Patients were prospectively followed for 10 weeks post-surgery. Objective measurements included range of motion and grip strength.

Results: A retrospective review was conducted for all zones IV and V extensor tendon lacerations in a single institution. 715 charts were reviewed for extensor tendon lacerations from 2006-2013. Sixty-five patients met the inclusion criteria, whom completed the entire 10 week study protocol. All extensor tendon injuries were repaired primarily with a figure of eight non-absorbable nylon or prolene. The index finger was the most common affected digit. Ten weeks post-operatively, all five patients demonstrated excellent range of motion at all joints. Mean range of motion was: MCP - 85º, PIP - 102º, and DIP - 68º. Wrist motion was full in all patients. Grip strength returned to equal the non-injured hand in all but 6 cases. No evidence of tendon rupture occurred and no patient required a tenolysis.

Conclusions: All patients completing the study demonstrated excellent range of motion with no evidence of rupture or need for tenolysis. Our results suggest that the "Modified" Merritt Splint is an appropriate method for post-operative treatment of Zone IV and Zone V extensor tendon injuries.

P49. Endoscopic Fascia Release for Forearm Chronic Exertional Compartment Syndrome: Case Report and Surgical Technique

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Introduction: Chronic exertional compartment syndrome (CECS) of the forearm is traditionally treated with open compartment release requiring large incisions that can result in less than optimal esthetic results. More recently, minimally invasive endoscopic compartment release techniques have been described. The purpose of this study is to describe a case report of a professional motocross patient with forearm CECS treated endoscopically using a novel, not previously reported minimally invasive technique.

Materials & Methods: A 23-year-old professional motocross racer presented with a six-week history of chronic right-sided proximal volar forearm pain when riding his motocross bike. Other symptoms included paraesthesias and weakness of his right hand, which led to his inability to continue riding. He was treated unsuccessfully with conservative management. Compartment pressure measurements were performed before and after provocative exercises to confirm diagnosis of CECS. An endoscopic procedure for CECS of the forearm was performed. Grip strength and wrist range of motion were collected pre- and postoperatively.

Surgical Technique: A portal was placed over the subcutaneous border of the ulna, midway between the olecranon and the ulnar styloid. The skin was mobilized to allow access to the volar and dorsal compartments. The fascia of the volar compartment was opened. An EndoRelease[a] cannula was placed under the fascia and advanced distally. The cannula has an attached retractor, which slides on the external surface of the antebrachial fascia, thereby separating the superficial nerves from the fascia. The fascia was divided under direct endoscopic visualization. Similarly, the proximal fascia of the volar compartment was released. The skin was mobilized and the dorsal compartment was released in the same fashion through the same portal (Figure 1).

Results: The patient's symptoms resolved following surgery. He resumed riding at 1 week, competing at 3 weeks, and continues to ride competitively without symptoms at 1 year. Images of minimal scarring are shown in Figure 2. Preoperative and postoperative grip strengths were 46kg and 57kg respectively. Wrist extension/flexion was 70°/52° preoperatively and 76°/63° postoperatively.

Conclusions: This technique is simple and effective. The cannula used protects the superficial nerves while allowing release through a small, cosmetically pleasing incision.

Figure 1: Intraoperative photo showing endoscopic release of the volar and dorsal compartments through a single incision for a patient presenting with forearm chronic exertional compartment syndrome.

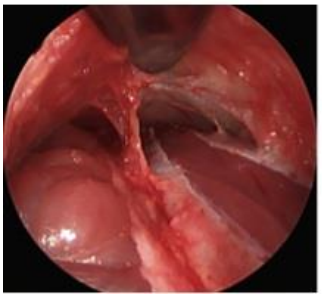

Figure 2: Photo showing postoperative scar at the 1-month follow-up visit following endoscopic release of chronic exertional compartment syndrome.

P50. Rotator Cuff Repair Suture Retriever as Tendon Graft Passer for Flexor Pulley Reconstruction: A Cost-Comparison

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Introduction: One option for flexor pulley reconstruction involves wrapping a free tendon graft around the phalanx. The process can be frustrating, and reported make-shift techniques include right-angle hemostats, penrose drains or bending a k-wire into a loop for a passer. These options are not time efficient, add surgical steps, and do not address the challenge and frustration associated with multiple passings of the graft around the acute curvature of the phalanx while minimizing local tissue trauma. We present a cost-comparison of using a small shoulder rotator cuff repair suture retriever instrument (SRI) to facilitate tendon wrapping around the phalanx.

Method: Twelve plastic surgeons within 3 hospital networks were surveyed on their preferred method of tendon looping and average time for preparation for tendon looping and looping. The proposed method is comprised of six-steps: 1) Minimal dissection of the surrounding soft tissue is required. 2) A suture is weaved through both ends of the tendon graft and the sharp is cut off. 3) The SRI tip is placed against the phalanx and rotated around the digit. It easily autodissects under/over the extensor mechanism. The instrument is run up and down the phalanx creating a plane for future passes. 4) The suture is passed through the loop of the SRI and the graft pulled around the phalanx. 5) Repeat steps 3-4 for more loops. 6) The sutures at the tendon ends are pulled upon, like one would to secure an inflatable arm tourniquet, to tighten the loops while final sutures are placed.

Results: Using the SRI helps to easily obtain the correct plane, minimizes local tissue trauma, and improves surgical efficiency. Surgical time for pulley looping is less than two minutes with the SRI, compared to the surveyed mean of 11 minutes (range 5-20 minutes) without a SRI. The SRI costs $73.17, and by saving a minimum of three minutes of surgical time, calculated total saving is a minimum of $16.83 at a conservative estimation of $30/minute of operating room time (range $20-$60/minute).

Conclusion: In using the shoulder rotator cuff repair suture retriever, surgical efficiency is increased while minimizing local tissue trauma and decreasing over-all costs.

P51. Common Radiographic Imaging Modalities Fail to Accurately Predict Capitate Morphology

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Background: There are three morphologies of the capitate based on its lunate and scaphoid articulations: flat, spherical, and V-shaped. Following a proximal row carpectomy (PRC), the capitate articulates with the lunate facet of the radius, altering contact biomechanics at the radiocarpal joint. Therefore, capitate morphology may influence the contact pressure at the capitolunate articulation and influence clinical outcomes after PRC. However, it remains unclear which diagnostic imaging technique most reliably distinguishes between capitate morphologies.

Methods: We evaluated the ability of plain radiographs, 2-dimensional computed tomography (2D-CT), 3-dimensional (3D)-CT reconstruction, and magnetic resonance imaging (MRI) to predict capitate type in 47 fresh frozen cadaver wrists. Two attending hand surgeons and one hand surgery fellow characterized capitate type based on each imaging modality. True capitate type was determined after gross dissection. We determined the reliability of each modality to predict capitate morphology.

Results: We found all four imaging modalities to have a low sensitivity and specificity for predicting capitate morphologies. Plain radiographs, 2D-CT, 3D-CT, and MRI had sensitivities/specificities of 0.46/0.57, 0.54/0.72, 0.54/0.52, and 0.56/0.65, respectively. All modalities had high negative predictive values for detecting the more rare V-shaped capitate subtype (range 91-94%). Inter-rater reliability was poor for all modalities.

Conclusion: These data suggest that plain radiographs, CT, 3D-CT and MRI are poor predictors of true capitate variation. Plain radiographs are as effective as more cost-intensive modalities in ruling out V-shaped capitates. Overall, common diagnostic imaging techniques may be of limited utility in assessing whether capitate morphology can predict early PRC failure.

P52. Surface Replacement Arthroplasty of the Proximal Interphalangeal Joint in Border Digits using a Lateral Approach

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Purpose: To evaluate the outcomes of semi-constrained, surface replacement proximal interphalangeal joint arthroplasties (SRA) in border (index and small) digits using a dedicated lateral approach on the inside border of the involved digit.

Methods: 6 women (7 digits; 5 index and 2 small) with an average age of 69 underwent SRA for osteoarthritis. Average follow-up was 34 months. Patients were evaluated for active range of motion, coronal plane deformity, grip and pinch strength (compared to opposite hand), and asked to complete a visual analog pain scale, a quickDASH questionnaire, and a satisfaction survey. Radiographs were compared to previous ones for signs of implant loosening or subsidence.

Results: Activity related pain decreased from an average 8 to 0.6. Coronal plane deformity decreased from an average 21° to 7° of ulnar deviation. Average PIPJ total arc of motion decreased slightly from an average 51 degrees pre-operatively, to 47 degrees. Coronal plane deformity in the index finger decreased from an average 19 degrees to 10 degrees of ulnar deviation. Final lateral pinch averaged 4.4 kg. in the affected hands, compared to 4 kg. in the opposite hand. Average final grip strength in the affected hands was 19 kg compared to 16 kg in the opposite hand. Post-operative quickDASH scores averaged 24.The average satisfaction rating was 3.4 (range 1-5). There were no cases of instability. Radiographic analysis did not reveal implant subsidence, nor radiolucent lines involving any of the implants.

Discussion: SRA implants are appropriate in border digits. Pain relief and lateral stability are predictable, but motion is not improved. The lateral approach is advantageous in these border digits, because it preserves the outer collateral ligament, which is difficult to protect if repaired after injury using a dorsal or volar approach. Protection to the adjacent digit with buddy straps is recommended post-operatively. If a longitudinal midaxial incision is made, we recommend that it be placed as dorsal as possible to avoid a tender scar, or adherence to the proper digital nerve.

P53. WITHDRAWN

P54. Trends in Upper Extremity Injuries and Infections Presenting to United States Emergency Departments

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Objective: Hand injuries range from simple lacerations to complex amputations. These injuries result in significant use of emergency room resources annually. The purpose of this study is to identify the incidence rates of hand injuries presenting to emergency rooms nationally.

Methods: The Nationwide Emergency Department Sample (NEDS) database was queried using common ICD-9 codes specific for hand/wrist injuries and infections to identify national estimates of emergency department (ED) visits for these related diagnoses. The incidence, mean age, gender, payer mix, hospital type (teaching vs. non-teaching), location (metropolitan vs. non-metropolitan), and geographic region were recorded.

Results: A query of the NEDS database resulted in a weighted estimate of 2,791,257 records of traumatic hand/wrist injuries and infections treated at an emergency department in the USA in 2010. Of these visits only 207, 109 (7.4%) resulted in hospital admission. 57% of patients were male, 43% female. The most common age group affected was 18-44 years (44%) followed by <17 years (24%). 33% of visits were result of contusion, 27% fractures, 17% infection. 37% of patients had private insurance, 13% Medicare, 21% Medicaid, 19% uninsured, 10% other. 63 % of visits were seen in non-teaching emergency rooms, 80% of visits were seen in metropolitan cities, 65% of visits were seen at non Trauma designated hospitals. Geographically 37% of visits were in the South, 25% Midwest, 20% Northeast, 18% in the West.

Conclusion: Hand injuries are responsible for large number of visits to ER annually. Majority of patients do not require hospital admission. Less than half are insured and over half of these patients are seen at non-teaching facilities.

P55. Upper Extremity Injury Patterns in All-Terrain Vehicle Accidents

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Introduction: Every year, hundreds of adults and children suffer severe injuries or even death from all-terrain vehicle (ATV) accidents. In 2011, there were over 107,000 emergency department visits associated with ATVs in the United States, 27% of which included children younger than 16 years of age. Reportedly, 327 of these injuries resulted in death. A multicenter, retrospective study was conducted to determine the frequency and distribution of upper extremity injuries sustained from ATV accidents.

Methods: Medical records of all patients presenting to two trauma centers with ATV related upper extremity trauma from 2001-2013 were reviewed. Patient notes and radiographic images were analyzed for detailed extremity injury data. The identified injuries were classified by anatomic location (shoulder, arm, elbow, forearm, wrist, hand) and structures involved (fracture/dislocation, amputation, nerve, artery, soft tissue). In addition, patient demographic information, length of stay (LOS), airway status, intensive care unit (ICU) stay, Glasgow coma scale (GCS), use of safety equipment, associated traumatic brain injury, and surgical intervention were compiled.

Results: A total of 277 patients with upper extremity injuries secondary to ATV accidents presented from 2001-2013. 150 were male, 27 were female, average age was 31 years (range 9 – 65 years). Average length of hospital stay was 5.5 days (range 1 – 84 days). Average Glasgow coma scale was 14.4 (range 3-15). There was one death. 18% of injuries involved the shoulder, 20% arm, 16% elbow, 18% forearm, 40% wrist, and 24% hand. 30% of patients had injuries involving more than one anatomic location. 73% of these injuries were fracture/dislocations, 4% nerve, 2% artery, and 36% soft tissue. 15% of injuries were open fractures. 40% of patients were reported to have worn helmets, 12 patients tested positive for alcohol. 40% of patients suffered traumatic brain injury, 39% other orthopedic injuries, 11% spine injuries, 21% thoracic injuries, 9% intra-abdominal injuries, 5% facial fractures, 33% other related soft tissue injuries.

Conclusions: The most common upper extremity injuries experienced in ATV injuries were fractures/dislocations. One third of patients had injuries involving more than one anatomical location of the upper extremity. The most commonly affected anatomical location was the wrist. The most common associated injury was traumatic brain injury. Less than half of the patients were documented as having worn safety equipment. Safety mandates instead of recommendations should be enacted in order to decrease injuries and fatalities associated with ATVs.

P56. Mixed and Motor Nerve Functional Outcomes For Autograft, Processed Nerve Allograft and Conduit

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Introduction: Tension free reconstruction of a nerve gap, most often necessitates repair with either autograft or an off-the-shelf alternative. Limited comparative data is available, especially for mixed nerve repairs. This is the first study to directly compare outcomes for these repair modalities. We report our findings from a multicenter registry for outcomes with Autograft, Processed Nerve Allograft and Collagen Conduits.

Methods: Mixed nerve repairs since 2004 were collected from chart review for 5 large academic/trauma centers. When possible, prospective assessments were performed. Gap lengths were limited to < 70 mm, based on the available length of allograft (Avance® Nerve Graft, AxoGen, Inc. Alachua, FL). Outcomes data were collected using standardized forms and a centralized database. Centers followed their own standards of care. Follow-up evaluations included MRCC scale, grip strength, range of motion, electromyography (EMG) studies, 2-PD, SWMF and safety assessments. Meaningful recovery was defined as a MRCC score of S3/M3 or higher. Descriptive statistics, Chi Squared and Student t test were used to compare results.

Results: Quantitative outcomes data was available in 36 nerve repairs. Allografts and Autografts were used for similar gap sizes, average of 35 mm and 44 mm respectively. Allograft and Autografts were used in significantly larger gaps than Conduit, average gap was 12 mm. Conduits reported meaningful sensory outcomes in 80% of repairs, but no (0%) motor recoveries. Allografts reported meaningful sensory outcomes in 75% of repairs, and meaningful motor outcomes in 79% of repairs. Autografts reported meaningful sensory outcomes in 63% of repairs, and meaningful motor outcomes in 63% of repairs. See Table 1 for distribution details. In mixed nerves, both Processed Nerve Allograft and Autograft returned significantly better function than Collagen Conduit ($p < 0.001$)

Conclusions: Collagen Conduits were successful at returning sensory function when the gap was under 10 mm, over that no sensory function was reported. It is concerning that Collagen Conduit showed no signs of motor reinnervation and their use in mixed nerves at these lengths should be carefully considered.

Processed Nerve Allografts and Autografts were capable of returning similar rates of meaningful sensory and motor function. They both appear to have a place in the treatment algorithm for mixed nerve repair in the upper extremity.

Additional patients will provide further insight into these modalities.

Table 1: Demographics and Outcomes of Mixed Nerve Injuries Repaired with Nerve Autograft, Processed Nerve Allograft, and Conduit

	Nerve Autograft	Processed Nerve Allograft	Conduit
Subjects	9	20	5
Mean Age	31± 10 (21, 46)	41 ± 20 (19, 70)	36± 19 (20, 63)
Total Repairs	9	22	5
Median	3	14	2
Radial	1	3	0
Ulnar	5	5	3
Mean Gap (mm)	44 ± 12 (20, 60)	35± 15 (10, 65)	12 ± 6 (6, 20)
Mean FW-Up	18 months	11 months	16 months
Meaningful Recovery for Quantitative Outcome Measures (S3/M3 or greater)			
Sensory Function*	5/8	12/16	4/5
Motor Function*	5/8	15/19	0/4

* Only includes subjects reporting absent function or reporting a quantitative measure of recovery.

P57. The Treatment of Metacarpal Fractures: Conservative Management May Be Better

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Background: Metacarpal fractures account for twenty percent of all upper extremity fractures. Treatment of these fractures varies widely and is often based on surgeon preference and experience. The purpose of this study is to develop evidence-based best practice in the treatment of metacarpal fractures.

Methods: We conducted an IRB approved retrospective review and prospective hand therapy and radiographic follow-up study of patients treated for metacarpal fractures at our institution over the last five years. Hand therapy measurements, clinical exam, follow-up radiographs, and a validated patient questionnaire were utilized for critical analysis of non-operative and operative treatments of metacarpal fractures to assess complication rates, patient-centered outcomes (pain, stiffness, days off work, and cost), functional outcomes (measured range of motion and grip strength), and radiographic correlation.

Results: There were 902 patients identified as having received treatment for metacarpal fractures at our institution between 2007 and 2012. Mean length of follow-up ranged from 8 to 36 weeks. Retrospective review of 902 patients demonstrated less pain and stiffness, earlier return to work, less complications, and normal range of motion in the non-operative group. Sixty-four patients returned for the clinical and radiographic follow-up study, including 60 fractures treated non-operatively and 17 treated operatively. The overall complication rate was 10.4%. The complication rate in the non-operative group totaled 3.3% compared to 35.3% in the operative group ($p=0.0011$). Clinical assessment demonstrated stiffness and decreased range of motion in 5.0% of patients in the non-operative group and 35.3% of patients in the operative group ($p=0.0018$). Good functional outcomes including range of motion and grip strength measured by a certified hand therapist were demonstrated in the non-operative group, while patient-centered outcomes including days off work, out-of-pocket cost, stiffness and pain perceived by the patient were decreased in the non-operative group. Malunion and angulation were increased in the non-operative group; however, this did not correlate with functional or patient-centered outcomes.

Conclusion: This retrospective review and prospective clinical and radiographic follow-up study demonstrates that conservative treatment of metacarpal fractures presenting without scissoring or significant articular involvement may be better that operative management based on decreased pain and stiffness, earlier return to work, and lower costs. Despite radiographic evidence of malunion or persistent angulation in the non-operative group, there is no correlation with functional or patient-centered outcomes. We currently offer non-operative management with early range of motion for patients with uncomplicated metacarpal fractures. The results of this study support this practice.

P58. Outcomes of Vascularized Bone Grafts for Scaphoid Non-unions: 1, 2 Intercompartmental Supraretinacular Artery Versus Palmar Carpal Artery Grafts

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Introduction: Although less commonly used than the traditional 1,2 intercompartmental supraretinacular artery (ICSRA) vascularized bone graft (VBG), the palmar carpal artery (PCA) VBG has been successful in the treatment of scaphoid non-unions. We believe that the PCA VBG is an alternative treatment for scaphoid non-unions with efficacy equivalent to the traditional 1, 2 ICSRA graft.

Materials and Methods: A retrospective chart review was performed on patient who underwent one of the two procedures over a 5-year period. A total of 11 patients were included in the PCA group and 28 patients in the 1, 2 ICSRA group.

Results: Ten of eleven (91%) of patients healed in the PCA group. 18 of 28 (64%) of patients healed in the 1,2 ICSRA group. Only 4/8 patients (50%) with proximal pole fractures healed in the 1, 2 ICSRA group. However, both proximal pole fractures in the PCA group healed. Preoperative AVN was associated with 1 failure in the 1,2 ICSRA group. This patient also was a smoker. All other patients with suggested AVN preoperatively by MRI or CT scan went on to heal (n=6). The one failure in the PCA group was attributed to hardware failure. Seven of ten (70%) smokers went on to persistent non-union. This was the only statistically significant finding among the factors evaluated in ultimate healing including preoperative AVN and fracture location. Complications included 1 failure of fixation in the PCA group and 3 early losses of fixation in the 1, 2 ICSRA group. No deep infections, nerve injuries, or early return trips to the OR occurred in either group. In one case a PCA graft was attempted, however, due to size of the artery and possible iatrogenic injury, a 1,2 ICSRA graft was instead used.

Conclusions: In conclusion, we found that the PCA VBG was successful in the healing of scaphoid non-unions in 91% of patients in this series, and therefore remains a viable alternative in treatment of this difficult problem, however, tobacco use is an important predictor in failure of vascularized bone grafting and should be considered when treating scaphoid non-unions.

P59. Efficacy of Processed Allograft to Reconstruct Digital Nerves:

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Introduction: To investigate the outcomes of digital nerve repairs using processed nerve allograft for defects measuring 30 millimeters or less.

Materials and Methods*:* Seventeen patients with 21 digital nerve lacerations in the hand underwent reconstruction with processed nerve allograft.

Figure 1. The completed repair using processed allograft.

Outcome data for 14 patients with 18 digital nerve lacerations were available for analysis. Postoperative outcome data were recorded at a minimum of 18 months. The average nerve gap measured 11 mm (range, 5 - 30 mm). Outcome measures included postoperative sensory examination as assessed by Semmes-Weinstein monofilaments and static- and moving-2 point discrimination. Pain was graded using a visual analog scale throughout the recovery period. In addition, patients completed the Quick Disabilities of the Arm, Shoulder, and Hand survey pre- and postoperatively.

Results: Using Taras outcome criteria, 7 of 18 (39%) digits had excellent results, 8 of 18 (44%) had good results, 3 of 18 (17%) digits had fair results, and none had poor results. At final follow-up, Semmes-Weinstein monofilament testing results ranged from .08 grams to 279 grams. Quick Disabilities of the Arm, Shoulder, and Hand scores recorded at the patient's first postoperative visit averaged 45 (range, 2-80), and final scores averaged 16 (range, 2-40). There were no signs of infection, extrusion, or graft reaction.

Conclusions: The data suggest that processed nerve allograft provides a safe and effective alternative for the reconstruction of peripheral digital nerve deficits measuring up to 30 mm.

P60. Unstable Distal Radius Fracture: Reduce Prior to Surgery?

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Purpose Most distal radius fractures are not considered for surgery until manipulative reduction is attempted. There is a subset of fractures however that can be considered for immediate surgery, e.g. due to extensive comminution or displacement. We wonder if the discomfort and inconvenience of a closed reduction is worthwhile for the subset of patients who choose operative treatment prior to attempted reduction. We hypothesize that there are no differences in (1) adverse events and (2) subsequent surgeries between patients treated with manipulative reduction compared to those that were splinted without reduction prior to distal radius fracture surgery.

Methods We retrospectively included 1565 patients who underwent plating of their distal radius fracture between January 1st 2007 and December 31st 2012 of which 108 (6.9%) were not reduced prior to surgery. We recorded any infections, hematomas, disproportionate finger stiffness, (transient) neuropathology after surgery and resultant delayed carpal tunnel release, malunion, loss of alignment, plate removal and tendon ruptures within 1 year after surgery. Outcome measures were grouped to determine the overall adverse event rate and subsequent surgery rate.

Results We recorded 291 adverse events in 265 patients (17%) and 114 subsequent surgeries in 96 patients (6%). We found no difference in specific adverse events between unreduced and reduced fractures. After adjusting for possible confounding variables by logistic regression, we found no difference in overall rates of adverse events (odds ratio 1.4, 95% confidence interval 0.84-2.2) and subsequent surgeries (odds ratio 0.58, 95% confidence interval 0.21-1.6) between both groups.

Conclusion Conscious of the retrospective nature of this study, doctors could consider not putting the patient through the time and pain of closed reduction when surgery is planned within a few days.

P61. Repair of Chronic Distal Bicep Tendon Rupture without Tendon Graft Interposition

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Introduction: Chronic biceps tendon rupture (BTR) is often complicated by severe retraction and contraction and therefore traditionally thought to require tendon grafting. The purpose of this study was to report the clinical outcomes of late (≥ 12 weeks) distal BTR repair without interposition tendon grafting.

Methods: IRB approval was obtained. Thirteen patients underwent operative repair for chronic (≥ 12 weeks) distal BTR between August 2003 and December 2011. Patients were excluded based on intraoperative findings of partial tears (n=5) and concomitant surgeries (arthroscopic release of elbow joint contracture) potentially interfering with the variables of interest (n=1). This left 7 patients for review. All patients underwent endoscopic assisted distal BTR repair. Retracted bicep tendons were attached to the radial tuberosity by flexion of the elbow to allow the shortened musculotendinous unit to reach the radial tuberosity. No interposition tendon grafts were used. Charts were retrospectively reviewed for time to return to work, elbow range of motion, pain, grip strength, and postoperative complications. All patients had a minimum of a 2-year follow-up.

Results: The average time from injury to repair was 49 weeks (range 12 to 115). Demographics are shown in Table 1. Mean return-to-work time was 45 days (range 1 to 97) for limited duty and 85 days (range 7 to 125) for full duty. At a mean follow-up of 7 years (range 2 to 11), all patients had full range of motion and no pain. The average time to regain full postoperative range of motion was 6 weeks (range 4 to 7). Complications included paresthesias of the lateral antebrachial cutaneous nerve (n=3), all of which resolved within 1-year postoperatively. All patients were satisfied with the surgery and would have the surgery again.

Discussion and Conclusion: Distal BTR repair for chronic ruptures using elbow flexion without interposition tendon grafting is a safe and effective solution for symptomatic patients resulting in full range of motion and pain relief. Thus, the routine use of tendon allografts for chronic distal BTR repair is not warranted. While all of the musculotendinous units in this series were successfully elongated to allow full range of motion, we do not know if there is a limit to the amount of chronicity tolerated with this approach.

Table 1. Baseline characteristics of patients who underwent late distal biceps tendon rupture repair for complete ruptures.

Demographic	Chronic Distal BTR Repair Patients (n=7)
Gender-n (%)	
Male	7 (100)
Age-mean (range)	49 (32-73)
Dominant Side Involved-n (%)	4 (57)
Work Comp Cases-n (%)	6 (86)
Type of Fixation-n (%)	
Endobutton	3 (43)
Anchor	4 (57)

P62. Erythropoeitin Preserves Function in Crush-Injured Nerves and Confers Protection for Myelin and Neurofilaments

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Introduction: Clinical classifications of peripheral nerve crush injury suggest uniformity across all fibers in a nerve: intact or severed, myelinated or unmyelinated. We hypothesized that by performing three different intensity crush injuries, microstructural differences could be observed in quantities of neurofilament (NF) and myelin. We further hypothesized that pharmacologic intervention with erythropoietin (EPO) treatment could be investigated in these nerve injuries of varied severity, and that microstructural analysis might elucidate the mechanism of EPO's protective effect.

Methods: Mice were randomized to undergo standardized crush injuries to the sciatic nerve of mild, moderate, or severe intensity with calibrated pressure jigs. Pressure sensitive film was used to demonstrate the destructive force applied in each crush type (figure 1). NF and myelin protein zero (P_0) immunofluorescence were performed to gauge the extent of axonal disruption. On post-injury day (PID) 0, randomly chosen mice were treated with 50 U EPO. P_0 and NF immunofluorescence were analyzed using ImageJ software to calculate total area of staining in mm^2 for nerve cross sections of each crush type with and without EPO. Functional changes were analyzed using standard walking track analysis for sciatic function (SFI).

Results: ImageJ analysis confirms microstructural differences between crush types ($p<0.05$) and demonstrates a protective effect of EPO on preservation of myelin and neurofilaments. The total area staining for NF was significantly greater in EPO-treated sciatic nerve cross sections than in control (saline treated) counterparts at PID7 for moderate and severe crush intensities ($p<0.05$)(figure 2). Total cross sectional area staining positive for myelin was significantly greater in EPO-treated cross sections for all crush types ($p<0.05$)(figure 3). Moderately crush-injured animals have significantly improved SFI in the setting of EPO treatment ($p<0.05$)(figure 4).

Discussion: Microstructural damage is dependent on intensity of crush injury and is non-uniform, with intact fibers adjacent to severed fibers. EPO has a positive effect on the number of neurofilaments and total cross sectional area of myelin present following crush injury, and these improvements confer significant functional benefits in moderately crush-injured mice. Mildly crushed nerves may not have suffered sufficient injury for EPO to be functionally significant and severely crush-injured nerves might have too few salvageable fibers for EPO to demonstrate a significant effect. The implications for non-uniformity in nerve injury coupled with the positive effect of EPO on a particular degree of crush (far earlier than possible with neuro-regeneration), strongly suggests that EPO acts on partially uninjured fibers within the nerve.

Figure 1. Three different crush intensities
A. Forceps and needle driver producing mild and severe crush types
B. Pressure sensitive film used to show different crush intensities

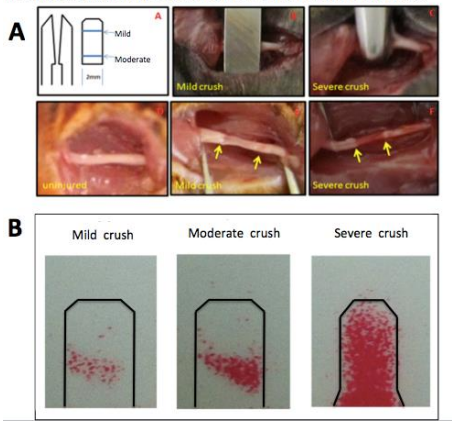


Figure 2. Immunohistochemical staining on post-injury day 7 of saline- and EPO-treated neurons in cross section demonstrate increased neurofilament content in um^2 in erythropoeitin treatment group
A. Neurofilament staining cross section at 10x power
B. ImageJ analysis of cross sectional area

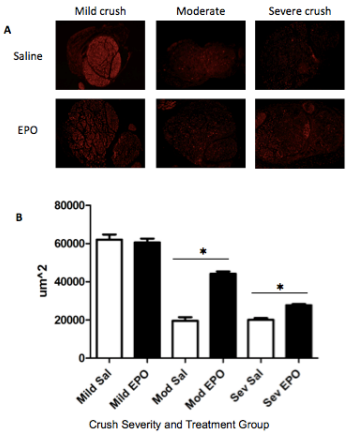


Figure 3. Immunohistochemical staining on post-injury day 7 of saline- and EPO-treated neurons in cross section demonstrate myelin content in um^2 in erythropoeitin treatment group
A. P_0 staining cross section at 10x power
B. ImageJ analysis of cross sectional area

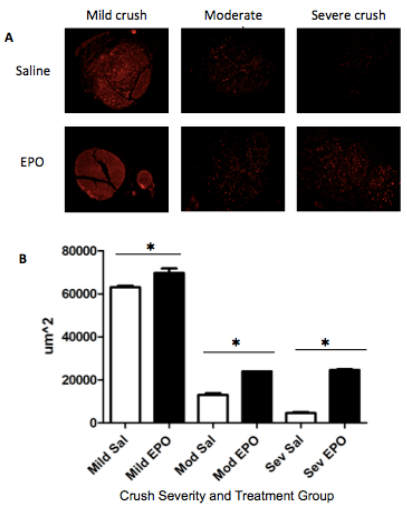
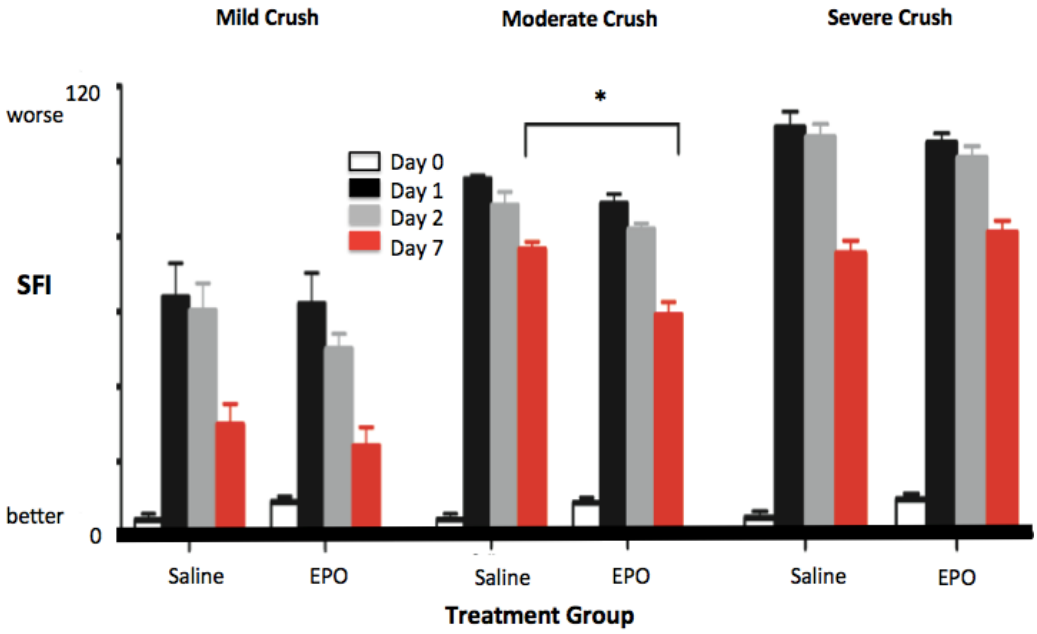


Figure 4. Sciatic Function Index derived from walking track analysis of mice with each crush type demonstrates functional improvement with EPO treatment for moderately crush-injured mice



P63. The High Risk of Infection with Delayed Treatment of Pediatric Seymour's Fractures

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Purpose: The purpose of this study is to describe treatment methods and complication rates of all Seymour's fractures (open Salter-Harris I/II fractures of the distal phalanx with associated nailbed laceration) treated at or referred to a pediatric level one trauma center over a ten year time period. We hypothesized that delayed, or inappropriately treated Seymour's fractures would be associated with higher infectious complication rates.

Methods: All patients treated in the pediatric orthopaedic hand clinic at our institution with an ICD-9 diagnosis of 816.02 or 816.12 (closed or open fracture of distal phalanx or phalanges of hand, respectively) between August 2002 and December 2012 were identified. All charts and radiographs were retrospectively reviewed. 47 patients treated for 48 Seymour's fractures were identified. Patients were divided into groups based on timing and quality of treatment. 'Appropriate' treatment was defined as irrigation and debridement, fracture reduction, nailbed repair, and antibiotics. 'Partial' treatment was defined as any type of incomplete treatment. 'Acute' treatment was defined as management within 48 hours of the injury, and 'Delayed' as presenting for treatment past 48 hours from time of injury. Statistical comparisons were performed using Fisher's exact test.

Results: Average patient age was 8.7 years (range 1-15 years), with 35 males and 12 females. Most common mechanism of injury was sports (32%, 15/47), followed by closed in door/window (30%, 14/47). 57% (27/47) were treated in an acute, appropriate manner, 15% (7/47) received acute, partial treatment, and 28% (13/47) received delayed treatment. 1 patient initially treated at an outside hospital had inadequate documentation to determine appropriateness of treatment but had no complications. There were 9 complications: 3 superficial infections, 5 osteomyelitis, and 1 malunion. With respect to infectious complications, only 1 (superficial infection) occurred in the acutely, appropriately treated group (infection rate 3.7%, 1/27), 1 (osteomyelitis) occurred in the acutely, partially treated group (14%, 1/7) and 6 (2 superficial, 4 osteomyelitis) occurred in the delayed treatment group, (46%, 6/13). Differences in infection rates among the treatment groups were statistically significant ($p < 0.003$ including all infections; $p < 0.007$ including osteomyelitis only).

Summary Points: * Timing and quality of treatment of Seymour's fractures significantly influences infectious complication rates * Patients with delayed treatment had a 12-fold risk of infection compared to those treated early and appropriately

P64. Metacarpal Subsidence Rates following Thumb CMC Arthroplasty

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Background: Thumb carpometacarpal (CMC) arthritis causes significant disability in affected patients. When conservative measures have failed, various surgical options exist including simple trapeziectomy, hematoma distraction, and ligament reconstruction tendon interposition (LRTI). Post surgical metacarpal subsidence may lead to pain due to abutment on distal scaphoid, eventually leading to a weaker thumb. Anecdotal experience by the senior authors suggested that subsidence was more related to age than surgical technique. The purpose of this study was to compare the rate of metacarpal subsidence between LRTI and simple trapeziectomy with tendon interposition (TI).

Methods: An IRB approved, retrospective chart review of patients undergoing CMC arthroplasty from 2010-2013 by the senior author (JEI) was performed. Surgical technique (LRTI or TI) was performed at the surgeon's discretion. All patients undergoing CMC arthroplasty who had hand radiographs performed pre-operatively, 2 weeks, 3 months and more than 6 months post-operatively were included. Metacarpal subsidence was evaluated as post-operative trapezial space ratio (distance from base of thumb metacarpal to scaphoid / proximal phalanx length) post-operatively compared to pre-operative evaluation. Univariate analysis for demographic factors and multivariate logistic regression analysis for factor association with >50% metacarpal subsidence performed using SPSS for Mac. Results expressed as odds ratio (95% confidence interval). $P<0.05$ was considered significant.

Results: 86 patients underwent CMC arthroplasty over the study period; 29 patients (31 thumbs) matched our inclusion criteria. There were 10 males and 19 females. Average age was 60 years (range 46-81 years). Long-term follow up averaged 13 months (range 6 – 35 months). On average, 2 weeks post-operatively there was 50% metacarpal subsidence that remained constant even at long-term follow-up. Eaton grade, gender, thumb laterality or type of operation were not significantly associated with >50% subsidence. Age was significantly associated with >50%subsidence [OR 1.17 (1.0092 – 1.3583)]. Controlling for type of operation age >60yrs was most associated with >50% subsidence [OR 11.0652 (1.0856 – 112.7827)].

Conclusion: This study assessed the degree of long-term metacarpal subsidence following CMC arthroplasty and the factors associated with it. Previous studies have found that surgical technique does not appear to affect outcomes or subsidence after CMC arthroplasty. The current study has found patient age as a significant independent predictor in the amount of subsidence that occurs, irrespective of technique. In carefully selected patients, performing the shorter, less complex operation may result in equivalent outcomes.

P65. Comparison of Cortisone Injection and Percutaneous Trigger Finger Release For 398 Trigger Thumbs

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Introduction: The cortisone injection is the gold standard treatment for trigger finger however the percutaneous trigger finger release (PTFR) is gaining popularity as it can be done under local anesthesia in the physician's office but remains to be controversial when used in the thumb. This study sought to compare the success rate of cortisone injection to that of PTFR in patients presenting with trigger thumbs and to evaluate the safety of this procedure in a large series of patients.

Materials and Methods: Outcomes via retrospective review were evaluated over a 5-year period from 2008-2013. We looked at patients who were either treated with local cortisone injection (N=196) or PTFR under local anesthesia in the office with a sterile 18-gauge needle (N=202). Patients had at least one year of follow up. Patient demographics included age, gender, associated conditions, side, average pain, trigger finger grade (all grades were included), and duration of symptoms. Patients were assessed at follow up for pain, continued triggering, need for therapy after treatment, complications, and overall satisfaction.

Results: A total of 196 patients treated with cortisone injection had a success rate of 76.5%. In this group 13.7% required a second injection, 1.5% a third injection, 11.2% underwent a PTFR, and 1.3% of patients received an open release. In the PTFR group 202 patients had a success rate of 98.5% with one patient that received a second PTFR. In the injection group there were no complications and in the PTFR group there was one incident of pseudoaneurysm in of the digital artery for a complication rate of 0.5%. The therapy rate for the injection was 10% and 25% in the PTFR group.

Conclusions: PTFR while widely demonstrated to be safe in the other digits, the use of this procedure in the thumb continues to be a controversial topic given the proximity of the neurovascular bundle and further studies were indicated to evaluate the safety and efficacy of this procedure. The results of this study demonstrate a greater rate of success of PTFR for trigger thumbs compared to the standard cortisone injection. However, while there was a very low complication rate the potential severe consequence of arterial injury along with reports of potential digital nerve injury in other studies in very concerning. As a result, the authors of this study would recommend that the PTFR not be performed in the thumb given the risk of iatrogenic neurovascular injury.

P66. Patient Education for Carpal Tunnel Syndrome: Analysis of Readability

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Introduction: Limited patient access to health information contributes to important health disparities in satisfaction, outcomes, and mortality. Increasingly widespread internet access has led to growing interest in creating online resources for patient information. Unfortunately, up to 46% of American adults lack basic health literacy skills. In order to provide understandable material, the National Institutes of Health and American Medical Association recommend a sixth grade reading level for patient-directed content. This study aims to quantitatively evaluate the readability of the most commonly used resources for surgical treatment of carpal tunnel syndrome in the context of average adult American literacy.

Methods: A web search for "carpal tunnel surgery" was performed using the largest public internet search engine, and the thirteen most popular sites were identified (Figure 1). Relevant, patient-directed articles immediately accessible from the main site were downloaded and formatted into plain text. A total of 102 articles were assessed for readability using ten established analyses: first overall then by website for comparison.

Results: Patient information about carpal tunnel surgery had an overall average reading level of 13.1 (Figure 2). Secondary analysis by website revealed a range of mean readability from 10.8 (high school sophomore level) to 15.3 (university junior level, Figure 3). Flesch reading ease analysis produced an index score range from 29 (Wikipedia.org) to 58 (AAOS.org) (Figure 4). All sites exceeded the recommended 6th grade reading level.

Conclusions: Online patient resources for carpal tunnel surgery uniformly exceed the recommended reading level and are too difficult to be understood by a large portion of American adults. A range of readability across sites was identified, and may be useful in directing patients to more appropriate resources for their level of literacy.

Figure 1: Websites identified

Website	Organization	Number of Articles
AAOS.org	American Academy of Orthopaedic Surgeons	2
ASSH.org	American Society for Surgery of the Hand	3
Carpal-tunnel.net	Carpal-tunnel.net	11
Carpaltunnelsyndromepain.com	Carpaltunnelsyndromepain.com	5
Emedicine.com	Medscape	15
Emedtv.com	Clinaero, Inc.	10
Health.nytimes.com	The New York Times Company	11
Healthgrades.com	Health Grades, Inc.	3
Joint-pain-solutions.com	Joint Pain Solutions	6
NINDS.nih.gov	National Institute of Neurological Disorders and Stroke	4
Surgeryencyclopedia.com	Advameg, Inc.	8
WebMD.com	WebMD, LLC.	16
Wikipedia.org	The Wikimedia Foundation, Inc.	8
	Total	102

Figure 2: Grade Level Analysis

Readability Test	Mean Reading Grade Level
Coleman-Liau	13
Flesch-Kincaid	12.6
FORCAST	11.6
Fry	14
Gunning Fog	13.9
New Dale-Chall	12.8
New Fog Count	10.8
Raygor Estimate	15
SMOG	13.9
Average	**13.1**

Figure 3: Grade Level by Website

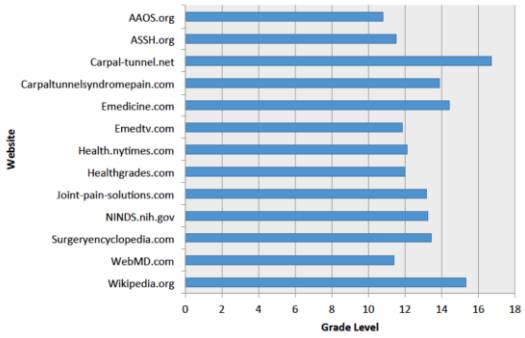
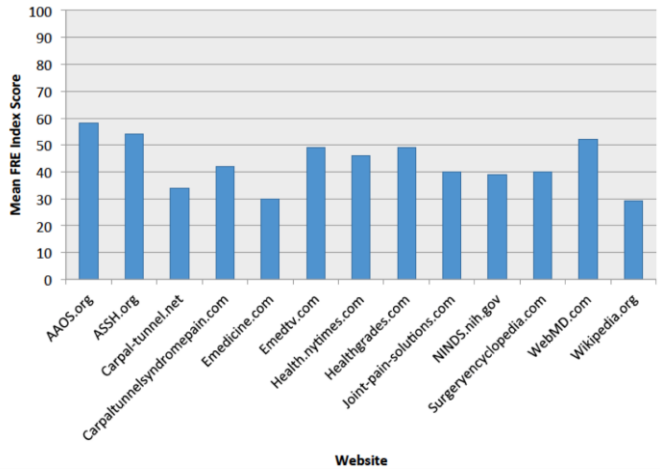


Figure 4: Mean Flesch Reading Ease Score



P67. Knee Arthroscopy Simulation Training: Does It Translate to Improved Arthroscopic Proficiency in the Wrist?

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Introduction: Wrist arthroscopy is a challenging discipline requiring extensive training before achieving proficiency. Most orthopaedic training programs offer limited wrist arthroscopy experience when compared to shoulder and knee arthroscopy. Simulation training has a growing role in orthopaedic training. Virtual reality simulation models are effective but expensive and the use of multiple joint-specific arthroscopy models is impractical and cost-prohibitive. To our knowledge, no studies have evaluated how joint-specific arthroscopy simulation models affect skills proficiency in different joints. The purpose of this study is to investigate whether knee arthroscopy simulation affects wrist arthroscopy proficiency.

Materials and Method: Twenty-two orthopaedic residents during the 2013-2014 academic year participated in arthroscopy simulation over a 4-week period. All subjects were video-recorded performing a 10-minute simulated diagnostic wrist arthroscopy procedure that involved identification of 23 anatomic landmarks through four arthroscopy portals on a cadaveric wrist. The assessment included video arthroscopy footage synchronized with external footage of the trainees' hands only, which allowed observation of instrument handling without identifying the participant. Afterwards, subjects had four weeks to complete a diagnostic knee arthroscopy module on the ArthroSim knee simulator (Touch of Life Technologies, Aurora, CO). ArthroSim is a high fidelity, virtual reality simulator that features haptic feedback and real-time manipulation of a leg to simulate knee arthroscopy. After completion of the knee arthroscopy module, subjects repeated the wrist arthroscopy test. Three experienced hand surgeons were provided the randomized and blinded footage of the baseline and post-intervention assessments and graded each assessment using the ASSET Global Rating Scale. ASSET is a validated, video-based objective measure of technical arthroscopy proficiency. Data of interest included demographic data, subjective data from resident pre-intervention and post-intervention surveys and objective data from the ASSET.

Results: Table 1 summarizes residents' opinion of knee simulation training. A majority found the ArthroSim intervention helpful and reported improved wrist arthroscopy proficiency. Junior residents were more likely to find the intervention helpful. Preliminary ASSET scores show no conclusive pattern of improvement following the intervention, however further analysis including evaluation of the inter-observer reliability of ASSET for wrist arthroscopy is still in progress.

Conclusions: Knee arthroscopy simulation subjectively improves wrist arthroscopy proficiency among orthopaedic residents with greatest value reported by junior residents. Objectively measured changes in wrist arthroscopy proficiency remain inconclusive.

Table 1: Resident Survey Following ArthroSim Intervention

Number of Residents Who Found ArthroSim Helpful in Improving Wrist Arthroscopy Skills		
Program Year	**# of Residents**	**Percentage (%)**
All Residents	13/22	59.1%
PGY-1	5/5	100%
PGY-2	3/5	60%
PGY-3	1/5	20%
PGY-4	2/4	50%
PGY-5	2/3	66.7%
Subjective Change in Comfort Level Performing Wrist Arthroscopy		
Improved	15/22	68.2%
No Change	6/22	27.3%
Worse	1/22	4.5%
Subjective Areas of Improvement in Technical Wrist Arthroscopy Skills		
Camera Dexterity	12/22	54.5%
Flow of Procedure	9/22	40.9%
Bimanual Dexterity	5/22	22.7%
Quality of Procedure	4/22	18.6%
Instrument Dexterity	3/22	13.6%
Safety	3/22	13.6%
No Improvement	5/22	22.7%

P68. Intra-operative Evaluation of the Inter-osseous Ligament (IOL) of the Forearm

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Background: Disruption of radial head and neck can lead to instability, which may be more pronounced when accompanied with IOL disruption. IOL disruption can be difficult to diagnose and is often recognized late. Accurate clinical and intra-operative diagnosis can lead to earlier identification of the injury and optimize treatment. Objectives: To determine the amount of displacement after radial head resection with and without IOL disruption, and to determine the best position to test the IOL.

Methods: In this study, we used 10 fresh frozen cadavers. All of them were prepared using a dorsal extended Thompson incision to approach the inter-osseous ligament (IOL) and radial head. We resected the radial heads 1.5 cm distal to the articular surface. Steinman pins were placed into the radius medullary canal with the sharp tip facing the capitellum and marked the pin location on the capitelum. We applied 1 kg (2.2 lbs.) force to pull the proximal radius laterally and measured the displacement between the tip of the intramedullary pin and the marked point on the capitellum using a caliper. We measured the displacement in full supination, neutral, and full pronation of the forearm, in both elbow extension and 90 degrees of flexion. All measurements were performed twice with the intact and severed IOL.

Results: The least radius displacement (most stable position) was measured in supination in both extension and 90 degrees elbow flexion when IOL was intact. The mean displacement increased more than 10 mm in extension-supination (from 2.9 mm with intact IOL to 13 mm with disrupted IOL), and increased more than 12 mm in flexion-supination (from 4.7 mm with intact IOL to 17 mm with disrupted IOL). Comparing the displacement before and after IOL disruption, there was a significant difference in mean displacement in almost all positions with the greatest difference in both supination positions ($P < 0.001$).

Conclusion: Using the above measurement technique in forearm supination and 90 degree of flexion, it is possible to evaluate the IOL intra-operatively. This technique appears to be reliable and accurate in cadavers. It is quite likely that in an intra-operative setting, these results will be reproducible. However, this injury could also be influenced by dynamic muscle forces. These influences at this time remain at best, speculative.

P69. Aggressive Digital Papillary Adenocarcinoma—Case Series and Meta-Analysis of a Rare Hand Tumor

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Introduction: Aggressive digital papillary adenocarcinoma (ADPA) is a rare skin adnexal tumor with predilection for the hand. First described over 30 years ago, ADPA usually presents as a benign-appearing pink/tan nodule between the DIP joint and nailbed. 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. No clear consensus exists regarding wide local excision or amputation as initial treatment, and the role of sentinel node biopsy is unknown. Similarly, recurrence and metastasis rates vary tremendously, as does age, lesion history and location, recurrence or metastasis time, and follow up results. We present 3 cases of ADPA and a meta-analysis of the published cases to date.

Materials and Methods: We searched the Medline database for case reports and descriptions of ADPA. We included reports of individual variables and excluded reports without case-specific information. We statistically accounted for articles that reported data that had been averaged and compared the results of this meta-analysis with the results of other published case series.

Results: 198 cases were found in the literature, 173 of which were included in this analysis (including 3 of our own patients). Similar to published data, the mean patient age was 49, and 88.5% were male. The average tumor size was 1.9 cm and 81.5% were on the upper extremity. Duration of lesion until diagnosis was 42 months. 16.1% had a history of trauma. The most common treatment was wide local excision (80.9%) vs. 19.1% amputation. The recurrence rate was 30.5% with a metastatic rate of 24.2%, which was higher than the previously reported rate of 14%.

Conclusion: To our knowledge, the current report is the only meta-analysis of published ADPA cases. ADPA is a rare hand tumor with high recurrence and metastatic potential with a long time to diagnosis. Increasing awareness of this tumor may lead to quicker diagnosis and less morbidity/mortality. Our future analysis will investigate the impact of initial treatment on recurrence and metastasis rates. ADPA should be included in the differential diagnosis of hand lesions with unusual presentation or lack of response to other therapies.

P70. Functional Outcomes of Replantation Following Complete Radiocarpal Amputations

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Introduction: Amputation of the hand at the radiocarpal level is a devastating condition associated with profound functional and psychological disability. Despite advances in microsurgical techniques, it is difficult to achieve satisfactory functional results due to the complexity of the injury. Our purpose is to report the long-term clinical outcomes of patients who have undergone replantation for a complete radiocarpal amputation.

Methods: A retrospective review of complete radiocarpal joint amputations was performed at a level-1 trauma center over a 13- year period. Medical records of patients treated with replantation were queried for injury data, operative reports, complications, and clinical progress. Patients who met inclusion criteria were contacted for long-term follow-up. Total active motion (TAM) of each digit, strength (grip and pinch), and two-point discrimination (2PD) were measured. Functional outcomes were assessed with a Disabilities of Arm, Shoulder, and Hand (DASH) score, Mayo Wrist Score (MWS), Patient-Rated Wrist Evaluation (PRWE), and Michigan Hand Questionnaire (MHQ). Descriptive statistics were calculated, including frequencies for categorical variables and means and ranges for continuous variables.

Results: Six patients met our inclusion criteria (**Table 1**). The mean age was 35.9 (25.7- 49.9) years. All patients underwent successful replantation. One patient died from hemorrhagic shock on the first post-operative day after he dismembered his replanted limb during a psychotic episode. Five patients were available at a mean follow-up of 3.93 (1.00 - 6.90) years **(Table 2)**. Compared to the contralateral uninjured extremity, TAM of the hand was 38.0% (26.45 – 59.09) and grip strength was 8.62% (0 – 18.06). Neither tip nor key pinch was present. Mean 2PD was 10.6 mm (7.9 – 12.0). All mean outcome scores indicated moderate disability, including DASH (75.83; 45.0- 81.7), MWS (22.5; 5- 50), PRWE (85.5; 56.0 – 97.5) and MHQ (27.25; 15- 55). Two patients were able to return to work, and three patients were permanently disabled. All patients were satisfied with their hand function.

Conclusions: Replantation at the radiocarpal joint results in long-term patient satisfaction despite continued patient disability. Continued care and follow-up surgeries are imperative in this population years after replantation surgery.

Table 1: Demographics and Injury Characteristics

Mean Age (years)	35.9
Gender	
Male	4
Female	2
Race	
African American	3
Hispanic	3
Occupation	
Electrician	1
Mechanic	1
Other Manual Labor	1
Office Administration	1
Unemployed	1
Unknown	1
Mean Ischemic Time (hours)	6.4
Mechanism	
Electrical Wire	1
Glass	1
Heavy Machinery	1
Machete	2
Blade	1
Work-Related	3
Contamination	3
Dominant Extremity Involvement	5
GCS Score	13
Revised Trauma Score	10.2
Associated Injuries	
Neck Trauma (sharp)	1
Bilateral Eye Trauma (sharp)	1

**One patient was a transfer from the Cayman Islands with an 18 hours ischemic time

Table 2: Follow-up Functional Outcomes

Mean Follow- up	3.93 years (1.00 - 6.90)
Physical Examination	
Grip Strength	8.62% (0 - 18.06)
Tip Pinch	0%
Key Pinch	0%
TAM Wrist	8.93% (0 - 50)
TAM Thumb	47.12% (23.08 - 80.77)
TAM Index	38.89% (25.93 - 46.30)
TAM Middle	37.04% (24.07- 70.37)
TAM Ring	39.35% (18.52 - 62.96)
TAM Small	32.41% (11.11 - 62.96)
TAM Total Hand	38.02% (26.45 - 59.09)
2- PD	10.6 mm (7.9 – 12.0)
Functional Outcome Scores	
Real DASH*	75.83 (45.0 - 81.7)
Patient Rated Wrist Evaluation*	85.5 (56.0 - 97.5)
Mayo Wrist**	22.5 (5 - 50)
Michigan Hand Questionairre**	27.25 (15 - 55)
Return to Work Status	
Yes	2
No	3
Satisfaction	
Very Satisfied	2
Somewhat Satisfied	3
Neutral	0
Somewhat Dissatisfied	0
Very Dissatisfied	0

*Higher score signifies greater disability
**Lower score signifies greater disability

P71. Correcting the Type III Apert Hand

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Purpose: Correction of the Type III Apert hand is a monumental surgical task due to the complex pan-syndactyly, rotation and overlapping of the central digits and associated skin deficiency. Surgical treatment of this most severe form of the Apert hand has received little separate attention in the literature. Controversies remaining include: need to sacrifice a ray, number of stages and order of syndactyly releases, design of flaps and grafts, and the mode of correction of the thumb clinodactyly. We describe our technique that facilitates the creation of a five-fingered hand, safely, in 3 stages.

Technique: The conceptual goal is to convert the Type III to a Type I hand during the first stage using limited osteotomies of the central ray synostoses, while performing formal releases of the 1st and 4th webspaces. We release the border webspaces using triangular dorsal and palmar skin flaps to recreate the commissure, and full thickness grafts from the lower abdomen. To flatten the plane of the hand, longitudinal osteotomies are made through the fused central digital mass, now released from the border digits. The nail plates reflect the deeper anatomy: longitudinal nail ridges indicate phalangeal borders and nail angulation mirrors the phalanx below. The hyponychium is incised and a 1mm tunnel under the sterile matrix made. Osteotomies parallel the overlying nail ridges until through all conjoint bone on both sides of the middle phalanx. A 0.028 Kirschner wire is passed horizontally across the separated digits to maintain a uniplanar profile and full arm casts and k-wires are left for 3 weeks.

Results: 10 patients with Apert Type III hands were operated on between 1995 and July 2014. All patients are evaluated in a multidisciplinary clinic involving several surgical and medical disciplines. Patients averaged 12, 16, and 30 months at stages 1, 2, and 3, respectively. A thumb and four fingers were achieved for each hand. Length of stay averaged 2 days. There were no complications.

Conclusions: Although this technique necessitates a 3-stage approach to addressing the Type III Apert hand, it allows the deficient palmar skin to redistribute facilitating stage 2 and 3 syndactyly releases. This limits the amount of skin graft to the volar surface, which is a poor substitute for specialized glabrous tissue. Finally, this approach results in more pulp at the fingertip, allowing for paronychial fold creation. We conclude that these additional aesthetic and functional gains offset the requirement of an additional operation.

P72. Patient Satisfaction and Functional Status in Hand Surgery Patients: No Evidence for an Association

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Introduction: Patient satisfaction scores are being used to evaluate health care delivery and physician performance. The association between patient satisfaction and patient reported functional status in a hand and upper extremity practice is unclear.

Methods: The Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH) was administered to all patients presenting to two hand and upper extremity surgeons in an academic practice from March 2013 to January 2014. The Press-Ganey patient satisfaction survey was sent to all patients within 2 weeks of their visit.

All adult patients who returned both a scoreable DASH and the Press-Ganey survey linked to the same clinical encounter were considered eligible for this retrospective study. For those patients with multiple clinic visits, only the first visit with both completed surveys was used for the analysis.

Spearman correlation was performed between the DASH and Press-Ganey Mean Overall Score (MOS) data. Correlation between the five DASH questions specifically related to pain and emotional functioning and the Press-Ganey MOS were also performed. In addition, the effect of offering an intervention in the form of injection or surgery on the Press-Ganey MOS for a given encounter was analyzed using the Wilcoxon Rank Sum test.

Results: A total of 110 unique patients with scoreable DASH and Press-Ganey surveys for a single clinic visit were included in this study. Spearman correlation demonstrated no significant association between the DASH and patient satisfaction ($r = 0.079$, 95% CI -0.105 to 0.263, $p < 0.05$).

There was no correlation between patient satisfaction and the subset of DASH questions relating specifically to pain and psychosocial functioning. We were not able to show a significant effect of offering an intervention in the form of surgery or injection on patient satisfaction ($p = 0.781$).

Conclusions: There is no association between patient reported functional status (DASH) and patient satisfaction (Press-Ganey) during a single hand surgery clinic visit. Further investigation regarding the relationship between patient satisfaction and functional outcome is warranted.

P73. The Reliability and Effectiveness of a Novel Hand-Held Thumb Dynamometer for Measuring Thumb Abduction Strength

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Introduction: A reliable and effective, pocket-sized, easy-to-use, and inexpensive device to measure thumb abduction strength is needed to assess median nerve motor function in the hand.

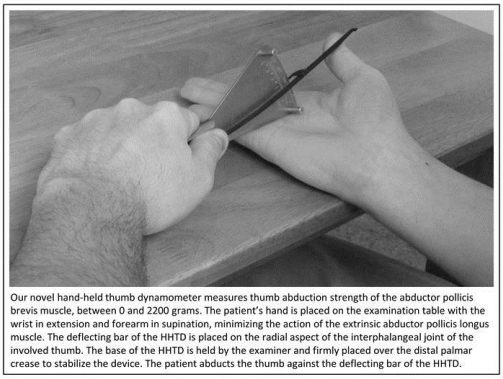
In order to validate the reliability and effectiveness of our novel hand-held thumb dynamometer (HHTD), a repurposed spring tension gauge used to tune pianos, we determined the inter- and intra-reliability in a hand-healthy control group then tested the effectiveness of the HHTD to detect thumb abduction strength changes before and after carpal tunnel release (CTR) in patients with carpal tunnel syndrome (CTS).

Methods: Two blinded investigators measured thumb abduction strength in 100 hands from 50 hand-healthy volunteers (22 men and 28 women; mean age, 45 years; range, 21-87 years) using the HHTD. Each investigator took two thumb abduction strength measurements per hand, for a total of 8 measurements per volunteer. This "Normal Hand" group established the reliability.

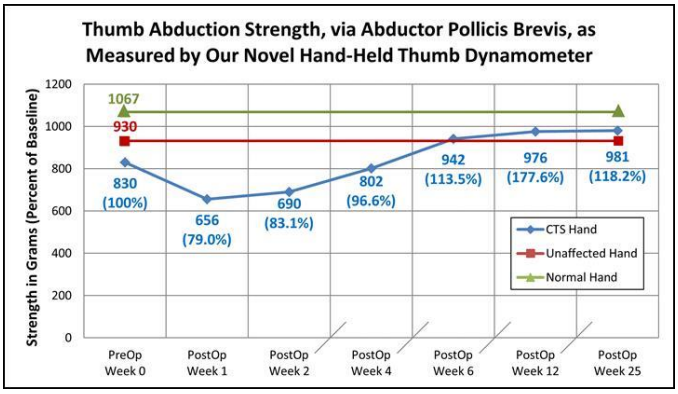
A single investigator then measured thumb abduction strength with the HHTD in 25 hands from 25 patients (6 men and 19 women; mean age, 52 years; range, 24-82 years) with clinical and electrodiagnostic diagnosis of CTS. Measurements were obtained preoperatively and postoperatively in the "CTS Hand." The single investigator took one thumb abduction strength measurement per assessment. In addition, thumb abduction strength of the "Unaffected Hand" was measured for comparison (Figure 1).

Results: The HHTD demonstrated excellent inter-observer reliability between the two independent raters (correlation coefficients: 0.955 right, 0.969 left) and excellent intra-observer reliability (correlation coefficients: 0.928 right/0.988 left of observer 1 and 0.980 right/0.965 left of observer 2). The HHTD tracked improvements in thumb abduction strength. Four weeks postoperatively, CTS Hand strength (802g) resembled that of a patient's Unaffected Hand (930g, p=0.81), but was still significantly weaker than a Normal Hand (1067g, p=0.001). Twenty-five weeks postoperatively, CTS Hand strength (981g) resembled a Normal Hand (1067g, p=0.37) (Figure 2).

Summary: Our novel HHTD isolates the abductor pollicis brevis, allowing one to reliably and effectively quantify median nerve motor function in the hand. Hand surgeons and therapists can now reliably and effectively evaluate patients with CTS and gauge response to CTR. Due to its reliability, effectiveness, small size, portability, simple design, ease-of-use, and low cost (approximately $47.15), the HHTD can be easily incorporated into the physical exam for hand surgeons and therapists more so than other previously reported devices.



Our novel hand-held thumb dynamometer measures thumb abduction strength of the abductor pollicis brevis muscle, between 0 and 2200 grams. The patient's hand is placed on the examination table with the wrist in extension and forearm in supination, minimizing the action of the extrinsic abductor pollicis longus muscle. The deflecting bar of the HHTD is placed on the radial aspect of the interphalangeal joint of the involved thumb. The base of the HHTD is held by the examiner and firmly placed over the distal palmar crease to stabilize the device. The patient abducts the thumb against the deflecting bar of the HHTD.



P74. WITHDRAWN

P75. 3D Printed Models of Bone Fractures: A New Tool to Improve Lesion Understanding, Surgery Plan and Refine Patient's Compliance

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Introduction: 3D printing is a new technology that uses a 3D computer representation to create solid objects. They improve understanding of anatomy and pathology by means of tactile and visual experience to complement images displayed on a computer monitor. Three-dimensional print models are already used in cranio-maxillofacial and dental surgery.

We decided to test this technology creating orthopaedics models of distal radius fractures and scaphoid non unions.

Material and Methods: Starting from the Computer Tomography DICOM-file, we exported the 3D-Reconstructions of the fractures in printable files.

Using a commercial 3D-Printer we reproduced models 1:1, white color, with high resolution of details only after 10 hours from CT scans.

The models are constructed layer by layer with the print-head spraying binder onto the segmented area working with a special resin material (ABS Plus White) with a cost ranging from 20€ to 45€.

Results: We used 3D-printed distal radius and scaphoid models to improve understanding of fracture's pattern: especially, it was easier to appreciate the yielding of the articular surface and the dislocation of the fragments. On these models we were able to simulate surgical procedures for fracture reduction and we were able to test the most suitable implants and their positioning and fixation, before going to surgery.

These personal realistic models were also showed to the patients, improving drastically their education to refine the consent.

Conclusion: The models allow better anatomical understanding of the lesion and help plan surgical management. Physical models can be used to improve patient's consent before surgery and for surgical skills training in student education. In the future we could be able to reconstruct bony defects with 3D printed biocompatible material.

P76. The Effect of Pre-Operative Hand Therapy Instructions on the Need for Post-Operative Hand Therapy

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Introduction: The role of formal pre-operative therapy prior to hand surgery has yet to be defined. We hypothesize that providing pre-operative occupational hand therapy instructions to patients undergoing small soft tissue procedures (carpal tunnel release, trigger finger release or de Quervain's release) will lead to a decreased need for formal post-operative therapy.

Methods: The outpatient records of 457 patients who had undergone elective carpal tunnel release, trigger finger release or de Quervain's release were retrospectively reviewed. Patients undergoing surgery between July 1, 2010 and June 30, 2011 did not receive pre-operative occupational hand therapy instructions. Those undergoing surgery from July 1, 2011 and June 30, 2012 did receive pre-operative hand therapy instructions. All patients were instructed to use their hand normally with a 10 pound lifting restriction. Those given instructions were given a "six pack" of hand exercises to be completed three times a day. The first post-operative office note was reviewed and the determination for further formal hand therapy was noted. A medical history of diabetes mellitus and use of tobacco were also recorded to determine possible effects on outcome.

Results: A total of 518 hands in 457 patients met inclusion criteria. 246 hands of the 518 hands examined (209 patients, 47%) were not given any pre-operative therapy instructions. 272 hands (248 patients, 53%) were given hand therapy instructions before surgery. Post-operative formal therapy was required in 80 of the 272 (29%) pre-operative therapy patients and 62 of the 246 (25%) patients who did not receive pre-operative therapy ($p=0.28$). History of diabetes mellitus and smoking status did not have a significant effect on this relationship. There were 96 of 518 hands in patients with diabetes (19%). 10 of 37 (27%) diabetic hands that had no pre-operative instruction and 18 of 59 (31%) diabetic hands in the pre-operative instruction group required post-operative therapy ($p=0.71$). Patients who actively smoke compromised 63 of 518 hands (12%). Post-operative therapy was required in 9 of 31 (29%) hands with no pre-operative instruction vs. 10 of 32 (31%) hands with pre-operative instructions ($p=0.85$).

Conclusion: Providing occupational hand therapy instructions to patients prior to surgery has no effect on the need for post-operative therapy. Medical comorbidities, such as diabetes mellitus and smoking, also have no effect on the need for post-operative therapy in patients receiving small soft tissue procedures.

P77. The Effect of Anesthesia on Non-Surgical Operating Room Time

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Introduction: Operating room efficiency is becoming an area of focus for hospitals. With the growing popularity of wide-awake local anesthesia in surgery of the hand, the surgeon's choice of anesthesia is increasingly important. We hypothesize that the choice of anesthesia has a significant effect on non-surgical operating room time.

Materials and Methods: The surgical records of 1,179 patients undergoing elective hand surgery were retrospectively reviewed. We calculated three time quantities for each case: (1) the time elapsed between the patient entering the room and the start of the case (in-room patient preparation time), (2) the time from the end of the case to the patient leaving the room (in-room post-surgical time), and, if relevant, (3) the time elapsed between one patient leaving the room and the next entering the room (room turnover time). We did not calculate room turnover time if the following case required significant time to setup the room, if the case was performed on a day in which the surgeon used more than one operating room, or if the case was the last case of the day. We also recorded the type of anesthesia used and the presence of any anesthesia providers (MD/DO vs. CRNA).

Results: Six hundred and twenty-eight cases performed on 550 patients met inclusion criteria. Room turnover times were not calculated for 334 cases. Of the 496 cases performed with general anesthesia or MAC/local, 400 included a CRNA and 96 had only an anesthesiologist. The choice of anesthesia has a significant effect on non-surgical operating room time. Local anesthesia cases had significantly less non-surgical time compared to general anesthesia and MAC/local. Cases with a combination of MAC and local anesthesia also had significantly reduced non-surgical time compared to general anesthesia. The presence of a CRNA had no effect on any of the time metrics recorded.

Conclusions: The choice of anesthesia has a significant effect on non-surgical operating room time. Local anesthesia cases have significantly less non-surgical overhead time compared to MAC, while both local and MAC cases have significantly less non-surgical time than general anesthesia cases. The use of a CRNA versus an anesthesiologist has no effect on non-surgical operating room time.

P78. Is The Use Of a Mini C-arm In Closed Reduction Of Distal Radius Fractures Necessary?

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Background: The use of mini c-arm-fluoroscopy in the emergency department (ED) for the reduction of distal radius fractures offers theoretical advantages. It allows the evaluation of fracture alignment during the reduction maneuver, and potentially improves the final outcome.

Objective: To evaluate whether the use of a mini c-arm in the ED for closed reduction of distal radius fractures increases the likelihood of achieving an acceptable fracture alignment, and consequently decreases the need for operative treatment.

Methods: All patients with distal radius fractures who were treated in our ED over two separate 3 month periods were identified. The 1st period (group 1) was prior to the use of a mini c-arm in the ED and the 2nd (group 2) was 2 years after the beginning of its use. Exclusion criteria included patients with open physis and non-displaced fractures. Radiographic comparison was performed between the two groups.

Results: There were 81 patients in group 1 and 88 patients in group 2. According to acceptable radiographic guidelines, which were applied on postreduction films, Conservative treatment was indicated for 61.3 % of the patients in group 1 and 56.8% of the patients in group 2. There was no significant difference between the two groups.

Conclusions: According to the results of this study, the use of a mini c-arm in the ED for closed reduction of distal radius fractures does not improve the likelihood of achieving acceptable fracture alignment and potentially avoiding the need for operative treatment.

P79. Treatment of Fingertip Amputations: A Survey Study

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Introduction: Distal fingertip amputations are common injuries in both work and non-work related accidents. Treatment options range from simpler treatments such as wound care to more involved interventions including soft tissue flaps and replant, all with reported good outcomes. There is a paucity of evidence to support the use of one technique over another.

Hypothesis: Treatment of distal fingertip amputations vary according to surgeon demographic factors such as country of origin, years of experience, institution type and training background.

Methods: A 16 question survey was sent to the members of the American Association for Surgery of the Hand, as well as reciprocal international hand societies. The survey was comprised of 6 demographic questions, 5 clinical scenarios with various level long fingertip amputations, and 5 treatment preference questions. The data was analyzed using a logistic regression model to assess for significant differences in treatment choices controlling for demographic data.

Results: A total of 199 hand surgeons, 62% from the US and 38% international, responded to the survey. For each clinical scenario (Allen level 2, 3, 4, and volar oblique amputation) there was a wide variation of treatment preferences from wound care to flap coverage and replant. Wound care was less likely performed by surgeons with greater than 30 years of experience or plastic surgery backgrounds ($p < 0.037$ and 0.01). Replantation was less likely to be performed by U.S. surgeons (OR 0.01; 95% CI 0.00-0.08; $p < 0.0001$) and by private practice compared to full-time academics (OR 0.09; 95% CI 0.01-0.91; $p = 0.042$). Pedicle and homodigital flaps were more commonly performed internationally irrespective of the amputated part's condition ($p < 0.038$). Surgeons with less than five years experience in practice were more likely to perform skeletal shortening than surgeons at any other stage ($p < 0.03$; $p < 0.05$).

Conclusion: For all levels and orientation of fingertip amputation queried, there is a wide range of treatment preferences among hand surgeons. Differences in treatment principles vary according to practice demographics and training background. However, clinical decision making is likely anecdotal in part given the limited amount of comparative research. This survey highlights the need for a prospective randomized trial to elucidate the most successful and cost effective treatments for distal fingertip amputations.

P80. Comparing Strength of Muscle Laceration Repairs Using Various Suture Techniques

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Introduction: Skeletal muscle lacerations are a relatively common injury. Compared to non-repaired lacerations, surgically repaired muscle lacerations are significantly stronger, regenerate faster, have smaller hematomas, and develop less scar tissue. Despite the benefits of repair, the optimal repair technique is still unknown. The purpose of this study was to examine the biomechanical properties of several common muscle repair techniques to determine the strongest repair.

Materials & Methods: Thirty-three fusiform porcine muscle specimens were dissected and used for the study. A pilot study was performed including nine different commonly used suture techniques to identify the three strongest repairs: Figure Eight, Mason Allen, and Perimeter. Each muscle was transected and then repaired using one of the three techniques. Eleven muscle-tendon specimens were prepared for each group for failure testing utilizing a MTS system (858 Mini-Bionix) to record biomechanical properties including breaking strength and stiffness.

Results: There were no statistical differences found between the three techniques in regards to breaking strength. Both the Figure Eight ($p = 0.039$) and Perimeter techniques ($p = 0.001$) were significantly stiffer than the Mason Allen technique.

Conclusions: The Figure Eight is a technically simple and time efficient repair that was found to be equivalent in strength as other more elaborate and time intensive repairs. For this reason, Figure Eight should be strongly considered for muscle laceration repairs.

P81. WITHDRAWN

P82. WITHDRAWN

P83. WITHDRAWN

P84. Arthroscopic-Assisted Elbow Interposition Arthroplasty without Hinged External Fixation: Surgical Technique and Short-Term Patient Outcomes

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Introduction: Severe elbow arthritis, especially in the younger population, is a difficult problem to manage. Surgical options including arthroscopic debridement with capsular release provide temporary relief but are usually not long-term solutions, and total elbow arthroplasty (TEA) imposes difficult activity restrictions. Therefore interposition arthroplasty is an alternative for younger, more active individuals, who want to minimize these limitations.

Methods: We present a novel surgical technique utilizing arthroscopy to assist in joint preparation and graft placement for interposition arthroplasty of the elbow. A hinged external fixator is not used, as we are able to preserve the medial collateral ligament and joint capsule, while only taking down the lateral collateral ligament (LCL) and repairing it afterwards. For a general step-by-step explanation of this procedure with accompanying images, see the figure below.

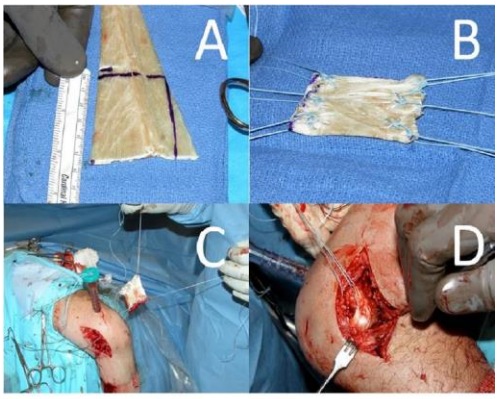
After IRB approval, a retrospective review of four patients with an average age 57 years old receiving Achilles allograft arthroscopic-assisted interposition arthroplasty was performed. Patients were contacted for follow-up elbow specific American Shoulder and Elbow Scores (E-ASES) and Disabilities of the Arm, Shoulder, and Hand (DASH) scores.

Results: The average follow-up for these patients was 3.6 years. One patient failed and was converted to a TEA at 2.5 years due to intractable pain. The remaining three have done well with regards to pain control, stability, and functional use of their operative extremity, with no post-operative complications. Their E-ASES and DASH outcomes are shown in Table 1.

Discussion and Conclusion: The purpose of this study was to report short-term outcomes for a novel procedure that can effectively treat advanced elbow arthritis in a younger patient population. In our technique, we do not use a hinged external fixator and try to minimize soft tissue disruption seen in other open interposition arthroplasty techniques. Although one patient failed and was converted to a TEA, the other three have done well at short-term follow-up. We recognize this is an imperfect solution, but believe this technique is a reasonable option for younger patients who hope to achieve improved function and not have the restrictions of TEA.

Table 1. Short-Term Outcomes after Surgery

Patient	Age At Surgery	Indication	Follow-up	ROM	Long Term Outcome Scores	
					DASH	ASES-E
1	48	Post-Traumatic OA	2.5 years	50-120 Full PS	N/A- converted to TEA	
2	62	RA	3 years	20-140 Full PS	33	73
3	55	Post-Traumatic OA	6 years	0-140 Full PS	13	65
4	63	Post-Traumatic OA	3 years	30-120 Full PS	35	50



- Positioning: Lateral over a tibial post
- Ulnar Nerve Transposition
- Standard elbow arthroscopy portals are made:
  - Direct Lateral
  - Direct Medial (under visualization)
  - Proximal Lateral
  - Posterior Lateral
- Preparation of the ulnohumera/radiocapitellar joint surfaces for graft placement
- Lateral approach to the elbow
  - Take down common extensor origin and lateral collateral ligament (LCL) from origin
- Measure dimensions of joint with arthroscopic assistance
- Achilles allograft measured **(A)** and graft cut according to measured dimensions
- Heavy non-absorbable braided locking stitches placed at the four corners and central anterior/posterior margins **(B)**
- Corresponding orientation of sutures are brought out with arthroscopic assistance **(C)**
- Graft is oriented into joint and sutures are tied to secure graft into joint **(D)**
  - Anterior and posterior central sutures are tied with arthroscopic assistance
  - Graft orientation is confirmed arthroscopically
- The LCL is repaired using bone tunnels and heavy non absorbable braided suture
- All layers are closed in standard sequential fashion
- Post-operatively the elbow is splinted in 90 degrees of flexion.

P85. Functional Outcomes Following Nerve Transfer Surgery for a C5-C7 Brachial Plexus Palsy are Improved with DAFRA Rehabilitation Technique

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Introduction: Nerve transfers are being used with increasing frequency for surgical reconstruction following brachial plexus injury. This systematic review compares functional outcomes of the donor activation focused rehabilitation approach (DAFRA) and general rehabilitation for C5-C7 brachial plexus palsy reconstruction with nerve transfers.

Materials and Methods: A literature review of all published data from 2005 to March 2014 was conducted using Pubmed, Cochrane Database of Reviews, Ovid-Medline, Web of Science, and PEDro databases. Studies were selected based on predefined criteria. Synthesis of 12 papers which fit the inclusion criteria was performed. To allow for easier comparison of results, outcomes of BRC manual muscle testing were converted into three categories: "poor," "moderate," and "excellent."

Results: Surgical delay ranged from 0-11 months in the DAFRA group and 0.5-15 months in the general group. Mean age ranged from 19-37 with a predominantly male population. Follow-up ranged from 1-4 years for both groups. Comparison between groups was performed by contingency table for the variables of ROM (shoulder abduction, external rotation, and elbow flexion), strength (shoulder abduction, elbow flexion, grip, and pinch), return to work time, and self-reported disability scales (DASH, pain). A meta-analysis of 12 studies was completed for the outcome of elbow flexion strength with a total of 231 patients. Analysis by SPSS showed a statistically significant group mean and median difference (Mann Whitney U=2330, $p < 0.001$, $z=-4.3292$, 1-tailed exact) for excellent elbow flexion strength grade outcomes in the DAFRA group (86.05%) compared to the general rehabilitation group (43.09%).

Table 1: Summary of Elbow Flexion Strength Grading by Group

DAFRA Group (N=43)	M4-5 (Excellent): 86.05% (37)
	M3 (Moderate): 9.30% (4)
	M0-2 (Poor): 4.65% (2)
General Rehabilitation Group (N=188)	M4-5 (Excellent): 43.09% (81)
	M3 (Moderate): 53.19% (100)
	M0-2 (Poor): 3.72% (7)

Conclusion: This review demonstrates positive rehabilitation outcomes for post nerve transfer patients after a C5-7 brachial plexus injury. Strength return to muscle grades of 4 and 5 are possible and may be achieved to a greater extent with a focused donor activation motor re-education program.

P86. Outcomes of Elbow Arthroscopic Osteocapsular Arthroplasty: A Retrospective Review of 48 Patients

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Introduction: Primary elbow osteoarthritis is a rare condition that typically affects patients who are heavy laborers or athletes. Elbow arthroscopic osteocapsular arthroplasty (AOA), which is a technically challenging procedure, is an option for treating elbow arthritis and has the potential for faster recovery over alternative approaches. There are very few studies which have demonstrated the efficacy and safety of this technique. Therefore, the objective of this study was to analyze elbow AOA patients for complications, pain relief, improvements in range of motion, and subjective outcome measures.

Methods: A consecutive series of 48 elbow osteoarthritis patients underwent AOA by a single surgeon between December 2005 and January 2013. 29 patients returned for final follow up at an average of 3.3 years for retrospective review. Subjective evaluation included Visual Analog Scale (VAS), Mayo Elbow Performance Scores (MEPS), Disabilities of the Arm, Shoulder and Hand (DASH) and American Shoulder and Elbow Society (ASES) scores. Clinical examination included range of motion, grip/pinch strength, and elbow pain. Preoperative and postoperative continuous variables were compared using the Wilcoxon signed rank test and categorical data were compared using the Chi-Square test.

Results: Of the 29 patients reviewed, the mean age was 52.1 years (range 25-77) with 26 males and 3 females. There were no complications. Significant improvements were observed in: extension (pre-operative 24.6 degrees to post-operative 11.3 degrees, $p<0.0001$), flexion (pre-operative 126.3 degrees to post-operative to 134.7 degrees, $p=0.003$), VAS (pre-operative 6.5 to 1.3 postoperatively, $p<0.0001$), and MEPS (pre-operatively a poor level score of 55 to post-operative excellent of 89, $P<0.0001$). Subjective scores included a mean postoperative DASH score of 12.7, ASES pain score of 40.97 and ASES composite score of 79.1. Statistical analysis revealed that ASES patient satisfaction strongly correlated with a decrease in VAS ($r = 0.54$, $p = 0.002$), and the overall range of motion change was not significantly associated with either change in MEPS or VAS.

Conclusions: Elbow AOA is a safe, efficacious treatment for patients with mild to moderate osteoarthritis. Our retrospective review found significant improvement in elbow motion, pain and clinical outcomes. The strongest correlation demonstrated high patient satisfaction with pain relief and not with range of motion increases. Future areas of research should include long-term outcomes of AOA vs. open debridement and release for pain control and objective clinical criteria.

P87. Handedness-based Patient Perceptions of Disability from Common Hand Disorders

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Introduction: The Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Measure is a commonly utilized questionnaire for people with upper limb disorders. Although intuition suggests that disease of the more utilized "dominant" hand would be associated with higher patient perceptions of disability, our clinical experience suggests otherwise. We hypothesize that whether the diseased hand is the dominant hand does not affect disability scores.

Methods: Patient charts from our institution were retrospectively reviewed over a two year period who initially presented with unilateral carpal tunnel syndrome (CT), DeQuervain's tenosynovitis (DQ), lateral epicondylitis (LE), thumb basal joint arthritis (TBJ), or trigger finger (TF). Charts were reviewed for hand dominance, side of injury, DASH, and SF-12 health survey scores. Linear regression was performed to estimate the effect of diagnosis and hand dominance on DASH scores; an interaction term was included to allow diagnoses to have differential impacts on dominant and non-dominant hands.

Results: DASH scores were available for 1016 patients (637 female, 379 male; mean age 60 years): 191 to 244 for each of the five diagnoses. SF-12 scores did not differ according to hand-dominance as well as for those within each diagnosis-specific subgroup. Linear regression showed that DASH scores were associated with both diagnosis and hand dominance, and that diagnoses could have differential effects on dominant and non-dominant hands. When gender was included in the analysis, it was found to affect these differentials. For females, DASH scores were about ten points lower in the non-dominant hand for CMC (40.76 +/- 2.22 vs 31.29 +/- 1.87, mean + / -SE) and for TF (39.03 +/- 2.73 vs 29.17+/- 2.72). Male DASH scores were 12-14 points lower than female dominant hand scores in both these diagnoses and there was no differential between dominant and non-dominant within males. Subgroup analysis confirmed that for CTS, female DASH scores were 8.08 +/- 3.10 points higher than males but there was no association with dominance. There was no statistical association with gender and handedness for LE or DEQ.

Conclusions: Where there is a difference between hand dominance, it appears to be present in females over males. It is not clear whether a common cause explains the lower DASH scores for males and for non-dominant hands in females.

P88. The Use of Interference Screw Augmentation of the Modified Brunelli Technique for Scapholunate Dissociation

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Introduction: The modified Brunelli reconstruction of the scapholunate (SL) ligament has excellent biomechanical results, but some patients still experience long-term widening of the SL interval. Anatomic reconstruction with interference screw fixation has improved results in reconstruction of ligaments of the knee and ankle, and this theory could apply to SL reconstruction as well. As a precursor to clinical trial, we tested a new method of fixation of the flexor carpi radialis tendon autograft to both the scaphoid and lunate using tenodesis screws in a cadaveric model. The objective was to assess the correction for scapholunate (SL) dissociation under physiologic and supraphysiologic loads. We hypothesized that the anatomic reconstruction with interference screw augmentation would be of equal strength to the modified Brunelli technique.

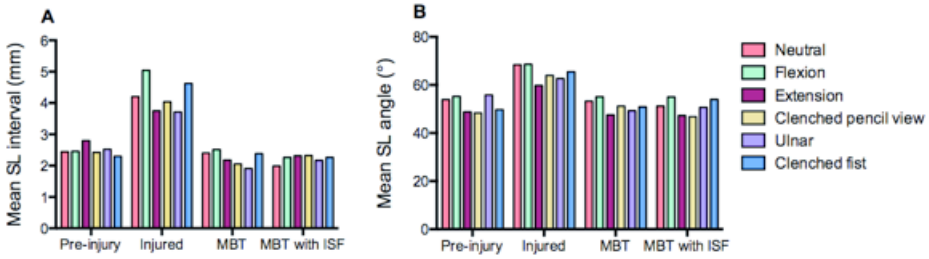
Methods: Ten fresh-frozen cadaveric wrists were used. Posteroanterior and lateral radiographs of the native uninjured wrist were taken to measure the SL interval and SL angle in the following positions using an applied load of 89N: neutral, flexion, extension, the clenched pencil view, ulnar deviation, and the clenched fist position. Radiographic measurements were repeated with the scapholunate interval sectioned, after the modified Brunelli tenodesis, and after the augmented Brunelli tenodesis with interference screw fixation.

Results: Statistics were reviewed with a statistician and significant differences between any of the 4 different conditions were evaluated using a two-way analysis of variance (ANOVA) followed by Tukey's multiple comparisons at the 0.05 significance level. SL ligament sectioning increased the SL interval and SL angle in all wrist positions to create the SL injury model. The modified Brunelli tenodesis and the interference screw technique provided similar restoration of the normal SL interval and SL angle (Fig. 1). Neither reconstruction showed significant differences in either the SL interval or SL angle when compared to the pre-injury wrist in any wrist position. Direct comparisons of the techniques showed no significant differences in either the SL interval or SL angle in any wrist position.

Conclusion: The tenodesis screw reconstruction performs comparably to the modified Brunelli technique in restoration of the SL interval and angle. This technique creates the possibility of tendon-to-bone healing at the dorsal SL ligament native attachment points. Over time, this technique may be superior to previously described techniques owing to this difference.

Figure 1. (A) Mean SL interval (mm). (B) Mean SL angle (°).

MBT: modified Brunelli tenodesis; MBT with ISF: modified Brunelli tenodesis with interference screw fixation.



P89. WITHDRAWN

P90. Pitfalls of Modified Step-cut Osteotomy for Correction of Post-traumatic Cubitus Varus Deformity

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Introduction A variety of osteotomies for posttraumatic cubitus varus have been proposed. However, additional correction of internal rotation is not needed because it is difficult to maintain the corrected position and acquire the planned carrying angle because of the small contact area (Takagi et al., JBJS-A 2010). Hence, we choose the modified step-cut osteotomy, which correct only in the coronal plane. We attempted to address the pitfalls of the osteotomy from our long-term results.

Materials & Methods We treated nineteen elbows (mean age, 7.4 years) with posttraumatic varus deformity who underwent modified step-cut osteotomies at our institutes. We investigated the clinical evaluation included assessment of the humerus-elbow-wrist angle (HEWA) and measurement of the active range of motion before surgery and at the time of the final follow-up (average follow-up period, 26.7 months). We also assessed complications after surgery.

Results Ranges of motion (ROM) were 15.0°/124.7° (extension/flexion) before surgery and 6.8°/132.6° at the final follow-up. HEWAs were -21.1° and 4.2°. There was a loss of 4.6° from immediately after the surgery to the time of the final follow-up. Eight patients had been fixed in hyperextension (≥ 5°). One patient had a transient radial nerve palsy. No patient had a postoperative infection and a late complication such as ulnar nerve palsy, posterolateral rotatory instability, or refracture.

Conclusions The modified step-cut osteotomy was developed to reduce the cosmetic problem associated with a conventional step-cut osteotomy, which had a problem of prominence of the lateral condyle. We can take care in placing the Kirschner wires for fixation of the osteotomy site. In some cases, we can insert the bone chips on the dorsal side using the excised bone for avoiding the fixation in hyperextension. We need to remove retractors occasionally to avoid radial nerve stretch and subsequent radial nerve palsy.

P91. Adipose Versus Fascial Sling for Anterior Subcutaneous Transposition of the Ulnar Nerve

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Hypothesis: We hypothesize that use of a vascularised adipose flap to secure an anteriorly transposed ulnar nerve can help reduce nerve adherence and may enhance nerve recovery. The purpose of our study was to retrospectively investigate the long-term outcomes of ulnar nerve anterior subcutaneous transposition secured with an adipose versus fascial sling.

Methods: A retrospective cohort study was performed with 33 patients. Seventeen patients received an anterior transposition of the ulnar nerve with a fascial sling versus sixteen patients whose anteriorly transposed nerve was secured in a pedicled adipofascial flap. Patients' charts were reviewed and were subsequently asked to return to clinic to undergo a physical examination and answer questionnaires (Disabilities of the Arm, Shoulder, and Hand questionnaire, visual analogue scales, and Modified Bishop's Rating Scale).

Results*:* No significant difference was found between adipose and fascial sling groups for DASH (p=.673), VAS pain (p=.413) and VAS weakness (p=0.362) scores. The physical examination showed no significant difference between operated and non-operated extremities for flexion/extension arc (p=0.668), supination/pronation arc (p=0.226) in both groups. Lateral pinch strength and grip strength were likewise comparable. Based on the Bishop's Rating Scale, the adipose flap group reported excellent results in 62% of patients and 38% good outcomes versus 59% and 41% in the fascial sling group, respectively.

Summary Points:

- The contributions of perineural scarring following anterior transposition of the ulnar on post-operative recurrent ulnar neuropathy have been well documented.
- We believe that the pedicled adipofascial flap provides benefits to the peripheral nerve that include a scar-tissue barrier and optimal milieu for vascular regeneration.
- All patients in our study experienced symptomatic improvement and there were no significant differences in patient objective outcomes when comparing the two groups.
- The subjective scale reported slightly better results in the adipose flap group, although not significant.
- These findings support the efficacy of an adipose flap in securing the anteriorly transposed nerve versus a current standard of care.

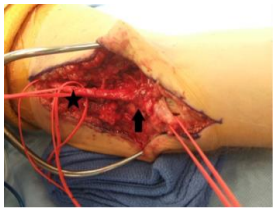
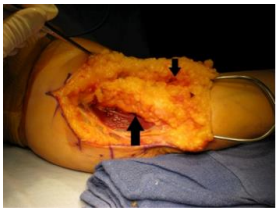
1:  2: 

Figure 1: The ulnar nerve is constricted by a scarred fascial sling four months after primary procedure. Asterix: ulnar nerve. Arrow: scarification around the ulnar nerve. **Figure 2**: Ulnar nerve (right arrow) wrapped in adipose tissue (left arrow). **LEVEL OF EVIDENCE:** Level III

P92. Osteointegrated Finger Prosthesis Using a Tripod Titanium Miniplate

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Purpose: Traumatic finger amputation can result in serious impairment for hand functionality. When autologous tissue is not an option, prosthetic reconstruction can be considered. We describe a new technique, the tripod titanium osteointegrated mini-plate for traumatic finger amputations.

Materials and Methods: This is a retrospective review, single surgeon experience, of patients who had traumatic finger(s) amputation(s) who further underwent reconstruction with this new technique. This is a two stage procedure in which the distal phalangeal stump is revised and a tripod titanium mini-plate is anchored and secured in 3 axis with mini-screws and covered with adjacent soft tissue flaps just leaving a small magnetic tip outside of the stump (Figure 1). On a second stage, a magnetic finger silicone prosthesis is attached the tip of the tripod mini-plate (Figure 2). Demographics, occupation, mechanism of injury, number of amputated fingers, level of amputation and complications were recorded and analyzed.

Results: 7 patients were included in the study, 5 males and 2 females, for a total of 10 reconstructed digits. The average age was 29 years (20-40), majority were university students and military personnel. Avulsion was the most common mechanism of injury. The majority of patients (n=5) had a single digit amputation (index finger the most common). Two patients had multiple amputated digits (#2,3,4) and (#2,3) respectively. Regarding the level of amputation, in 4 patients was at the proximal phalanx and in 3 patients was at the middle phalanx. Average follow-up was 24.4 months (14-40). Regarding complications, 1 patient presented with an episode of cellulitis which resolved with antibiotics. However, 2 patients required removal of the prosthesis due to chronic infection and bone resorption respectively.

Conclusion: The concept of osteointegrated implants has been applied to reconstruct other parts of the body. Due to multiple factors and when autologous finger reconstruction is not an option, other techniques for reconstruction should be considered. Even though this is a small case series, we obtained reasonable finger functionality and aesthetic outcome using this new technique. However, appropriate selection of patients is essential in order to reduce complications and improve final results.

Figure 1

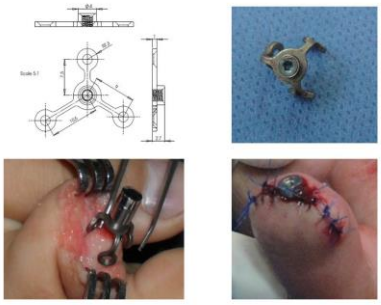

Figure 2

P93. DASH Score is a Significant Predictor of Surgical Intervention in Patients with Basal Joint Arthritis: A Prospective Review of 120 Patients

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Introduction: Radiographic classification, patient-reported symptoms, thumb range-of-motion, and grip/pinch strength are data points commonly used in the evaluation of basal joint arthritis (BJA) severity. We sought to determine which of these factors might be superior in predicting which patients will eventually undergo surgery for BJA.

Materials & Methods: The Basal Joint Arthritis Multicenter (BJAM) study is an IRB approved, prospectively gathered registry database of BJA patients, documenting Disabilities of the Arm, Shoulder, and Hand (DASH) score, radiographic grade based on Eaton classification, and physical exam measurements of range-of-motion and strength. From this database, 120 unique patients with 197 separate encounters were identified for analysis. For patients with multiple encounters, the encounter prior to surgery was used. Right and left-sided data were considered separate encounters. Patients with available radiographs were re-reviewed and graded based on Eaton classification by two fellowship-trained hand surgeons. Radiographic classification, MCP range-of-motion, radial abduction, palmar abduction, grip, key pinch, tip pinch and DASH score were analyzed with surgical intervention as the primary outcome.

Results: Thirty-three (28%) patients were male and 85 were female (72%) with an average age of 70 years (43-90 years). The nature of "missingness" was determined using Little's Test ($p=0.055$) signifying that the data was missing completely at random. We then proceeded through 20 imputations utilizing predictive mean matching. Backward elimination was used to select variables of age, MCP extension, DASH score and Eaton Classification. A multiple logistic regression model was created for these selected variables. There was a strong statistically significant association of DASH score with surgical intervention. For every unit increase in DASH score, the odds of undergoing surgery increase by a factor of 1.004 ($p=0.029$, 95% CI = (0.00, 0.007)). A ROC curve was created to determine the optimal DASH cutoff value that best predicted surgery. Cutoff values at various percentages were tried to give maximum area under the curve (AUC). The maximum AUC occurred at the 50^{th}-percentile cutoff, corresponding to a DASH score of 27.25.

Conclusion: An increase in DASH score is significantly associated with patients undergoing surgery for basal joint arthritis. A DASH cutoff value of 27.25 or greater seems to best predict those patients who had surgery and thus may be a useful tool for determining which future patients may require surgical intervention. As the database continues to mature, the relationship of surgery to this DASH score cutoff, as well as trends in DASH, may be further assessed.

P94. Assessing the Complications and Effectiveness of Open Carpal Tunnel Release in a Tertiary Care Centre in a Developing Country

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Introduction: Open surgical release for carpal tunnel syndrome is not devoid of complications and its quantitative assessment with the Boston questionnaire in a developing country had not been conducted, where, lack of facilities and surgical technique can influence the outcome.

Presentation of Cases: This was a prospective study in which all cases of carpal tunnel syndrome under-going open release between June 2007 and June 2012 and who returned for follow up were included. Each patient was requested to fill out the Boston questionnaire twice both pre and post op at 3 months. All complications were recorded as well as bio-data of patients and co morbidities. Follow up was at 2 weeks and at 3 months. Those reporting complications at 3 months were further followed up until 6 months. 373 patients were included in the study. Twenty four patients developed complications. Of these, 12 experienced pain resulting from reflex sympathetic dystrophy. Three patients developed wound dehiscence, 2 cases acquired infections, 4 patients developed immediate post-operative haemorrhage and in3 patients there was late recurrence of median nerve compression. The symptom severity score pre-operatively was 3.30 (±0.60) and it improved to 1.65 (±0.75) post-operatively indicating a significant change ($p < 0.0001$). The preoperative functional status score was 2.58 (±0.75) and post-op it became 1.60 (±0.80) again implying a good improvement with an effect size of 1.3.

Discussion: All of the complications produced were well managed. The complication incidence was low. The open release procedure produced good improvement in hand function and in decreasing the symptom severity.

Conclusion: Conducting open release for carpal tunnel syndrome in a tertiary referral centre in a developing country offers a good outcome.

P95. The Effect of Barbed Suture Tendon Repair on Work of Flexion

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Introduction: The strength and gap-resistance of knotless flexor tendon repair techniques using barbed suture have been examined in multiple studies. However, the effect of knotless barbed suture repairs on work of flexion has not been studied. Concern exists that the presence of suture barbs may impair gliding within the flexor tendon sheath, and result in increased work of flexion. The purpose of this study is to compare the work of flexion, ultimate strength, and gap-resistance of a conventional 4-strand tendon repair with a knotless barbed-suture 4-strand tendon repair.

Materials & Methods: Tendon repairs were performed on 16 flexor digitorum profundus tendons using one of two repair techniques; a four-strand double Kessler repair or a similar but knotless four-strand repair with unidirectional barbed suture. Work of flexion, gap resistance during cyclical loading, and ultimate strength of both techniques were compared.

Results: The mean maximum load and gap resistance of the traditional and barbed suture repair groups were not significantly different. The work of flexion was significantly higher for the barbed suture repair group when compared to the traditional repair group.

Conclusions: Although repair strength and gap-resistance characteristics were similar for the conventional and knotless barbed-suture repairs, the higher work of flexion in the barbed-suture group suggests the possibility that barbed suture may negatively affect tendon gliding within the flexor tendon sheath and has the potential to result in increased tendon repair failures.

P96. The Effects of Insurance and Access to Healthcare on Outcome in Zone 2 Injuries

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Purpose: This purpose of this study is to determine if insurance type or access to healthcare demonstrated by distance from a level 1 trauma center will lead to worse outcomes amongst zone 2 injuries of the hand. We hypothesized that uninsured patients would have worse outcomes.

Method: A retrospective review of all patients between 6/2012 to 12/2013 treated for Zone 2 injuries of the hand was performed. Patients were identified by CPT code. Demographics were recorded including age, race, address, type of insurance coverage, co-morbidities, hospital admission and discharge, distance from hospital and other associated injuries. Patients were either classified as to being self-pay or having some type of insurance. Access to care was based on distance to the treating hospital. Outcomes were based on complications and the patient's final range of motion of the injured finger.

Results: A total of 25 patients were identified. 10 (36%) patients had either governmental or commercial insurance while 15 (54%) patients were classified as self-pay. There was a statistical significance between length of follow-up based on type of insurance ($p=0.0288$). Patients who did not have insurance were much more likely to be lost to follow-up ($OR=0.083$). There was no correlation with distance to the hospital and being lost to follow-up ($p=0.79$). There was no relationship between complication rates and type of insurance ($p=0.32$). Due to poor follow-up, no correlation to final ROM could be obtained.

Conclusions: Patients without insurance are far less likely to continue with their post-op care than those who have insurance. This could lead to less adequate results. To date, no other study has evaluated insurance status in the hand population.

P97. Anatomic Restraints of the Extensor Carpi Ulnaris Tendon on the Distal Ulna

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Introduction: The extensor carpi ulnaris (ECU) tendon has a distinct subsheath at the distal ulna. Symptomatic subsheath tears and subluxation of the ECU tendon are common in racquet and ball-stick athletes. It is unclear what role variability in patient's own anatomy plays in developing symptomatic subluxation.

Methods: Twelve fresh frozen upper extremities were utilized for anatomic dissection. The ECU subsheath was exposed from under the retinaculum. A probe inserted into the tendon sheath delineated the isthmus of the subsheath proximally and distally, and the borders were marked. Fluoroscopy was then used to identify and mark the tip of the ulnar styloid, the distal ulnar joint surface, and the proximal extent of the distal radio-ulnar joint (DRUJ). All measurements were made with digital calipers.

Subluxation of the tendon was then assessed with and without an intact subsheath in six specimens. A flexible radio-opaque marker was placed in the center of the tendon. The travel of the tendon from a known point was measured in pronation through supination and flexion before and after sectioning of the subsheath. A MicroScribe (Raleigh, NC) was then used to define the bony anatomy of the ECU groove of the ulna.

Results: The ECU subsheath is 8.9 mm (standard deviation 0.8 mm) wide proximally and 9.0 mm (1.2 mm) distally. The radial border is 11.3 mm (2.8 mm) and ulnar border is 11.0 mm (3.0 mm). The distal ulnar insertion is 0.5 mm (0.8 mm) proximal to the tip of the styloid, and stretches 10.2 mm (2.7 mm) proximally. From maximum pronation to maximum supination and flexion the ECU tendon traveled 3.32 mm (4.24) medially when the subsheath was intact and 5.42 mm (5.0 mm) after sectioning. The maximum depth of the ulnar groove was 2.5 mm (range 1.59 to 3.56mm). In paired correlation analysis there was no significant association between changes in ECU subluxation and the depth of the ECU groove (Spearman rho coefficient 0.25, p=0.6).

Conclusion: The ECU subsheath is roughly 1 cm square stretching proximally from the ulnar styloid. ECU groove depth is not a significant independent predictor of tendon subluxation.

P98. A clinically weighted approach to outcome assessment in radial polydactyly

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Background: All available outcome assessment systems for radial polydactyly are based on expert opinion, rather than on clinical data. The aim of this study was to develop a clinically weighted outcome assessment system, based on long-term follow-up data from two large European congenital hand clinics.

Methods: In a multicenter cross-sectional study, 121 patients with radial polydactyly types II, IV and VII were assessed by at least two observers. Our alternative assessment system was developed from the original assessment system of the Japanese Society for Surgery of the Hand (JSSH). We investigated how items in the JSSH system impact VAS scores for overall functional and aesthetic outcome using linear regression. Based on their impact and the distribution of the data in our sample, items of the original JSSH systems were reweighted and rescaled.

Results*:* Active flexion, scar appearance and prominence at amputation site were the main items influencing overall functional and aesthetic outcome ($\beta = 0.393$, $\beta = 0.326$, and $\beta = 0.288$ respectively). These items went from 2 to 3 points in our proposed alternative assessment system. Palmar abduction, metacarpophalangeal joint deviation and nail appearance influenced overall functional and aesthetic outcome the least ($\beta = -0.002$, $\beta = -0.104$, and $\beta = 0.070$ respectively) and were reduced to 1 point each. Interphalangeal and metacarpophalangeal joint deviation had a more significant contribution in the aesthetic outcome model.

Conclusions: Based on the results from our study, we suggest an alternative outcome assessment system for radial polydactyly, modified from the JSSH assessment system. Because our alternative system is based on clinical data and reflects the way clinicians value various aspects of outcome as determinants of overall outcome, it helps guide in future treatment of radial polydactyly and subsequent evaluation of results.

P99. Distal Peripheral Nerve Blockade for Patients Undergoing Hand Surgery

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Background. Data are limited regarding the use of peripheral nerve blockade at the level of the forearm, and most studies regard these procedures as rescue techniques for failed or incomplete blocks. The purpose of the study was to investigate patients undergoing hand surgery with distal peripheral nerve (forearm) blocks and compare them with patients having similar procedures under more proximal brachial plexus blockade. No investigations comparing peripheral nerve blockade to proximal approaches are currently reported in the literature.

Methods. Medical records were retrospectively reviewed for patients who had undergone hand surgery with a peripheral nerve block between November 2012 and October 2013. The primary outcome was the ability to provide a primary anesthetic without the need for general anesthesia or local anesthetic supplementation by the surgical team. Secondary outcome measures included narcotic administration during the block and intraoperative procedures, block performance times, and need for rescue analgesics in the post anesthesia care unit (PACU).

Results. No statistical difference in conversion rates to general anesthesia was observed between the two groups. Total opiate administration for the block and surgical procedure was lower in the forearm block group. There was no difference in block performance times or need for rescue analgesics in the PACU.

Conclusions. Forearm blocks are viable alternatives to proximal blockade and are effective as a primary anesthetic technique in patients undergoing hand surgery. Compared to the more proximal approaches, these blocks have the benefits of not causing respiratory compromise, the ability to be performed bilaterally, and may be safer in anticoagulated patients.

P100. Case Series: Volar Plate Fixation of Recalcitrant Scaphoid Nonunions with Volar Carpal Artery Vascularized Bone Graft

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Introduction: Chronic scaphoid fracture nonunion continues to present a significant treatment challenge. We hypothesize that treatment of recalcitrant nonunions with a novel combination of a volar buttress plate and a pedicle graft will lead to high union rates and good functional outcomes.

Methods: Ten patients underwent volar buttress plating with a pedicle graft based on the volar carpal artery between 11/2011 and 2/2014. All procedures were done by a single surgeon at Yale-New Haven Hospital. Inclusion criteria were based on a finding of recalcitrant scaphoid nonunion. Decision for operative treatment with a volar buttress plate varied: Four patients demonstrated radiographic evidence of AVN of the proximal pole of the scaphoid, two patients had undergone prior treatment with a scaphoid screw, and seven patients presented with either a prolonged recalcitrant nonunion or non-union with severe cystic erosion. Patients were evaluated postoperatively with plain radiographs, CT scans, range of motion clinical exams, and QuickDash scores.

Results/Conclusions: Duration of follow-up to date ranges from 4-18 months. Radiographs (in all 9 patients with follow-up) and CT scans (in 4 patients) have been performed postoperatively. Ct scans demonstrate 50% or complete union in all but 1 case. Clinically, all patients with at least 5 weeks of follow-up are non-tender at the snuffbox. All patients with at least 6 months of follow-up have returned to typical activities, and report satisfaction with the procedure, except for tolerable wrist stiffness.

Summary Points:

-For recalcitrant scaphoid nonunion, volar buttress plating with volar pedicle graft may be considered an alternative treatment

-To date, all patients undergoing this novel procedure with follow-up times of at least five weeks times have shown clinical evidence of healing

-All patients with at least six months of follow-up up attained a good functional result and show some radiographic evidence of union

-All four patients who have undergone postoperative CT scans to date have demonstrated evidence of partial or complete union

P101. Radiographic Stage Does Not Correlate with Symptom Severity in Thumb Basilar Joint Arthritis

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Introduction: Conventional wisdom has held that radiographic staging of basilar thumb arthritis does not predict patient-reported symptom severity. We hypothesize that basilar thumb arthritis radiographic stage does not correlate with validated outcome measures of symptom severity.

Methods and material: We prospectively enrolled consecutive patients who presented to a hand surgery clinic with the diagnosis of unilateral thumb basilar joint osteoarthritis. The diagnosis was based on history, physical examination, and radiographic evaluation. All patients completed self-reported disability scores, including the QuickDASH, SF-12 mental, and SF-12 physical surveys. Patients with bilateral disease, concomitant diagnoses, or unwillingness to participate were excluded. A fellowship-trained hand surgeon assigned an Eaton-Littler radiographic osteoarthritis stage for each patient. Statistical analysis was utilized to determine the correlation between radiographic stage and objective outcome measures.

Results: Fifteen men and 47 women, with an average age 62.3 years (range 32-81), were enrolled in the study Based on radiographic grade, there were 13% (n=8) stage I, 32% (n=20) stage 2, 45% (n=28) stage 3, and 10% (n=6) stage 4 (Table 1). Eaton-Littler stage did not correlate with QuickDASH (rho = -0.013), SF-12 mental (rho = 0.019) or SF-12 physical (rho=0.14). The dominant hand was involved in 40% (25) of patients. Dominant hand involvement did not affect survey results (p>0.600). Interobserver reliability for radiographic stage was found to be good to excellent.

Conclusion: The severity of radiographic disease in thumb basal joint arthritis does not correlate with degree of patient symptoms. While conventional wisdom has traditionally held a disconnect between a patient's subjective complaints and degree of radiographic severity, this is the first study to confirm this scientifically. Validated metrics that link radiographic and subjective components of thumb basal joint arthritis may improve surgical decision-making and monitoring of treatment response.

	Eaton 1	Eaton 2	Eaton 3	Eaton 4
Sample Size	8	20	28	6
Age Avereage (years)	42.0	61.9	66.7	70.4
QuickDASH Average	31.5	37.9	30.1	39.4
SF-12 Mental Average	58.3	52.0	53.5	59.1
SF-12 Physical Average	40.7	40.3	43.6	43.9

Table 1. Age and validated survey data for different radiographic stages.

Table 1. Age and validated survey data for different radiographic stages.

P102. Predicting a Safe Screw Length for Volar Plate Fixation of Distal Radius Fractures: Lunate Depth as a Marker for Distal Radius Depth

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Purpose: Extensor tendon rupture is a recognized complication of volar plate fixation of distal radius fractures. The complex bony morphology of the distal radius can render intraoperative fluoroscopic assessment of screw length and trajectory challenging. We hypothesize that the lunate depth as measured on plain radiographs can be used to predict distal radius depth radially and ulnarly, and serve as a useful reference for intraoperative screw placement in volar plate fixation of distal radius fractures.

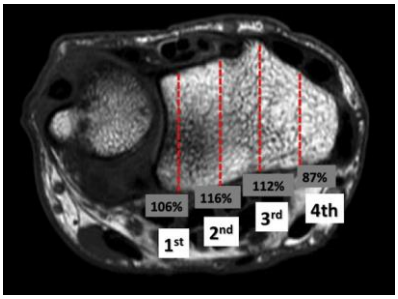
Methods: Plain radiographs and magnetic resonance imaging (MRI) of the wrists of 30 patients were reviewed. The lunate depth and the maximal depth of the distal radius were determined from plain radiographs. Depth of the distal radius, measured in quartiles, was determined from axial MRI images, and the lunate depth was obtained from sagittal MRI images. The depth of the distal radius in each quartile was then calculated related to the lunate depth.

Results: The mean depth of the lunate on plain radiographs and MRI was 17.5mm and 17.4mm, respectively (p=0.32). The depth of the distal radius from ulnar to radial was 18.4 mm, 20.2 mm, 19.4 mm, and 15.1 mm for the 1st through 4th quartiles respectively. The depth of the distal radius is the shortest radially (4th quartile), with a mean 87% of the lunate depth and longest in the 2nd quartile with a mean 116% of the lunate depth.

Discussion: The depth of the lunate as measured on plain radiographs can be used as a marker for drilling and placement of safe screw lengths during volar plate fixation of distal radius fractures. We recommend that surgeons use the lunate depth as a "ballpark" estimate for the length of their longest screw when fixing distal radius fractures with volar plate techniques to avoid extensor tendon irritation and rupture.

Figure 1. Lateral wrist radiograph showing lunate depth (A) and maximal radius depth (B).

Figure 2. Measurement location of each depth quartile moving across the distal radius ulnar-radially on axial MRI imaging.



P103. Pain Management Following Carpal Tunnel Release

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Introduction: Rodgers et al. revealed that orthopaedic surgeons routinely prescribe excess opioid analgesics following elective outpatient upper extremity surgery with a potential for diversion of leftover opioid pills. However, there is a paucity of information about patterns of pain management after hand surgery. Our aim was to investigate the pain patterns immediately after carpal tunnel release, a commonly performed outpatient hand surgical procedure, in order to evaluate the postoperative opioid analgesic needs in this patient population and to identify factors that influence postoperative pain management.

Materials & Methods: We identified 32 patients undergoing elective outpatient primary carpal tunnel release procedures in the practices of 3 hand surgeons. For patients meeting the inclusion criteria, information about their demographics, perioperative anesthesia and medication administration, postoperative opioid analgesics prescription and operative information were recorded from the hospital records. Patients were asked about their postoperative opioid analgesics consumption during the first and second postoperative visits at 1 week and 2 weeks after surgery, including the number of tablets used, use of over the counter medications, side effects, and number of days used.

Results: Of 32 patients qualified for the study, 30 agreed to participate and one was excluded due to a superficial postoperative wound infection. There were 15 males and 14 females with a mean age of 55 (range, 26-88). Among 3 surgeons, a total of 818 tablets (mean of 28 per patient) were prescribed at discharge. Only 386 (47%) of those tablets were consumed, leaving total of 432 unused tablets. In the non-VA patients, depending on the anesthesia type, patients consumed average of 1.3 to 4.4 tablets. The opioid usage was higher in the VA patients, 15 tablets on the average. The mean number of days patients consumed opioid analgesics was 3.7 (range, 0 to 14). We found that on the 11-point numeric rating scale, 62% and 86% of the patients reported only mild (0-3 out of 10) pain by 1 week and 2 weeks after surgery, respectively. The amount of opioid analgesics consumed was not influenced by patient's age or gender.

Conclusions: We found that most patients had mild pain for a short period of time after elective primary carpal tunnel release. Hence the use of postoperative pain medication after carpal tunnel surgery should be managed judiciously and a prolonged use of a large quantity of the opioid analgesics is unnecessary.

P104. Silicone Arthroplasty for Nonrheumatic Proximal Interphalangeal Joint Arthritis: Long Term Clinical Follow Up

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Background: The proximal interphalangeal joint is the third most common site of nonrheumatic arthritis in the hand affecting millions of individuals. Pain, limited joint mobility, and angular deformity due to underlying articular destruction can be disabling. Arthrodesis provides excellent pain relief and stability, but at the cost of loss of range of motion (ROM). Silicone arthroplasty was introduced as a method to relieve pain with preservation of function and ROM. We aim to report our long-term clinical outcomes and patient satisfaction with the use of these implants.

Methods: A cross-sectional review of subjects who had PIP arthroplasty for nonrheumatic arthritis was performed. Clinical assessment included range of motion, grip/pinch strength, deformity, and DASH score. Subjective evaluation of function, satisfaction, and pain relief was assessed using a patient questionnaire.

Results: 47 PIP joints (23 patients) with a mean follow up of 45 months (median 45 months) were evaluated. Trauma accounted for 22% of the arthritis. Finger distribution was MF 41%, RF 39%, IF 12%, SF 7%. Postoperative range of motion is summarized in Table 1. Average postoperative deviation was 4.8 degrees ulnar. Pinch strength average was 10.5 lbs (vs 11.8 lbs unaffected side), and grip strength was 40.3 lbs (vs 47.6 lbs unaffected side). Postoperative mean DASH score was 27.8 (0-66). As summarized in Table 2, overall satisfaction and functional ratings were high, and patients had excellent pain relief with average pain score of 2.3 (0 to 10 scale).

Table 1: Post Arthroplasty PIP Motion		
	Mean (in degrees)	Range (in degrees)
Active Extension	5	-20 to 45
Passive Extension	-3.7	-45 to 29
Active Flexion	62.6	0 to 90
Passive Flexion	70.3	20 to 100

Table 2: Patient Subjective Evaluation
87.5% responded that there joint problem was better or much better
85% were somewhat or very satisfied
92.5% would have the surgery again
85% had good or excellent pain relief
65% had 50% or greater improvement in function
47.5% had 50% or greater improvement in strength
56% saw an improvement in their deformity

Conclusion: Silicone implant arthroplasty of the PIP joint remains a common and effective surgery for the correction of symptoms due to underlying nonrheumatic arthropathy. Our study has shown that this technique provides considerable pain relieve, near normal grip/pinch strength, improved ROM/function and high satisfaction for patients in the long term.

P105. Measurement of the Radiographic Anatomy of the Small and Ring Metacarpals using Computerized Tomographic Scans

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Introduction: To date, only plain radiographic definitions of normal anatomical parameters have been described. Our study aims to describe normal anatomic measurements of small and ring metacarpals relevant to determining fracture displacement using a novel digital reconstruction technique based on raw CT image data. We hypothesize that current plain x-ray data incorrectly describes normal metacarpal anatomy in the lateral plane.

Methods: Thirty-five scans of the small and 30 scans of the ring metacarpals form the basis for this study. Using custom digital 3D image reformatting software, CT sections were reconstructed in the plane of each studied metacarpal. The 3D images were converted to sagittal and coronal weighted projections to represent lateral and posteroanterior (PA) two dimensional images that are equivalent to 'perfect orthogonal' radiographs. Using a customized image measurement program, shaft lengths, shaft- bending angle (SBA), and capital-axis angle (CAA) were measured.

Results: Our results show that CAA averaged 14 and 12 degrees in the ring and small metacarpals respectively. Apex dorsal SBA averaged 12 and 10 degrees in the ring and small metacarpals respectively. On the PA images the shafts are nearly straight. In contrast to prior reported values, we found the CAA to be less acute and the metacarpal curvature less pronounced on the lateral projection. We also demonstrated that much of the metacarpal apex dorsal bend is in the shaft itself.

Discussion: Normal anatomic parameters of metacarpals are based primarily on radiographic data, and as such are limited due to bony overlap in the lateral plane, as well as imperfect radiographic projections that are known to distort anatomical relationships. This novel method of image reconstruction eliminates metacarpal overlap and defines precise anatomical reference for metacarpals.

P106. Incidence of Recurrent Complex Regional Pain Syndrome in Patients who Incur Subsequent Extremity Surgery or Trauma

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Introduction: Complex regional pain syndrome (CRPS) is a rare but challenging condition for the upper extremity surgeon, which encompasses pain associated with a spectrum of neuropathic, vasomotor and sudomotor symptoms, typically following trauma or surgery. Population-based studies suggest that it is very rare with an incidence rate of approximately 20 per 100,000.[1] Rates of occurrence after common upper extremity injuries and procedures have also been studied, with distal radius fractures and carpal tunnel releases associated with a CRPS occurrence rates of 1[2] and 2.1-5%,[3] respectively.

Methods: An IRB-approved, retrospective chart review was conducted of patients presenting to the Wake Forest Baptist Medical Center Department of Orthopaedic Surgery with CRPS between November 2012 and June 2014, as identified by using ICD-9/CPT codes for complex regional pain syndrome, algoneurodystrophy, reflex sympathetic dystrophy and causalgia. The age, sex, etiology of initial CRPS diagnosis, treatment modalities utilized and whether CRPS was again diagnosed in association with subsequent extremity surgery or injury were assessed.

Results: The review identified 130 patients, ages 8-84, who carried a diagnosis of CRPS in at least one upper or lower extremity. The majority of these patients had an identifiable traumatic or surgical insult prior to developing symptoms, but a few patients had no identifiable etiology. These individuals were more likely to subsequently develop CRPS in another extremity than those with a known causative event. While few patients had documentation of a subsequent injury or surgery on another extremity on record, a significant portion of patients did go on to develop CRPS in that extremity.

Conclusion: While recurrent CRPS in a second extremity is rare, this study does suggest that CRPS occurs more frequently in those with a known history of the condition compared to previously established rates among both the general population and among individuals with a known traumatic or surgical event.

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P107. 3-Dimensional Computer Modeling for Correction of Pediatric Forearm Deformities

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Background: Post-traumatic and congenital forearm deformities in children can be difficult to appreciate in all planes. In cases of distal radioulnar joint (DRUJ) instability and loss of forearm rotation, surgical correction is challenging. Advances in 3-dimensional printing allow creation of custom guides at a reasonable cost, enabling more precise correction.

Methods: A total of 8 children with deformity of the forearm had corrective osteotomies performed using preoperative 3-dimensional computer modeling and patient specific surgical guides. Surgicase software (Materialise, Plymouth, MI) was used for 3-dimensional planning of the corrective osteotomy, by superimposing a mirror image of the unaffected side as a template. Based upon this planning, patient specific surgical guides were manufactured. Radiographic deformity and clinical measures were assessed both pre- and post-operatively.

Results: The clinical and radiographic results of 8 patients were evaluated. Six patients had a diagnosis of fracture malunion. The remaining 2 patients had diagnoses of multiple hereditary exostoses and Madelung's deformity. Five patients underwent osteotomies of both the radius and ulna, 2 had double osteotomies of the radius, and 1 had a single osteotomy of the radius with a radial head replacement. All osteotomies went on to union, at an average time of 3 months. No patient lost range of motion. Six of the 8 patients had limited forearm rotation preoperatively, and all demonstrated improvement after the surgery. For these patients, preoperative pronation averaged 30 degrees (range 10 to 60 degrees) and preoperative supination averaged 67 degrees (range 45 to 80 degrees). Postoperatively, pronation improved to 30 degrees (range 20 to 90 degrees), and supination improved to 74 degrees (range 65 to 90 degrees). Four patients had distal radioulnar instability preoperatively, all of which normalized following surgery. There were 2 complications: one hypertrophic scar and one transient sensory loss in the superficial radial distribution.

Conclusions: This case series demonstrates that 3-dimensional computer modeling permits complex and multiple osteotomies to be done safely to achieve deformity correction in children. Limitations in forearm rotation and distal radioulnar malalignment due to post-traumatic and congenital etiologies can be improved using this technique.

P108. Hand Surgery Procedures with the Highest 30-day Complication rates: A Retrospective Analysis of 9969 Patients Using the 2006-2011 ACS-NSQIP Datasets

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Introduction: The 30-day complication risks of hand surgery have not previously been defined or quantified. While assumed to be low, it is imperative to formally define these risks in order to counsel patients and minimize complications. The ACS-NSQIP database compiles surgical data for the purpose of understanding patient demographics, comorbidities, and surgical variables in the context of 30-day complications. In this study, we isolated 9969 patients who underwent hand surgery from the ACS-NSQIP database from 2006-2011 and evaluated the 30-day complication rates of patients by surgical procedure.

Methods: ACS-NSQIP data from 2006 to 2011 was compiled into a single document and sorted by CPT code. 293 hand-specific CPT codes were queried, and 204 were identified in the ACS-NSQIP database. CPT codes were grouped into 13 clinically relevant categories, and complication rates were determined for both single and multiple CPTs. The individual CPTs that resulted in the highest complication rates and/or highest numbers of complications were identified. Statistical analysis was used to evaluate the significance of patient demographics, comorbidities, and complications incurred with respect to each procedure.

Results: The overall rate of 30-day postoperative complications in hand surgery was approximately 2.7%. Amputations and emergent decompressions had the highest 30 day complication rates, while fractures and osteotomies had the lowest. 81 individual CPTs had at least one complication. The individual CPTs with the highest rates of complications were flexor/extensor compartment decompression (CPT: 25025; 55%), disarticulation (25920; 44%), nonviable muscle decompression 25012; 44%), and brachial artery decompression (24495; 36%). All were statistically significant ($p<0.0001$). The CPTs with the greatest number of complications were flexor/extensor compartment decompression (CPT 25020; 16 complications), interposition arthroplasty (25447; 13 complications), open intra-articular distal radial fracture (25609; 13 complications), and ganglion excision (25111; 12 complications).

Conclusions: Hand surgery has been associated with low complication rates. However, through analyzing the ACS-NSQIP database, we have quantified these risks, and identified procedures and procedure types with the highest rates of 30-day complications. Amputations and emergent decompressions had the highest 30 day complication rates, while fractures and osteotomies had the lowest. By identifying these procedures with higher complications rates, and studying patient characteristics and complications associated with each, efforts to reduce morbidity can be focused where they will have the greatest impact.

P109. Two- Versus Three-Screw Fixation of Long Oblique Proximal Phalanx Fractures of the Hand: a Biomechanical Cadaver Study

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Purpose: Interfragmental compression screw fixation is a favored management option for long oblique and spiral fractures of the proximal phalanx. Lag screws offer stability sufficient for early motion protocols with little or no profile. While there is no formal rating, the A.O. recommends using 3 screws instead of 2 if there is enough space. We feel strongly that the third screw is unnecessary.

Methods: Cadaveric index, middle, and ring fingers of 9 hands were experimentally osteotomized. 5 fingers were assigned to a control group with no fixation, and 22 were fixated with 2- or 3-lag screws. The fingers were fitted with a differential variable reluctance transducer that measured maximum interfragmental displacement while the fingers were subjected to 2000 full flexion and extension cycles. ANOVA and Equivalence tests were performed to determine statistical significance and clinical adequacy.

Results: ANOVA revealed a significant difference between the control group (n=5, 2.58 ± 1.65mm) and both the 2-screw group (n=11, 242 ± 242mm) and 3-screw group (n=10, 247 ± 210mm). The 2- and 3-screw groups were not significantly different. The two groups were statistically equivalent (equivalence limit = 500mm) with a power of 90%.

Conclusions: Biomechanical stability did not differ in experimentally osteotomized cadaver hands treated with two screws versus three. There is no evidence in the literature that using three screws confers superior outcomes. Because a third screw costs time, money, and the potential for soft tissue injury, we encourage hand surgeons to routinely utilize two screws in the management of long oblique proximal phalangeal fractures, even when three screws will fit.

P110. Long Term Results of Wrist Hemiarthroplasty for Wrist Arthritis

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Introduction: Classically end stage wrist arthritis was treated by total wrist fusion until the advent of motion sparing procedures. Proximal row carpectomy (PRC) was the first of these, described by Stamm in 1944. Subsequently the four corner fusion with scaphoid excision (SLAC procedure) was described by Watson and Ballet in 1984. Each of these presented a motion preserving option for the arthritic wrist considering fusion. Even more recently total wrist arthroplasty (TWA) and wrist hemiarthroplasty have emerged as options. Wrist hemi arthroplasty is technically easy to perform with advantages of limited bone resection as compared to PRC, and no risk of nonunion seen in wrist fusion and SLAC procedure. It also allows for conversion to TWA or wrist fusion as a salvage procedure in the case of failure. Given the relative infancy of wrist hemiarthroplasty in clinical practice there is limited data on patient outcomes especially with significant follow up.

Materials and Methods: Eleven patients were treated with wrist reconstructive hemiarthroplasty (BIOMET Maestro). Indications included one patient with scaphoid nonunion advanced collapse (SNAC), nine patients with scapholunate advanced collapse (SLAC), and one patient with capitolunate arthritis. Average age was 63 years, average follow up was 4 years. Objective parameters included DASH, grip strength, range of motion (ROM). Implant failure defined by necessity of revision procedure.

Results: DASH scores initially improved postoperatively (55.7 vs. 58.3) but were not stastically significant. Grip strength was 60% of contralateral side. Postoperative ROM at six months was flexion 40.3 degrees, extension 39.3, supination 87.0, pronation 77.8, radial deviation 14.5, ulnar deviation 13.8. A 36% failure rate was observed. Complications included failure with conversion to TWA (2) or wrist fusion (2) secondary to development of ulnar sided wrist pain.

Conclusions: Despite promising early results, wrist hemiarthroplasty in our series had a significant failure rate. In each case of failure the patient developed ulnar sided wrist pain. It is believed that this is due to increased forces on the lunate facet caused by articulation with the metal implant. This likely represents a combination of inappropriate material and poor geometric fit. Future developments may include adjusting implant geometry to be more similar to the native lunate or possibly the capitate given the success of PRC. Also, alternative biomaterials (ie pyrocarbon) may be investigated for use. In the presence of more reliable procedures, wrist hemiarthroplasty is not indicated in its current incarnation.

P111. Acellular Dermal Matrices for Tendon Sheath Reconstruction: A Novel Method for Pulley Reconstruction and Adhesion Prevention

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Background: Tendon and pulley reconstruction after tenolysis is a complex task often complicated by adhesion formation and delayed range of motion. Various autologous and synthetic materials have been described for pulley and sheath reconstruction with limited success. Ideally, materials used for pulley reconstruction should be biocompatible, strong enough for early motion and adequately smooth for tendon gliding. Basic science literature suggests that the epidermal surface of acellular dermal matrices prevent adhesion formation and support migration and proliferation of tendon progenitor cells. Recent rabbit models reported successful A2 pulley reconstruction with acellular dermal matrices with no foreign body reactions and no differences in tendon excursion and work of flexion versus controls. The purpose of this case series is to describe a novel method of using acellular dermal matrices for flexor tendon sheath and pulley reconstruction after tenolysis with the goal of preventing adhesion formation and allowing earlier range of motion.

Methods: From 2012 to 2014 the senior author reconstructed a total of seven zone 2 pulleys in three patients using acellular dermal matrix (Flex HD, Ethicon). Patient demographic, pre-operative, operative and post-operative data were examined.

Results: Two of the three patients had suffered crush/laceration injuries in the past and had previously undergone bone and tendon repair, resulting in motion and strength limiting contractures. Patient 1, a 44 year-old man with scarring, rupture and tissue loss of the A2 and A4 pulleys of the fourth and fifth digits (Figure 1) had the pulleys reconstructed with Flex HD anchored subperiostially (Figure 2). The same technique was used to reconstruct Patient 2, a 20 year-old female with extensive A2 scarring and rupture. Patient 3 sustained a laceration of the thumb A2 pulley, radial digital nerve and flexor tendon, which were all reconstructed acutely. (Figures 3 and 4). There were no infections or foreign body reactions. All patients began early active therapy at 1 to 2 weeks post-operatively. Post-operatively, all patients noted significantly improved range of motion and strength, which was sustained over the length of follow up (two months to one year).

Conclusion: In theory, the use of acellular dermal matrices in tendon sheath and pulley reconstruction allows for biologic incorporation and decreased adhesion formation. These advantages allow for earlier range of motion and better functional outcomes without donor site morbidity. Our case series demonstrates that acellular dermal matrices are a viable option for tendon sheath and pulley reconstruction after tenolysis.

P112. Treatment of Proximal Pole Scaphoid Nonunion with Capsular-Based Vascularized Distal Radius Graft

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Introduction: Treatment of proximal pole scaphoid nonunion with avascular necrosis is a challenging issue. We reviewed the results of 53 patients with proximal pole scaphoid nonunion, 41 with avascular necrosis, treated with a capsular-based vascularized distal radius graft.

Materials & Methods: Thirty-nine male and fourteen female with symptomatic nonunion at the proximal pole of the scaphoid were included in this study. Mean patient age was 28 years (range, 19-43). The vascularized bone graft was harvested from the distal aspect of the dorsal radius and was attached to a capsular flap of the dorsal wrist capsule. The graft was vascularized by the artery of the fourth extensor compartment. After fixation of the scaphoid with a Herbert screw, the graft was inserted press-fit into a dorsal trough across the nonunion site. Supplementary fixation of the graft with a micro suture anchor into the scaphoid was used in 34 patients. At follow-up each patient was evaluated with physical and radiographic examination.

Results: At a mean time of 13.6 weeks (range, 6-24) after surgery, solid union was achieved in 46 of 53 patients (87%). Six patients had persistent non-union and one fibrous union as determined by CT scan. Forty of the patients with solid bone union were completely pain free and six complained of slight pain with strenuous activities. Wrist flexion and extension were improved postoperatively. Grip strength was improved significantly by a mean of 66%. The mean modified Mayo wrist score significantly improved from 43 to 84. No arthritic changes were noted at the dorsal ridge of the radius. No donor site morbidity was observed.

Conclusions: The capsular-based vascularized distal radius graft is a simple technique that eliminates the need for dissection of small caliber pedicle or microsurgical anastomoses. Results of the use of this graft for proximal pole scaphoid nonunions compare favorably to those of pedicled or free vascularized grafts.

P113. A Simple Technique for a Common Problem

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Introduction: Digital Mucous cyst is a common pathology seen daily by hand surgeons. Non-operative treatments have been recommended in the past; however, high recurrence rates have lead to a prominence of surgical interventions. Studies show recurrence rates between 36% to 68% for various conservative options. The purpose of this study is to compare the recurrence rate of a conservative treatment for mucus cyst with those reported in previous literature.

Materials & Methods: The conservative technique used in this study consists of a local block around the cyst with Lidocaine 1% without epinephrine. Once numb, a 0.5ml kenalog injection is apply to the DIP joint and cyst. The cyst is drained with multiple punctures using a 27 G needle. Silver nitrate cauterizes the cyst wall. A DIP aluminum splint is used for 2 weeks. Enrollment is reserved for patients seen for first time with mucus cyst pathology treated with this conservative technique. Patients that received other conservative treatments before to our consult or surgical treatment where excluded. Sixteen patients meet the inclusion criteria giving a total of 19 mucous cysts treated with this technique. The maximum follow up was 9 months.

Results: Average age was 64 years with a female prevalence of 62% for all the cases. The index and ring were the most commonly affected fingers. Associated osteoarthritis was found in 79% of cases. Onichodistrophy was present in 15.7% off cases. One patient (5.2% of cases) had a superficial infection that resolved with antibiotics. Another patient had delay wound healing of the cyst that resolve by secondary healing. Recurrence rate was 10.5 %. Average time for recurrence was 2.5 months post treatment. Preliminary analysis consisting of a two sample t test, showed a significantly lower recurrence rate using this conservative method compared to others reported in literature. Cost when treated with this technique is 3.29% if compared to a surgical treatment that involves cyst excision, joint debridement and a local flap for closure (only physician fees).

Conclusions: Digital mucous cyst is a common pathology seen by hand surgeons. High recurrance rates with conservative treatments ledt to a surgical approach. Conservative treatment, consisting of steroid injection of the cyst and joint, multiple punctures of the cyst, and cauterization of the cyst walls with silver nitrate has show in a preliminary analysis less recurrance than other reported conservative techniques.

P114. Biomechanical Evaluation of a Tendon Graft Anchor Basal Joint Suspensionplasty Versus an Abductor Pollicis Longus Suspensionplasty

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Introduction: Many surgical techniques have been described for reconstruction of the arthritic basal joint of the thumb. Despite promising results in the literature, concerns regarding the durability of hematoma distraction arthroplasty remain. The majority of hand surgeons nationwide still perform ligament reconstructions (Wolf, et al). Ligament reconstruction may have advantages over HDA and pin fixation in obviating pin fixation, allowing earlier range of motion and limiting future subsidence. We have developed a novel ligament reconstruction technique designed with the intent of accomplishing these goals.

Methods: Six matched pairs of cadaveric forearms were randomized into one of two groups. One group underwent an abductor pollicis longus suspensionplasty as described by Diao et al. and the other underwent the new technique using a tendon graft anchor placed into the base of the 2nd metacarpal with a two-tailed palmaris tendon graft passed through the base of the 1stmetacarpal and secured with an interference screw. The specimens were then loaded onto a motorized platform that simulated active pinch as previously described by Zlotolow et al. The trapezial space was measured using graduated feeler gauges at 0.5 mm increments. Measurements were taken prior to applying load across the basal joint, then after 1000, 2000, and 5000 cycles (Table 1). Statistical analysis was performed using a matched t test comparing the subsidence between matched pairs of reconstructions in the interval between the unloaded state and after 5000 cycles.

Results: After 5000 cycles, there was a statistically significant amount of subsidence between the two reconstruction methods ($p=0.02$) when compared to the unloaded state with the established technique having a mean subsidence of 7.8 mm and the new technique a subsidence of 5.5 mm.

Discussion: Reconstructing the volar ligament of the basal joint after trapeziectomy with a tendon graft secured by an anchor into the 2nd metacarpal base rather than a tendon weave resulted in less subsidence after a simulated early motion protocol, although the difference was only 2.3 mm. None of the reconstructions developed contact between the 1st metacarpal and the scaphoid. The results of this study show promise that the new technique may be better than the more traditional suspensionplasty at resisting 1st metacarpal subsidence. Also, based on these results, stout fixation at both ends of the interposed graft within bone may allow earlier range of motion, thereby potentially decreasing recovery time in these patients.

P115. Relevant Anatomy of the Insertion Site for Conventus Distal Radius System

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Introduction: The Conventus Distal Radial Implant is a fixation device that is inserted into the medullary canal of the radius from its radial aspect. We identified the anatomy of this insertion site as it relates to the radial sensory nerve (RSN) and tendons.

Materials/Methods: We utilized ten fresh frozen cadavers. With the aid of fluoroscopy, we introduced a 1.1mm target k-wire and Conventus template as per manufacturer's guidelines. We then utilized a large access guide to mark the insertion site. Dissection was carried down to the level of the RSN. We attempted to leave the structures in their normal anatomic location. We again introduced the access guide and marked the potential insertion for the side-cut drill. This point was measured in relationship to the RSN, BR, and distance from RS tip. These measurements were then repeated with the small access guide.

Results: The large access guide landed on the RSN in 6/10 cadavers, landed volar to the RSN in 4/10. When volar, the distance to the RSN averaged 3mm. The distance from the tip of the radial styloid (RS) to the insertion site of the large access guide averaged 46.2mm.

The small access guide landed on the RSN in 2/10 cadavers, landed volar to the RSN in 4/10, and landed between the RSN bifurcation in 4/10. When volar, the distance to the RSN averaged 2mm. When RSN bifurcated, the distance from the small access guide to the dorsal branch averaged 4mm and the distance to the volar branch averaged 3mm. The distance from the tip of the radial styloid (RS) to the insertion site of the small access guide averaged 38.7mm.

The LABC was found in 4/10 cadavers. It was consistently found dorsal to both access guides at a distance of 7mm.

Both the large and small access guides landed either on or just dorsal to the brachioradialis (BR) tendon in all specimens.

Conclusions: The RSN is in close proximity to the entry sites for both the small and large Conventus DRS devices. Based on this study, it is advised that the RSN and/or its branches be retracted dorsally along with the LABC nerve when exposing the radial shaft for Conventus DRS insertion.

If one uses the small access guide, there is greater chance of being in a location distal to the bifurcation of the RSN.

Volar retraction of the BR tendon should be considered.

P116. A Novel Approach to Fixation and Grafting of Scaphoid Non-Unions

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Introduction: Scaphoid non-union fractures present a challenge as untreated they will progress to osteoarthritis and impaired wrist range of motion (SNAC wrist). Significant technical difficulties are described when using traditional techniques (debridement and grafting with cortico-cancellous bone, with or without fixation) for non-displaced scaphoid fractures without AVN. These include: unstable proximal and distal fracture fragments, loss of correct scaphoid shape when using solid bone grafts, and difficulty maintaining the graft reduction during screw insertion.

The purpose of this study is to describe and evaluate a novel surgical technique of treating non-displaced waist and proximal pole scaphoid non-unions without avascular necrosis (AVN).

Materials & Methods: A retrospective review was performed on all patients with non-displaced, non-united scaphoid waist or proximal pole fractures without AVN treated with the following technique. Two Kirchner-wires are positioned volar: one perpendicular to the fracture and one parallel to the scaphoid axis. Access to the center of the non-union is gained through a dorsal-ulnar burr hole parallel to the fracture that allows passage of a curette/burr for debridement of bone cysts and sclerotic fracture edges. Debridement is undertaken proximally and distally until punctate bleeding bone is encountered and the K-wires are visualized (representing approximately 50% of the fracture interface). The volar, radial fibrous union is left intact. Cancellous bone graft harvested from the distal radius is packed into the non-union site. A headless screw is placed perpendicular to the fracture and the k-wires are removed.

Results: Between 2012-2014,12 patients (11M:1F, age 13-29 years) with clinical and radiographic evidence (9 had CT/MRI, 3 had radiographs only) of scaphoid non-union were identified (10 transverse waist, 2 proximal pole fractures). The median interval from injury to surgery was 34 weeks (range: 14-468 weeks). Two patients failed previous interpositional iliac crest bone grafting. All patients were healthy although 4 were active smokers. All patients had pre-operative wrist pain.

All patients healed (confirmed radiographically by CT scan) although 4 had delayed union requiring a bone stimulator (2/4 of whom had proximal pole fractures, none were smokers or had prior surgery). The average interval from surgery to healing was 14 weeks; all patients had resolution of pain and there were no complications.

Conclusions: The technique described is an effective and efficient method of treating non-displaced scaphoid non-unions without AVN. Maintaining the volar fibrous union likely prevents instability and complete debridement of the non-union is not essential in achieving union

P117. Thumb Reconstruction Using Toe Transfer and Chimera Flap for Repair of Four Finger Losses

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Objective: Repair of finger losses has always been challenging for reconstructive surgeons. It has developed rapidly with the advance in microsurgical techniques.
We report a case of thumb reconstruction using toe transfer and chimera flap for repair of four fingers (from the thumb to the ring finger), bringing about a good result of pinch function even after a prolonged lapse of time.

Methods: The patient was a 23 years-old female. Her right hand was caught in a mincing machine. Four digits, from the thumb to the ring finger, were amputated with detrition of skin, bones and soft tissue. We performed thumb reconstruction using second toe transfer to regain the pinch function with remaining little finger after stump plasty of four fingers. Simultaneously, we covered the exposed metatarsal bone of the second toe, which was transferred to the thumb, with a deep circumflex iliac artery perforator (DCIP) flap. The dorsalis pedis artery of the second toe was anastomosed. In addition, the DCIP was anastomosed to a side branch of the first metatarsal artery and DCIP in a chimeric fashion. A gap between the digital nerves of the thumb and the toe was bridged with a nerve graft procured from the lateral femoral cutaneous nerve.
Six months after the first operation, contracture of the web space was released using an anterolateral thigh (ALT) flap as a "jumping flap."

Results: Transferred flaps all survived completely. The patient was able to pinch and hold lightweight objects one year later after the first operation. Good pinch function and sensory recovery was confirmed 7 years after the second operation.

Conclusion: Generally, it is difficult to perform functional reconstruction using single flap for complicated and complex defects as in this case. We postulate that chimeric transplantation, in which more than two flaps can be transferred simultaneously, is more suitable for reconstruction of these defects.

P118. Epidemiology Of Upper Extremity Amputations In The Province Of Québec

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Background and Purpose: The injury mechanism is the most important factor determining survival rate and functional outcome in replantation surgery of the upper extremities. However, injury causes are often underreported in the literature and overlooked in medical records. Thus, we sought to study the epidemiology of upper extremity injuries referred to our provincial replantation hand center.

Methods: We conducted a retrospective analysis of all records of patients referred to our center for digital amputation or devascularization from 2010 to 2013. Further data were obtained through a validated telephone survey. The gathered information included demographics and a narrative of the mechanism of injury including factors involved.

Results: A total of 377 patients were referred during the period of 2010-2013. The referral rate was 1.17/100 000 person/year. 131 patients completed the questionnaire. The majority were male (85.41%), mostly in the 40-60 years-old age category (43.5%). 66.4% of the injuries occurred in the non-dominant hand. 66.31% involved one finger, with the thumb and index comprising 48.42% of the cases. They mostly worked an average of 30hours/week (64.12%), though most injuries (61.83%) occurred at home.

Power handtools or fixed powered machines accounted for 69.12% of the injuries with the table saw being responsible for 35.2% of them. Most patients reported that guards were absent at the time of injury (80.1%). 70.59% had more than 10 years experience with the machine. When respondents were asked what was according to them the reason of the injury, a clear pattern was noticed. For the table saw it was the absence of guard that was most cited (66.5%). They mentionned the lack of dexterity with small pieces as the main reason for guard retrieval (88.6%). For the miter, radial and mechanical saw it was an imporper position adopted while performing the cut that was mentioned the most, as it led to the unexpected kickbak of the tool in 95.5% of the cases. For the wood splitter, the lack of coordination was responsible for 65.4% of the injuries, as they were two persons performing the task at the moment of the accident.

Conclusions: A closer examination of amputation causes shows a clear pattern. Unexpectedly, most events occurred at home. Further development in safeguards and a better population awareness is required to prevent further injuries.

P119. Ethnic and Gender Diversity in Hand Surgery Trainees

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Introduction: Diversity in the medical field has shown to be a beneficial factor in many aspects including research productivity and patient care. However, lack of diversity in orthopedic and plastic surgery trainees have been documented in the past and may be reflected in their subspecialty, hand surgery. Consequently, we assessed trends in ethnic and gender diversity in hand surgery trainees.

Methods: Ethnic diversity was assessed using the proportions of minority trainees. We analyzed the trends in ethnic diversity in hand, orthopedic, and plastic surgery from 1995 to 2011 by evaluating the changes in proportions of African American, Hispanic, and Asian trainees. Additionally, we compared the proportions of minority trainees in various surgical specialties including hand surgery, orthopedic sports medicine, orthopedic surgery, plastic surgery, neurological surgery, and general surgery from 2009 to 2011. Trends in gender diversity were similarly analyzed and compared using the proportion of female trainees.

Results: There were significant linear growths in Hispanic and Asian populations in hand surgery from 1995 to 2011 (0.08% and 0.40% per year; $p<0.05$ for both). Similar significant increases exist in orthopedic surgery for African American and Asian populations (0.13% and 0.95% per year; $p<0.01$ for both). The plastic surgery residency also witnessed a significant increase in the Asian population (0.75% per year; $p<0.001$). However, there was no significant difference in the proportions of non-Caucasian trainees between hand surgery and other surgical specialties. Proportions of female trainees in hand, orthopedic and plastic surgery increased significantly from 1995 to 2011 (0.65%, 0.58%, 0.34%; $p<0.001$ for all). Furthermore, from 2009-2001, the female trainee proportion in hand surgery was significantly greater than those of orthopedic sports medicine and neurological surgery ($p<0.005$ for both), significantly less than that of general surgery ($p<0.001$), and not significantly different from those of orthopedic and plastic surgery.

Conclusions: Our data shows that gender and ethnic diversity in hand surgery has significantly increased from 1995 to 2011. Indeed, the sum of all minority populations accounts for a third of hand surgery trainees. However, women constitute only a fifth of hand surgery trainees. Therefore, efforts to increase diversity should be further pursued.

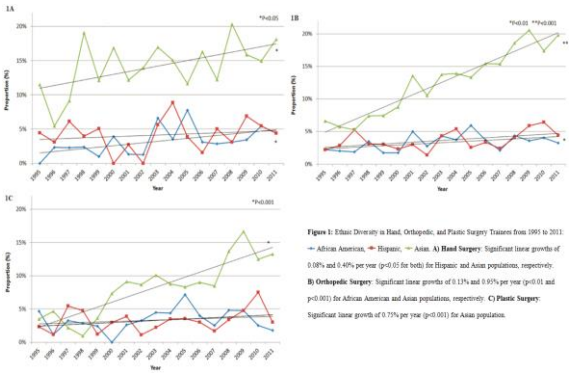

Figure 1: Ethnic Diversity in Hand, Orthopedic, and Plastic Surgery Trainees from 1995 to 2011: African American, Hispanic, Asian. **A) Hand Surgery**: Significant linear growths of 0.08% and 0.40% per year ($p<0.05$ for both) for Hispanic and Asian populations, respectively. **B) Orthopedic Surgery**: Significant linear growths of 0.13% and 0.95% per year ($p<0.01$ and $p<0.001$) for African American and Asian populations, respectively. **C) Plastic Surgery**: Significant linear growth of 0.75% per year ($p<0.001$) for Asian population.

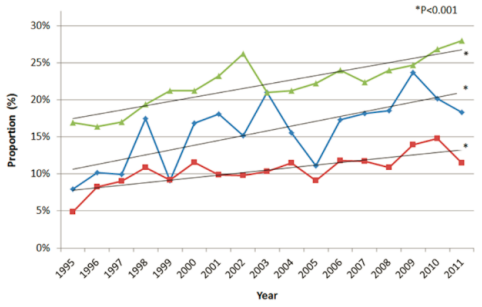

Figure 2: Gender Diversity in Hand, Orthopedic, and Plastic Surgery Trainees from 1995 to 2011. Hand Surgery, Orthopedic Surgery, Plastic Surgery. Significant linear growth of 0.65%, 0.58%, 0.34% per year ($p<0.001$ for all) found for proportions of female trainees in hand, orthopedic, and plastic surgery, respectively.

P120. Trapeziometacarpal Osteoarthritis: Atrhroscopic Partial Trapeziectomy

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Introduction: Open procedures for Trapeziometacarpal Osteoarthritis are well- described in the literature and include trapeziectomy with or without ligament reconstruction and tendon interposition and trapeziometacarpal arthrodesis. These open procedures are associated with an increased risk of complications. Our hypothesis is that arthroscopic partial trapezectomy technique can be applied to Eaton grade II injuries with satisfactory outcomes and reduced complications

Methods: Fourty patients presenting synthomatic trapeziometacarpal osteoarthritis were diagnose. They demonstrated a positive Grindt test, and Eaton grade II on radiographs views. Arthroscopy confirmed the degree of injury . Arthroscopic debridement of the sinovitis and partial trapeziectomy was performed. Visual analogue pain score, grip strength, range of motion, radiographic assessment was used for evaluation of outcomes.

Results: 30 female and 10 male patient was treated. The mean age was 55 years, and average follow-up 2 years. Immobilization was removed 3 weeks after surgery. Range of motion and grip strength exercises are started at 1 month. Visual analogue pain score average was 8.8 preoperative and 1.1 postoperative. Mean range of motion was a complete interphalangeal and metacarpophalangeal flexion and extension. Average grip strength was 73% of the normal contralateral extremity. There were no complications.

Summary: Arthroscopic debridement and partial partial trapeziectomy of the grade II trapeziometacarpal joint demonstrates reduced pain, increased range of motion, and satisfactory outcomes over 2 years. Further assessment of this operative technique with direct comparison to standard approaches is warranted.

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P121. Minimally Invasive Approach with Pronator Quadratus Preservation for Distal Radius Fractures

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Introduction: Open reduction and internal fixation using volar approach has become the most popular option. However, to place the plate through a volar conventional approach, it is necessary to cut the Pronator Quadratus (PQ), which has been shown to contribute significantly to the forearm pronation.

Objectives: The purpose of this study is to describe a technique of volar locking plate for distal radius fractures with PQ preservation, determining if with a less invasive approach we can achieve good clinical, radiographic and functional outcomes.

Methods: We retrospectively reviewed 24 patients who underwent minimally invasive approach (16 women, 8 men), with a mean age of 65 years. Fractures were classified according to the AO classification, finding four A2 and three A3, five type B1, two B2 and two B3 and the five remaining were three C1 and two C2. The surgical technique begins with a closed reduction and fixation with temporary K-wires under an image intensifier. A 25mm skin incision is then performed and deepened between the flexor carpi radialis tendon and radial artery to expose the PQ. Afterwards, we continued with a distal edge dissection of the PQ in order to introduce the volar locking plate under the muscle. Distal screws are placed under direct vision and proximal screws percutaneously. Postoperative evaluation was determined by clinical and functional assessment by visual analog scale, range of motion, grip strength, and DASH score. Radiographic evaluation was performed by measuring the volar tilt, radial inclination, ulnar variance, joint congruity of the distal radius and plate alignment regarding to the shaft of the radius.

Results: All patients had clinical and radiographic signs of bone healing after 1 year follow-up. The 24 patients were able to return to their jobs at an average of 8 weeks. The average score on the DASH scale during the last control was 4.8 points. Regarding postoperative radiographic evaluation, there was an average volar tilt of 14.3¡ and an average radial inclination of 26.3¡. We observed no complications.

Conclusions: Although we did not obtain better results with this technique than with the conventional one, we believe that the fact of getting similar results with both approaches justifies carrying out this technique with PQ preservation, especially in patients concerned about the cosmetic appearance of the scar.

P122. Conservative Management of Elbow Dislocations with an Overhead Motion Protocol

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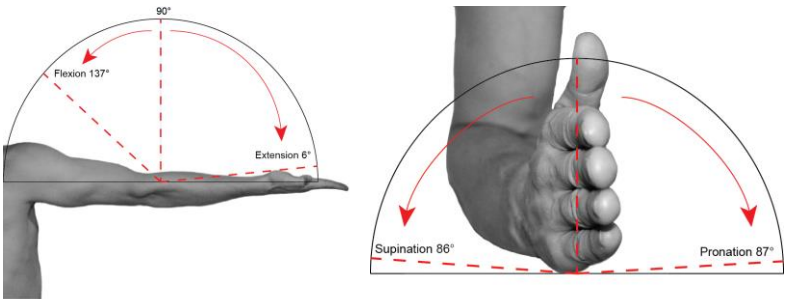
Introduction: The preferred management of simple elbow dislocations is a non-operative rehabilitation protocol. Initiating early mobilization is integral to optimizing functional and motion outcomes, but must be done appropriately to minimize the risk of recurrent instability. We managed a cohort of patients who had sustained a simple elbow dislocation with an overhead motion protocol, and hypothesized that immediate motion in an inherently stable position could maximize range of motion and functional outcomes while minimizing the risk of recurrent instability.

Methods: 27 patients were included who sustained a simple elbow dislocation and were treated non-operatively with an overhead motion protocol designed to convert gravity from a distracting to a stabilizing force (Figure 1). Motion was initiated at an average of 1.3 days following initial presentation, and average follow-up was 27 months. Final arc of motion and prevalence of instability were the primary outcomes measures.

Results: Final mean arc of motion was 6 to 137 degrees in the flexion-extension axis (Figure 2), with 87 degrees of pronation and 86 degrees of supination (Figure 3). No recurrent instability was observed in this cohort, and all patients were fully functional and without limitations at latest follow-up.

Conclusion:

- We demonstrate that with an appropriate, supervised rehabilitation protocol, early motion can be initiated following an elbow dislocation event, and excellent functional outcomes can reliably be obtained.
- The motion protocol utilized in this cohort places patients in a supine position with the arm overhead, thereby minimizing the varus and distraction gravitational force and transitioning the triceps into an elbow stabilizer.
- The early motion maximizes the ability to achieve a full flexion-extension arc, while the positioning allows the collateral ligamentous complexes to heal in an isometric fashion.
- A functional arc of motion was reliably obtained, with no observed cases of recurrent instability.



P123. Tire Explosion Injuries to the Upper Extremity

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Introduction: Although rare, tire explosion injuries to the upper extremity are capable of producing severe soft tissue and bony injuries. While the injuries sustained by the upper extremity during industrial-sized tire explosions have been described in the literature, very little is known about those sustained after small tire explosions in a non-industrial setting.

Materials & Methods: Four patients treated for tire explosion injuries to the upper extremity from 2012 to 2014 were retrospectively reviewed. One patient was injured when a tractor-trailer tire exploded and three sustained injuries from small, non-industrial tire explosions sustained at home. Injury and intra-operative radiographs were used to evaluate bony injuries. Medical records were reviewed for the presence of soft tissue injuries and compartment syndrome. Time from injury to the operating room (OR), administration of antibiotics, development of post-operative infections, need for return to the OR, and return to baseline function were also evaluated.

Results: All four patients were available for follow-up. All patients sustained multiple open fractures and each patient sustained at least three bony injuries. While not always evident on injury films, every patient sustained at least one, and as many as four, carpometacarpal (CMC) dislocations or fracture-dislocations. Two of the four patients developed compartment syndrome and were treated with fasciotomies. Each patient received antibiotics and a tetanus booster upon arrival at the primary hospital and was taken to the operating room for formal irrigation and debridement within 20 hours from the time of injury. Three of the four patients required a return to the OR for repeat irrigation and debridement and wound closure. Three of the four patients returned to baseline function, while one remains out of work due to functional limitations of the involved upper extremity.

Conclusions: Although rare, tire explosions are capable of producing severe soft-tissue and bony injuries to the upper extremity. With expeditious administration of antibiotics and tetanus prophylaxis, and formal irrigation and debridement in the operating room within 20 hours from injury, no patient developed a post-operative infection. Patients sustaining these injuries should be carefully evaluated for development of compartment syndrome, as half of the patients in this series required compartment releases. Imaging should be carefully scrutinized for the presence of CMC dislocations or fracture dislocations. While not always evident on injury radiographs, this injury was present in every patient.

P124. One-Stage Functional Preservation and Soft-Tissue Coverage for an Ankylosed Elbow Joint with Invasive Basal Cell Carcinoma – 55 Years After Initial Injury

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Introduction: In extremity malignancies, limb-sparing resection and reconstruction has become the treatment of choice. R0 resection, the removal of the tumor *in sano* remains the prerequisite and most important oncologic parameter to avoid local recurrence. This is achieved by excision with adequate healthy margins. Amputation does not provide better long-term survival rates nor functional advantages and limb salvage procedures achieve comparable survival rates with a better quality of life. Successful treatment therefore requires the combination of surgical eradication and rehabilitation of the patient's specific functional and aesthetic deficiencies. We present a rare case of basal cell carcinoma (BCC) arising 55 years after chronic osteomyelitis with invasion into the elbow joint to illustrate the complex interplay of patient and surgical factors involved in the post-resection defect reconstruction.

Material and Methods: A 68-year-old man presented with an ankylosed right elbow with a fixed flexion deformity of about 50 degrees and an overlying, fungating soft tissue mass with wound discharge. Previously, he had suffered a supracondylar fracture of the right humerus when he was 13 and had undergone arthrotomy and wash-out without complete resolution as he had ongoing chronic osteomyelitis. Wedge resection and open biopsy of the wound was performed and confirmed malignant transformation of the wound into invasive BCC. Surgery was planned for a wide resection of the involved joint and reconstruction with a free fibular autograft and plate construct in view of the anticipated bony defect and the lack of existing dynamic function.

Results: Following wide, en-bloc resection, there was sufficient contact between the bony remnants. The arm was shortened with elbow fusion using a 4.5 mm titanium locking compression plate and the lateral bone defect was filled with radial shaft autograft. The resection defect was circumferential and included expossure of the plate and radial and ulnar neurovascular structures. A contralateral, muscle-sparing free latissimus dorsi flap was then harvested for soft tissue coverage; a short saphenous vein graft was also used to bridge the transected cephalic and basilic veins. Post-operatively, the patient's arm was splinted and kept in a specially-designed cast. He was discharged on POD 19 and has managed to regain function in his hand uneventfully at about 1 year post-operative.

Conclusion: Special consideration for the pre-existing functional status of the affected limb is warranted during limb-sparing surgery because major ablation may result in an even poorer functional outcome. Functional preservation may thus be preferable after massive bone loss, as illustrated in this case.

P125. Anatomic Study of the Surgical Approaches to the Radial Tunnel

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Introduction: If non-operative techniques do not improve symptoms of radial tunnel syndrome, then surgical release of the posterior interosseous nerve (PIN) may be indiacted. Review of the literature shows inconsistencies in the recommended surgical approach, often with limited discussion and comparison of surgical techniques and unpredictable patient outcomes. Residual pain has been reported in nearly one third of patients. The purpose of this study was to examine the differences visualization of the anatomical sites of compression between the three described exposures used for surgical release of the posterior interosseous nerve (PIN) within the radial tunnel in order to evaluate efficacy of each approach in visualizing the five points of compression.

Method: Twenty-three fresh frozen cadaveric specimens were used to perform 8 anterior, 8 anterolateral, and 7 posterior approaches to the radial tunnel. For each approach, the 5 documented anatomical sites of compression that were clearly visualized were recorded. The portion of the supinator that could be released with clear visualization was performed through each window. After complete release of the visualized portion, a second window was exposed to measure the uncut portion of the supinator.

Results: The superficial branch of the radial nerve (SBRN), fibrous bands of the radial head, the leash of Henry, origin of the ECRB, and the Arcade of Frohse were visualized 100% of the time in the anterior and anterolateral approaches. This was significantly different to that of the posterior approach, in which the fibrous bands were never visualized ($p < .001$), and the SBRN, leash of Henry, origin of ECRB and Arcade of Frohse were visualized 25% of the time. ($p = .011$). The distal border of the supinator was visualized through the posterior approach in all specimens. The distal border was never seen in the anterolateral and anterior approaches; this was significant ($p < .001$). The average uncut supinator distance was 14.4 mm in the anterolateral group, 21.2 mm in the anterior group, and 6.5 mm in the posterior group. The difference between the anterolateral and posterior groups as well as the difference between the anterior and posterior groups were significant ($p=.022$).

Conclusions: No single approach is adequate for complete visualization and release of all compression points of the radial tunnel. In cases of radial tunnel release, complete visualization of the PIN compression sites is best achieved through multiple windows.

P126. Peripheral Mycotic Aneurysm with Enterococcus Faecalis Bacteremia, a Rare Case Report

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Case Report: A 70 year-old man with history of coronary artery disease who received coronary bypass surgery 6 months prior to this episode was admitted due to acute left elbow tenderness, swelling and weakness accompanied with fever. MRI study revealed only myofasciitis with abscess formation. However, mycotic aneurysm of radial artery at elbow region with arterial-venous fistula and thrombus formation was incidentally found when performing abscess drainage and debridement. Excision of the necrotic aneurismal vessel with vein graft reconstruction was performed. The hand circulation was good after the operation and the wound healed well. The bacterial culture of blood and necrotic tissue all yielded *Enterococcus faecalis*. No infected endocarditis was detected by echocardiogram. He completed 6-week antibiotics treatment and his fever and bacteremia status were subsided.

Discussion: Peripheral mycotic aneurysm is a rare complication of infected endocarditis and might also be related to intravascular foreign body, such as stent prosthesis. Without evidence of infected endocarditis or prosthesis infection, peripheral mycotic aneurysm was rarer reported in the literature. *Enterococcus faecalis* is a pathogen with less virulence. *Enterococcus faecalis* peripheral mycotic aneurysm can be less clinically aggressive and mimic with myofasciitis and abscess formation. However, this can still cause bacteremia and may clinically progress and become lethal if left untreated. Complete resection of the aneurysm with vein graft reconstruction and complete antibiotics management can cure this disease.

Conclusion: A very rare case of *Enterococcus faecalis* peripheral mycotic aneurysm which was mimic with soft tissue abscess formation was reported. A patient can suffer from peripheral mycotic aneurysm without infected endocarditis or intravascular prosthesis placement. Complete resection of the aneurysm with autologous graft reconstruction and complete antibiotics treatment can cure this disease.

Image: (Fig.1) Abscess accumulated at elbow, mimic the mycotic aneurysm

(Fig.2) Mycotic aneurysm of radial artery

(Fig.3) Reconstruction of radial artery with vein graft

P127. Ablative Fractional Photothermolysis in the Treatment of Scar Restricted Upper Extremities

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Hypothesis: Ablative Fractional Photothermolysis (AFP) has recently been applied in the treatment of debilitating scars and contractures that limit satisfactory upper extremity range of motion after surgical treatment of orthopedic hand injuries despite ideal surgical repair and compliance with a standard motion protocol postoperatively. Our hypothesis is that AFP is a useful adjunct treatment for improving digital range of motion (ROM) when the primary restraint to motion is hand scarring.

Methods: We conducted a retrospective review of patients with limited finger range of motion as a result of hand scars who were treated with AFP at our institution (October 2009 to October 2012). Exclusion criteria were age less than 18 and any history of or current connective tissue disease.

Measures of efficacy were: (1) Changes in total arc of motion from pre- to post-treatment (2) patient satisfaction and (3) Grip strength changes from pre- and post-treatment. ROM, grip improvement and patient satisfaction were assessed with 95% confidence intervals and the Wilcoxon signed rank test, with significance assigned to confidence intervals not including zero and p-values <0.05.

Results: During the study period, 30 fingers in 19 patients were treated. Twenty-four fingers had pre- and post-treatment ROM measurements and 11 had grip strengths that were directly comparable. The mean age of patients treated was 28 years. Resulting scar and joint contractures were a result of a wide range of injury mechanism requiring various surgeries including tendon repairs, fracture fixation, and soft tissue reconstruction. Patients were treated from one month to 28 months after injury (mean 9.6 months). The number of laser treatments was between one and six per patient (mean 2.7). Median percentage improvement in total arc of motion for each finger was 20.4% ($p=0.0001$), range -11% to 69%. Median grip strength improved 21 pounds ($p=0.002$), range -11 to 90 pounds. No unexpected adverse events were associated with 48 treatments performed and all patients noted subjective satisfaction.

Conclusions: The study is limited by its retrospective nature as well as the lack of a control group, thus direct correlation of AFP to patient improvements cannot be drawn. The data is promising, suggesting AFP is efficacious in improving digital motion secondary to scarring in the hand when patients have plateaued with standardized treatments and therapy. AFP is a safe procedure with excellent patient satisfaction. Future prospective studies are necessary to prove further effectiveness of AFP.

P128. Mini Open Carpal Tunnel Release with a Pediatric Nasal Speculum: A 10-Year Retrospective Case Series

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Introduction: Nasal speculum assisted carpal tunnel release (CTR) is performed using smaller incisions than are normally achieved with open procedures. We performed a retrospective case series analysis to evaluate short and long-term symptom and functional outcomes of a single surgeon's results with this technique.

Materials & Methods: During the period of 2005-2011, 678 cases met the inclusion criteria. Of these, 174 cases representing 152 unique individuals were contacted and consented to participate in the study. A chart review was performed to identify demographic, pre-operative, and post-operative characteristics. Pre-operative and post-operative Symptom Severity Scale and Functional Status Scale results from the Carpal Tunnel Questionnaire were then obtained via telephone interviews.

Results: The mean (StDev) time to follow up was 4.08 (2.1) years with the mean age at follow up 61.94 (14) years. More females (56%) were included than males (44%). Using linear mixed models, patients with nasal speculum assisted CTR had significant ($p<0.0001$) improvements in both symptom severity and functional status following surgery. In addition, 97.7% of patients reported their incisions were aesthetically pleasing and only 78.7% reported their incisions were still visible. Several pre-operative factors had a significant association with good surgical outcomes, including: Positive Compression Test/Durkin's; Severe/very severe difficulties on the Functional Status Scale; High scores on the Symptom Severity and Functional Status Scales.

Conclusions: This surgeon's experience with nasal speculum assisted CTR shows that this technique results in not only aesthetically pleasing results, but also excellent symptomatic and functional outcomes.

P129. Prospective Effectiveness for Supportive Care for First CMC Arthritis

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Background: Several standard treatments exist for patients suffering from first carpal metacarpal joint arthritis. These range from activity modification and physical therapy to surgical intervention. The effectiveness of surgical therapy is well studied and outcomes are well documented. However, the effectiveness of non-surgical physical therapy for this condition is poorly understood. We propose a prospective observational study of patients with first CMC joint arthritis to better understand the effectiveness of physical therapy on this disease.

Methods: Between March 2014 and July 2014, 20 consecutive patients with a new diagnosis of Eaton Stage I-IV CMC arthritis that had been symptomatic for a minimum of 6 weeks were enrolled. 10 subjects had completed treatment as of this writing. Patients were asked to complete the following instruments at the initial visit and at two months:

Multidimensional Health Locus of Control Scale
DASH
Visual Analog Scale
Pain Catastrophizing Scale
Center for Epidemiologic Studies Depression Scale

Patients were then referred to a certified hand therapist where a custom hand based thumb spica splint was fabricated. In addition, the patient was shown specific exercises for thenar strengthening and specific activity modifications. Grip strength, 3-point and lateral pinch were measured during this visit and at their two month follow-up.

Statistical analysis of the results were performed by calculating means and standard deviations followed by a t-test.

Results: After two months of standardized conservative management, our patients demonstrated very modest improvement in the above instruments. Average DASH scores decreased from 57.2 to 49.9. VAS scores decreased from 3.8 to 3.4. Grip strength increased from 53.9 to 58.6 on the dominant side and 44.9 to 48.3 on the non-dominant side. Lateral pinch increased from 13.5 to 14.4 on the dominant side and 12 to 13.2 on the non dominant side. 3 point pinch increased from 12 to 13.2 on the dominant side and 9.8 to 12.2 on the non-dominant side. MHLC scores showed slight improvement throughout the instrument. Pain Catastrophizing scores decreased slightly from 11.9 to 10.9. Depression scores slightly increased from 31.3 to 33.2. No differences were found to be statistically significant.

Conclusions: Initial conservative management of Eaton Stage I-IV CMC arthritis on average enjoyed very modest improvements on Multidimensional Health Locus of Control Scale, DASH, Pain scores via the Visual Analog Scale and the Pain Catastrophizing Scale. The Center for Epidemiologic Studies Depression Scale score demonstrated a slight increase. None of these results proved to be statistically significant.

P130. Distal Humeral Hemiarthroplasty: Indications, Results, and Complications. A Systematic Review

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Introduction: Distal Humeral Hemiarthroplasty (DHH) is an infrequently utilized treatment for comminuted intra-articular fractures of the distal humerus. DHH has specific advantages over other, more common, treatment modalities of unreconstructible distal humerus fractures: Total Elbow Arthroplasty (TEA) and Open Reduction Internal Fixation (ORIF). Preservation of bone stock, lower rates of loosening, and less post-operative restrictions make DHH a reasonable option in these difficult cases. The reported cases of DHH are few in number. We present the first systematic review of DHH and describe the indications, results, and complications of this uncommon procedure.

Methods: A literature search yielded 13 primary articles with 116 elbows that underwent DHH for fractures and 4 papers with 17 elbows that underwent DHH for non-fracture causes. A systematic review was generated; patient indications, outcomes, and complications were recorded.

Results: For fractures; good to excellent results were achieved in 67.4% of patients with a mean arc of motion of 98° at mean follow up of 42 months. 28% of patients experienced a complication, and only 1.7% of patients experienced loosening of the prosthesis. For non-fracture indications; good to excellent results were achieved in 76.5% of patients with a mean arc of motion of 62° at mean follow up of 46 months. Half of patients experienced a complication; most commonly stiffness. Loosening of the prosthesis was not noted in any patient.

Conclusion: Here we present the first review of the indications, outcomes, and complications for DHH. DHH is a reasonable treatment option for young patients with unreconstructible intra-articular distal humerus fractures, especially with specific comorbidities to include rheumatoid arthritis, tumor, bone loss, or osteomyelitis.

Key words: Elbow arthroplasty, distal humerus fracture, rheumatoid arthritis.

P131. Biomechanical Comparison of Double Grasping Repair Versus Cross-Locked Cruciate Flexor Tendon Repair

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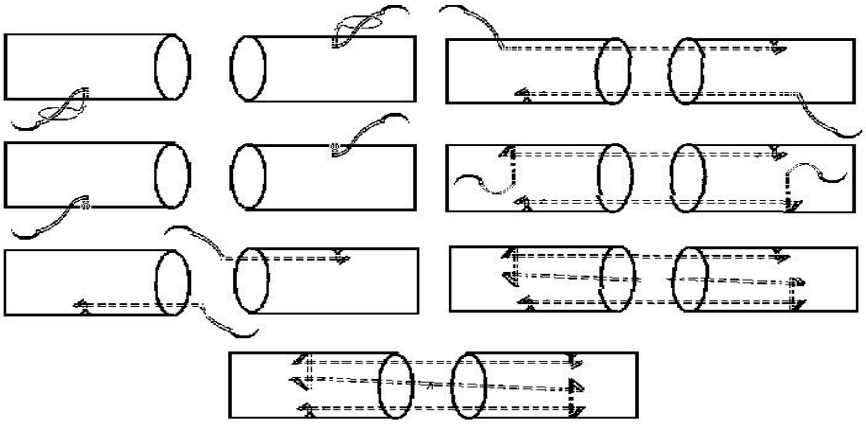
Introduction: The purpose of this study is to compare the in vitro biomechanical properties of tensile strength and gap resistance of a novel double grasping loop (DGL) flexor tendon repair with the established 4-strand cross locked cruciate (CLC) flexor tendon repair, both with an interlocking horizontal mattress epitendinous suture (IHM). The hypothesis is that the DGL-IHM method which utilizes two looped core sutures in a "3-double-stranded" configuration that incorporates grasping loops and locked loops with a single intralesional knot will have a greater strength and increased gap resistance than the CLC-IHM method.

Materials & Methods: Forty Porcine Tendons were evenly assigned to either the experimental DGL-IHM or the control CLC-IHM group. The tendon repair strength, in terms of 2-mm gap force and load to failure, was measured as a constant rate of distraction was applied across the repair site. From these measurements, stiffness of tendon repair gap resistance was calculated. The method of repair failure was analyzed under the microscope.

Results: The CLC-IHM group exhibited a statistically significant greater resistance to gapping, a statistically significant higher load to 2-mm gapping (62.0N), and load to failure (99.7N) than the DGL-IHM group (37.1N and 75.1N, respectively). 90% of the CLC-IHM failures were a result of knot failure in opposition to the DGL-IHM group, in which only 30% failed by knot failure.

Conclusions: This study demonstrates that CLC-IHM flexor tendon repair method better resists gapping and has a greater tensile strength when compared to the novel DGL-IHM flexor tendon repair method. It is suspected that because the DGL-IHM group failed to maintain its position within the tendon under load, as demonstrated by the high percentage of suture pullout, it was unable to tolerate loads as high as the CLC-IHM group.



Double Grasping Loop Flexor Tendon Repair Method: Looped Suture is initiated (A), passed through suture looped and tightened (B), advanced through grasped tendon portion to laceration site (C), attaining 10mm purchase length of opposite segment (D), passed from lateral wall to central point (E), locked as inserted centrally returning to laceration site (F), and knotted within repair site with mirrored suture of opposite segment (G).

P132. Palpable Scaphoid Surface Area in Various Wrist Positions: A Cadaveric Study to Optimize Clinical Examination of Scaphoid Fractures

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Introduction: The scaphoid is the most commonly fractured carpal bone in the wrist. Secondary to a tenuous retrograde blood supply, unrecognized fractures can lead to malunion, avascular necrosis, and post traumatic wrist arthritis. Radiographs only have a limited sensitivity making clinical exam findings important for an accurate diagnosis

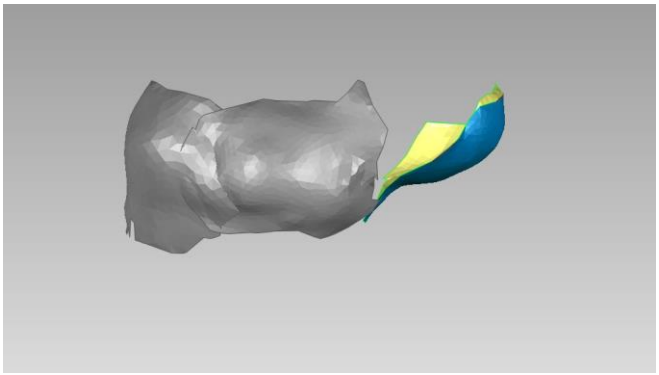
Placing the wrist in a position that exposes the scaphoid to palpation is essential for clinical assessment. However, after a review of the literature, there is no study demonstrating the most optimal wrist position when performing routine exams. In this cadaveric study, the exposed, palpable surface area of the scaphoid was calculated in different wrist positions to determine the optimal wrist position to perform diagnostic clinical exams.

Methods: Three cadaveric specimens were carefully dissected to expose the dorsal, radial, and volar aspect of the scaphoid to mimic the aspects of the scaphoid palpated during a routine examination. Using a table clamp and Kirschner wires, the wrist was rigidly placed in several positions (flexion, neutral, neutral/radial deviation, neutral/ulnar deviation, and extension). A six-degrees-of-freedom commercial device, Faro Arm (Faro Technologies, Lake Mary, Florida), was used to obtain a 3D plot of points from which surface area of the scaphoid, in different positions, was extrapolated (Image A).

Preliminary Results: In the snuffbox region, average scaphoid surface area palpable was 81.33 mm^3 (50-139) in neutral-radial deviation, 191.0 mm^3 (135-242) neutral-neutral position, and 357.0 mm^3 (294 -421) in neutral -ulnar deviation. With wrist flexion, the average dorsal aspect of the scaphoid exposed was 234 mm^3 (250-415). The full surface area of each individual excised scaphoid is in the process of being measured. This will help us determine percentage of total surface area exposed for each specimen and will also provide us with digital images of the entire scaphoid to depict which aspect of the scaphoid is palpable with each wrist position.

Conclusions: The palpable area of the scaphoid in the snuffbox increases significantly when the wrist is held in ulnar deviation and is significantly decreased with the wrist in radial deviation. Wrist flexion also exposes a large proportion of the scaphoid. These results would suggest that the optimal wrist position for exposure of the scaphoid during clinical examination is ulnar deviation with the wrist at neutral with snuffbox palpation and palpating the dorsal aspect of the scaphoid with a flexed wrist.

Image A



P133. Primary Melanoma of the Hand: an Algorithmic Approach to Surgical Management

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Purpose: Melanoma, the skin cancer with the lowest incidence, causes the majority of all skin cancer-related deaths. Early detection has lead to the discovery of melanoma at less advanced stages, thus shifting the reconstructive paradigm from solely survivorship to the improvement of function and cosmesis while still maintaining an overall adequate outcome. Reconstructive approaches rely on two main factors: location of the lesion and size of the lesion. Due to the complexity of the hand, reconstructive options are quite heterogeneous. The purpose of this study is to explore the clinical data and reconstructive strategies of hand and digital cutaneous melanoma and subungual melanoma, review the current reconstructive options presented in the medical literature, and offer a reconstructive algorithm to surgically approach primary melanoma of the hand.

Methods: A retrospective chart review was conducted for all patients undergoing oncologic resection of primary melanoma of the hand at New York University Langone Medical Center (NYULMC) between April 2003 and October 2013. Variables collected included age, race, gender, type of melanoma, Breslow depth, stage, oncologic resection, reconstructive surgery, and outcomes.

Results: A total of 35 patients with primary melanoma of the hand comprised our study cohort. The mean age of presentation was 56 years with a total of 24 women and 11 men. The average Breslow depth of the cohort was 1.58mm. There were 13 cases of melanoma in situ (MIS). All MIS cases were treated with wide local excision, yet the subungual group needed more extensive reconstruction including paronychial advancement flaps and full-thickness skin grafts (FTSG). Twenty-two cases presented as malignant melanoma. The majority of the patients with cutaneous melanoma underwent wide local excision with primary closure or FTSG. In the subungual group, all patients underwent amputation at the most distal interphalangeal joint or wide local excision. The reconstruction consisted of local advancement flaps, FTSG, or primary closure.

Conclusion: Reconstructive options for primary melanoma of the hand are quite varied without strong guidelines as to which technique is superior. Location, size, and type of lesion (cutaneous or subungual) help shape which reconstructive strategies are optimal. With more conservative oncologic approaches and advanced reconstructive techniques, patients are able to maintain function with a satisfactory degree of cosmesis.

P134. Finger Motion for Detection of Intratendinous Needle Placement During Collagenase Injection: A Cadaveric Study

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Introduction: Collagenase clostridium histolyticum (CCH) injection has proven to be an effective nonoperative treatment for Dupuytren's disease with tendon rupture, although reportedly rare, being the most concerning potential complication. The use of finger range of motion to help the clinician detect errant placement of the needle within the tendon is recommended in the CCH injection technique guide. Our study evaluates the validity of this technique.

Methods: Using 12 cadaveric hands disarticulated through the wrist, 48 fingers were dissected using a midaxial approach to identify the flexor sheath and flexor tendons. We made a small window in the A2 pulley and a 25-gauge needle was placed through the skin, distal to the palmar-digital flexion crease, and into the area over the A2 pulley. The fingers were then randomized into one of three conditions for needle placement: 1) in the flexor digitorum superficialis (FDS), 2) in the flexor digitorum profundus (FDP), or 3) outside of the tendons. The skin was closed and the hands were individually mounted on a computer-controlled longitudinal translation jig that allowed for controlled, simulated active flexion and extension of a single digit through attachments to the flexor and extensor tendons at the level of the wrist. During each digit's trial-run, 3 Certification of Added Qualification (CAQ)-hand surgeons that perform CCH injections in their practice and were blinded to needle placement and to each other's responses attempted to determine the needle placement location while holding a syringe attached to the needle.

Results: Interobserver agreement was slight to fair (kappa 0.04-0.24) and did not reach statistical significance (p=0.10-0.77). The sensitivity (ability to detect the needle was in the tendon) was 60% while the specificity (ability to detect the needle was not in the tendon) was 76%. The positive predictive value (observer stated the needle was within the tendon and it was) and negative predictive value (observer stated the needle was not within the tendon and it was not) was 71% and 66% respectively. The ability to correctly detect the needle was in the FDS, FDP, or out of the tendon was 56%, 64%, and 76% respectively.

Conclusion: Due to a low interobserver agreement, sensitivity and negative predictive value we conclude that range of motion of the digit is not a reliable test to detect intratendinous needle placement when injecting CCH.

P135. WITHDRAWN

P136. The Relationship between the Striking Ninja Line and the A1 Digital Pulley: a Cadaveric Study

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Introduction: The Striking Ninja Line (SNL) represents a transverse line between the radial edge of the proximal palmar crease and the ulnar edge of the distal palmar crease. This is an alternative to the previously described proximal interphalangeal crease (PIC) to proximal digital crease (PDC) distance method to identify the location of the A1 pulley. This study evaluates the SNL and its spatial relationship to the proximal extent of the A1 pulley.

Methods: The SNL was marked on seven cadaveric hands. Dye was injected into the palm at the SNL at all non-thumb digits. On each finger, a point was marked proximal to the PDC the distance between each digit's PIC and PDC (PIC/PDC point). The A1 pulley was dissected each finger. The distance between the SNL and the proximal extent of the A1 pulley was measured with a caliper. The distance between the PIC/PDC point and the SNL was measured. From this, the distance between the PIC/PDC point and the proximal A1 pulley was calculated.

Results: The PIC/PDC point was proximal to the A1 pulley in the index, middle, and small fingers. The mean distance from the PIC/PDC point to the A1 pulley was 3.44mm in the index finger, 0.78 mm in the middle finger, and 1.29mm in the small finger. The PIC/PDC point was distal to the A1 pulley in the ring finger, by a mean distance of 0.78mm. The SNL was proximal to the A1 pulley in all digits. The mean distance from the SNL to the A1 pulley was 3.44mm, 7.83mm, 5.75mm, and 3.9mm in the index, middle, ring and small fingers, respectively. The PIC/PDC point was closer to the A1 pulley than the SNL in the middle and ring fingers ($p < 0.05$). However, the standard deviation was smaller for the SNL to A1 distance than the PIC/PDC point to A1 distance in all digits.

Conclusions: The SNL can guide the clinician to the A1 pulley. The SNL is proximal to the proximal extent of the A1 pulley in all non-thumb digits. Despite being less accurate than the PIC/PDC distance at approximating the location of the A1 pulley in the ring and long finger, the SNL has a lower standard deviation across all digits. Though less accurate, the SNL may have a more reliably proximal relationship to the A1 pulley. Trigger finger corticosteroid injection sites and surgical incisions should be placed distal to the SNL.

P137. Dorsal Locked Plating Reduces Soft Tissue Complications of Ulnar Shortening Osteotomy

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Introduction: Ulnar impaction syndrome is associated with positive ulnar variance and can lead to a number of degenerative processes. Ulnar shortening osteotomy (USO) is the most commonly used procedure to treat symptomatic wrists with positive ulnar variance. Various techniques have been described, generally involving fixation with a volar- or ulnar-positioned 3.5 mm plate. The reported incidence of hardware complications including plate removal is up to 55% with such techniques. We present a technique of USO utilizing 2.4/2.7 mm fixed-angle dorsal plating, and compare the results and complications of this technique to volar plating.

Patients and Methods: We performed a retrospective review of 32 patients undergoing USO on 34 wrists, and compared the outcomes of 16 cases with dorsal 2.4/2.7 mm fixed-angle plating and 18 cases with traditional volar 3.5 mm plating. The primary outcomes were painful hardware and removal of symptomatic implants. A minimum follow-up of 12 months was used to assess these outcomes. Other outcomes of interest were: pain, Patient-Rated Wrist Evaluation (PRWE) score, range of motion (ROM), union, grip strength and other complications.

Results: There were 12 males and 20 females and the mean age at surgery was 47 (SD, 15) years. There were no significant differences in baseline characteristics, pre-operative ulnar variance, length of surgery and degree of correction. More patients in the dorsal group had surgery to the dominant wrist (75% versus 39%, $p < 0.01$). There were no significant differences in PRWE, pain score, ROM and time to union. The relative grip strength compared to the contralateral upper extremity in the dorsal group was higher than the volar group (101% versus 71%, $p = 0.01$). After adjusting for hand dominance, dorsal plating was significantly associated with higher relative grip strengths ($p = 0.02$). There were 2 (13%) complications in the dorsal group, including one case with painful hardware. This was significantly lower than the volar group, with 10 (56%) complications, including 6 cases of hardware-related soft tissue irritation ($p = 0.01$).

Conclusion: Both volar and dorsal plating techniques for USO yield good functional outcomes. There was a higher incidence of painful hardware requiring removal of implants in the volar plating group. Based on these findings, we advocate dorsal plate position using a smaller, fixed-angle plate for USO in symptomatic ulnar impaction syndrome.

P138. Arthroscopic Resection Arthroplasty with Arthroscopic Ligament Stabilization for Treatment of Thumb CMC/STT Arthrosis

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Introduction: Arthroscopic resection arthroplasty (ARA) for carpometacarpal (CMC) degenerative joint disease has been shown to yield excellent pain relief yet does not address metacarpal instability when present. The purpose of this study is to report outcomes of a new arthroscopic ligament stabilization procedure for thumb metacarpal subluxation in patients with a minimum of 5-year follow-up (FU) who underwent ARA for basal joint arthritis.

Materials & Methods: Twelve patients underwent ARA combined with arthroscopic ligament stabilization for thumb basal joint arthrosis associated with 1st metacarpal instability. Two were revision cases and were excluded. Two were less than 1 year since time of surgery. One patient was lost to FU. This left 7 patients for analysis. Mean FU was 84 months (range 63 to 108). The ligament stabilization procedure, similar to an arthroscopic anterior cruciate ligament reconstruction, stabilizes the subluxed base of the 1st metacarpal by stabilizing it to the base of the 2nd metacarpal. Data were collected preoperatively and at postoperative intervals of 1, 3, 6, and 12 months and annually thereafter. Objective data collected by an occupational hand therapist at each time interval included numeric rating scale for pain (0-10; 0='no pain', 10='worst possible pain'), disabilities of arm, shoulder, and hand (DASH) questionnaire (0-100; higher score = greater disability), range of motion, grip strength, and key pinch. Patient satisfaction was evaluated at final FU (0-5; 0='completely dissatisfied', 5='completely satisfied').

Results: There were 5 females and 2 males. Average age was 58 years (range 43 to 72). Preoperative length of conservative treatment averaged 29 months (range 1 to 48). Average time of postoperative immobilization was 3 weeks (range 1 to 6). Mean pain was 6 preoperatively and 2, 1, 1, 1, 0, and 0 at the aforementioned FU intervals respectively. Mean DASH score was 46 preoperatively and 5 at final postoperative FU. All patients could reach the base of their small finger. Grip strength averaged 25.0kg (range 12 to 43) preoperatively and 27.3kg (range 16 to 47) at final FU. Key pinch averaged 3.2kg (range 1.4 to 4.5) preoperatively and 6.4 kg (range 1.8 to 14.6) postoperatively. Patient satisfaction averaged 5 (range 4 to 5) at final FU.

Conclusions: Outcomes of ARA for thumb basal joint arthrosis combined with arthroscopic ligament stabilization for thumb metacarpal subluxation yields good results with respect to pain, strength, function, and patient satisfaction. Pain relief was rapid and remained consistent over time.

P139. Dual Mini TightRope Suspensionplasty for Thumb Basilar Joint Arthritis: A Case Series

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Purpose: To evaluate the efficacy of a new technique of dual Mini TightRope suspensionplasty for treatment of basilar thumb arthritis.

Methods: We conducted a retrospective study investigating the use of a new dual Mini TightRope suspensionplasty technique from 2010 to 2013 at a single institution. Grip and pinch strength, thumb range of motion, and complications were reviewed. The trapezial space ratio (TSR) was measured from the preoperative, postoperative, and follow up radiographs. All patients completed Disability of Arm, Shoulder and Hand (DASH) survey, Patient Rated Wrist Evaluation (PRWE), and the Michigan Hand Outcome Questionnaire (MHQ) at the latest follow up.

Results: We identified 11 patients (12 thumbs) with an average follow up of 18 ± 4 months (mean ±SD)(range, 13-26). The group consisted of 10 women and a man with an average age of 60 ± 8 years (range, 43-73). Average postoperative DASH score was 19 ± 19, MHQ score was 75 ± 22, and PRWE score was 21 ± 26. Grip strength improved from 13 ± 7 kg to 24 ± 8 kg ($p < 0.0005$). Appositional pinch strength improved from 4 ± 2 kg to 6 ± 2 kg ($p < 0.002$). Oppositional pinch strength improved from 4 ± 2 kg to 6 ± 3 kg ($p < 0.007$). Radiographs demonstrated maintenance of trapezial space height. There were no cases of impingement or fracture of the first and second metacarpal bases.

Conclusions: Dual Mini TightRope suspensionplasty in the management of basilar thumb arthritis yields satisfactory results with improvements in strength and function.

P140. Stenosing Flexor Tenosynovitis – Validity of Standard Assessment Tools of Quality of Life and Function

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Background: There is a paucity of evidence regarding the validity of valuable outcome measures, specifically for patients with stenosing flexor tenosynovitis (SFT). The purpose of this study was to validate common assessment tools for the evaluation of dysfunction and quality of life related to SFT clinical severity.

Methods: Seventy-one patients with SFT were matched to 71 healthy controls. Patient's symptoms were graded using the Quinnell classification. Function and quality of life were evaluated using standard questionnaires, the Disabilities of Arm Shoulder and Hand (DASH, score range 0-100) and the World Health Organization Quality of Life (WHOQOL-BREF, score range 4-20). Correlations, One-way ANOVA and post hoc tests were used to evaluate the sensitivity of these tools to the clinical grading scale.

Results: A significant effect of SFT grade was found demonstrating an increase in DASH scores with increasing severity of SFT (scores 24, SD 16, 38, SD 21 and 45, SD 26, for grades 1, 2 and 3, respectively; p=.044). A similar effect was found for the total WHOQOL-BREF score (scores 15.5, SD 0.6, 14.7, SD 0.3 and 12.2, SD 0.6, for grades 1, 2 and 3, respectively; p=.001) demonstrating a reduction in Quality of life scores with increasing severity of SFT. Although the DASH could only differentiate between the first and third clinical grades, the WHOQOL-BREF score was found to be more sensitive to the different clinical grades. There was a significant difference between the SFT and the healthy groups in both questionnaires (DASH t=-8.4, p=.001; WHOQOL-BR EF t=4.1, p=.001). A mild significant correlation was found between clinical grades and the DASH score (r=.272, p= .024) and a moderate correlation with the WHOQOL-BREF (r=-.433, p= .001).

Discussion: Both questionnaires are useful tools to distinguish between patients with SFT and healthy controls and can distinguish between mild and severe clinical grades. These tools may be implemented in the management as well as in research of treatment of SFT.

P141. Radiographic and CT Evaluation of the Frequency of Distal Radius and Carpal Bones Fractures in Acute Wrist Joint Injuries

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Introduction: Wrist joint injuries are increasingly seen in the emergency orthopedic clinics. Since traumas to wrist joint leading not only to distal radius fractures but also to carpal bones fractures, its recognition comes into prominence. The purpose of the study was to evaluate retrospectively distal radius(DRF) and carpal bones(CBF) fractures; their frequencies, association and varieties in patients who presented to our emergency clinic with acute wrist joint trauma.

Material and Method: Between 1September2013 - 28February2014 all patients with acute wrist joint injury of any cause who presented to our emergency orthopaedic clinic have been scanned retrospectively. In addition to direct radiographs, patients who had done computerized tomography (CT) scan within seven days of the trauma have been included to the study. All patients Xrays and CT scans had been evaluated by single fourth year resident doctor.

Results: 245 patients matched to inclusion criterias. There were 175 male and 70 female, the mean age was 31.6 years (range 4-80). 123 patients had DRF, 86 patients had total of 97CBF. There were 48 CBF in 42 of the 123 DRF patient. 81 patient with isolated DRF and 44 patient with only CBF are identified. While 99 DRF had been detected by direct radiographs, the other 24 were detected by CT. Radiographs identified 36 CBF of 36 patients. CT has diagnosed another 61 CBF in 50 patients. Totally, 97 carpal bone fractures in 86 patients had been revealed (37 scaphoid, 28 triquetrum, 13 lunate, 5 capitate, 4 pisiform, 4 trapezium, 4 trapezoid, 2 hamatum).

Conclusion: Especially non-displaced CBF, due to difficulty of its recognition, and some DRF can be missed easily leading to chronic wrist joint pain and patient dissatisfaction. When CBF is predicted, scaphoid should be the first that come to mind. There are many studies on the frequency of scaphoid fractures, their association with DRF and their managements, such numerous articles are not available for other carpal bones in the literature. CBF are relatively seldom, still must be suspected in every wrist joint injury patient, thus at least accurate physical examination should be done. For example: in displaced DRF which can be easily seen in X-rays, additional carpal bones fracture must be especially sought. Since many studies had shown the superiority of CT over the direct radiographs in detection of CBF, then early obtained CT helps in making definitive diagnosis and commencement of appropriate treatment.

P142. Resistant Nonunions Involving the Distal Radius in Patients with Comorbidities and Multiple Prior Surgeries Treated with Free Vascularized Descending Genicular Artery Bone Flap - Structural Block Combined with Extended Corticoperiosteal Sleeve

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Purpose: To evaluate the clinical outcomes of a specially designed free vascularized bone flap for a select subset of treatment resistant patients.

Methods: Six patients (5 males, 1 female) with a mean age of 52 years had failed to achieve union involving the distal radius metaphysis after a mean of 3.7 prior surgeries over a mean period of 24 months. The most recent failed surgeries, that included non-vascularized bone grafting, prior to vascularized bone flap were for: distal radius fracture, corrective osteotomy of the distal radius, and total wrist fusion. Comorbidities included smoking, alcoholism, chronic nutritional deficiency, and prior osteomyelitis. The specific free flap designed to address this problem consisted of a central structural block graft in continuity with an extended corticoperiosteal sleeve; both vascularized by the descending branch of the genicular artery. The structural block filled the bone defect, and the corticoperiosteal sleeve wrapped around the bone junctions and the neighboring bone margins. The mean flap size was 5.3 (+/- 1.3) cm long by 4.5 (+/- 0.9) cm wide.

Age	Sex	Time since injury (months)	Prior surgeries	Most recent surgery	Flap length (cm)	Flap width (cm)	Time to union (weeks)	Comorbidities
53	M	14	3	radius fracture	5	4	5	smoking, alcoholism, nutrition
58	M	7	3	total wrist fusion	7	5.5	6	smoking, osteomyelitis
45	M	82	2	corrective osteotomy	4	4.5	6	smoking
37	M	23	6	total wrist fusion	5	5	6	smoking, alcoholism, osteomyelitis
52	M	6	5	radius fracture	7	5	7	smoking, alcoholism, osteomyelitis, nutrition
67	F	12	3	radius fracture	4	3	11	smoking, alcoholism, osteomyelitis, nutrition

Results: All flaps incorporated, achieving union across the prior bony defect at a mean of 6.8 (+/- 2.1) weeks following surgery.

Conclusions: With few alternative solutions able to address this unique and difficult problem, the structural block of vascularized bone with the extended corticoperiosteal sleeve proved able to both achieve a union that had failed multiple previous attempts and to resist reactivation of infection, in a challenging group of patients with comorbidities.

P143. Pathologies of the Extensor Carpi Ulnaris Tendon in Tennis Players

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Introduction: Tennis become one of the most popular sports in the world today and different from the past where the wrist remained fixed, nowadays players use the wrist to increase the speed and ball spin like a whip – causing a great load in the wrist. Extensor carpi ulnares (ECU) is the anatomic structure most affected on tennis player wrist, due to its particular anatomy and the type of racquet grip**.** We present our experience with high performance tennis players with ulnar side wrist pain related to ECU tendon.

Material & Methods: From 1994 to 2013 we treated 52 tennis players with ulnar side wrist pain related to isolated ECU pathology. Patients with other wrist pathologies like TFCC injuries or lunotriquetral tears were excluded. Diagnostic was confirmed by clinical examination, dynamic ultrasound and MRI. Patients were evaluated in terms of type of racquet grip, wrist range of motion, grip strength, analogic scale of pain and return to tennis activities

Results: There were 40 male and 12 female, average age 32,5 year-old, dominant wrist was affected 46/52 patients. Most of the patients used the Western racquet grip. Minimum follow up was 15 months. 29 patients had isolated ECU tenosynovitis, 18 had ECU tendinopathy, 04 had ECU subluxation and 01 had ECU rupture. 20/29 patients with tenosynovitis got better with conservative treatment (NSAID + wrist splint + Hand Therapy), 09/29 required cortisone injection. All 04 cases with ECU instability were submitted to retinacular subsheat sling reconstruction. 4/18 with tendinopathy were submitted to tendon debridement.

Conclusion: The ECU must receive a special attention on treating tennis players wrist due to its frequency and the great variation in terms of pathologies.

P144. Cost Analysis of Dexmedetomidine Administration to Prevent Complex Regional Pain Syndrome

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Background: Complex Regional Pain Syndrome (CRPS) is not only a challenging entity to diagnose and treat, it is also extremely costly. The reported postoperative incidence rates of upper extremity CRPS vary from 2-37%, with medical expenditures totaling $9,613 per year of treatment. Interventions to prevent development of the syndrome could result in substantial savings to our healthcare system. Evidence suggests that the α_2-adrenoreceptor agonist, dexmedetomidine, may act through sympatholytic, peripheral and central analgesic mechanisms to prevent CRPS. The purpose of our study was to analyze the cost effectiveness of prophylactic dexmedetomidine administration as a treatment to prevent CRPS development in high-risk surgical patients.

Methods: From January 2006 to February 2014, patients within our multispecialty group who underwent an upper extremity procedure at high-risk for CRPS development received an intraoperative dose 0.5 mcg/kg of intravenous, dexmedetomidine. We analyzed the cost of this prophylactic intervention with the potential costs of treating patients with CRPS.

Results: We identified a total of 262 patients who met our inclusion criteria and very conservatively hypothesized that 5% (13/262) would develop postoperative CRPS. Medical care, for that conservative assessment, would total $124,969 per year. The institutional cost of administering an intravenous bolus of dexmedetomidine, according to our protocol, was calculated at $65 per patient. This gives a total cost of $17,030 to prophylactically treat all patients in our cohort. Accordingly, if this intervention were effective in decreasing the incidence of postoperative CRPS by only 0.76% (2/262), the resulting institutional cost savings would total $19,226, effectively covering the cost of treating all patients in our cohort.

Discussion: Our study has shown that intraoperative dexmedetomidine administration is an inexpensive intervention intended to prevent the development of CRPS. Substantial cost savings could result from adopting this protocol, however further prospective studies are required to determine the efficacy of dexmedetomidine in CRPS prevention.

P145. Outcomes of "Spaghetti Wrist" Injuries at a City Hospital

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Introduction: Volar wrist lacerations involving at least three major structures—often termed "spaghetti wrist"—are some of the most severely debilitating upper extremity injuries and are associated with significant morbidity. We sought to evaluate outcomes of this detrimental injury at a publicly funded city hospital.

Methods: We queried a patient database at our institution for the ICD-9 codes relating to radial and median nerve/artery injuries and repairs over the past 5 years, and who were treated by Plastic Surgery attendings and residents. Using a retrospective analysis, we characterized each of these injuries with regard to patient demographics, mechanism of injury, and type of repair performed. Outcomes data were recorded with regard to recovery of nerve function, range of motion and overall patient satisfaction.

Results: Over the past 5 years, 21 patients (17 men, 4 women) with an average age of 28 had volar wrist lacerations involving at least one major artery or nerve. 17 of these injuries were related to assault, while the remaining were due to occupational injuries. In total, 14 median nerves, 13 ulnar and 2 radial nerves were severed. Of the 29 nerve injuries, 20 were repaired primarily, 5 with autograft (sural nerve), and 4 with nerve conduits. There were 4 complete lacerations of the radial artery and 11 to ulnar artery; all were repaired primarily except 1 (saphenous vein graft). Out of the 21 patients, 17 sustained injuries to at least one tendon. Overall outcomes with regard to nerve function and range of motion were good. Patients were satisfied with their result.

Conclusions: Wrist lacerations that include damage to major nerves, vessels and tendons were seen with relative frequency at our publicly funded city hospital, with good overall functional outcomes after repair.

P146. Dorsal Fracture-Dislocations of the Proximal Interphalangeal Joint: Evaluation of Closed Reduction and Percutaneous Kirschner Wire Pinning

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Background: The purpose of this study is to evaluate the outcome of closed reduction and percutaneous Kirschner wire pinning in acute dorsal fracture-dislocations of the proximal interphalangeal (PIP) joint.

Methods: Eight men and one woman were treated with closed reduction and percutaneous Kirschner wire pinning by one orthopaedic surgeon. The ring finger was injured in six patients, the small finger in two patients, and the middle finger in one patient. The mean joint surface involvement was 39% (range, 26 - 49%). The Kirschner wires were removed after an average of 27 days (range, 24 - 37 days).

Results: All patients demonstrated a painless, but fusiform swollen PIP joint after a mean follow-up of 6.5 months. The average flexion of the PIP joint was 106 degrees (range, 80 - 110), and the average extension at the PIP joint was 4 degrees short of full extension (range, 10 hyperextension - 15 flexion contracture). All patients had a concentrically reduced PIP joint with a healed fracture on radiographs. Two patients had radiographic evidence of degenerative changes, but were asymptomatic. One patient developed a superficial pin track infection, which quickly resolved with a short course of antibiotics, and an avascular necrosis affecting one of the condyles of the proximal phalanx.

Conclusions: In agreement with previous studies, closed reduction and percutaneous Kirschner wire pinning in dorsal fracture-dislocations of the PIP joint is a minimally invasive and simple technique which appears to give satisfactory outcomes in the short to intermediate term.

P147. Bilobed Flap for Web Reconstruction in Adult Syndactyly Release: An Update of the Results

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Introduction: The goal for syndactyly release is to create a more normal web space in order to improve the function and appearance of each finger and incur the minimum amount of long-term morbidity (**1**). In syndactyly release or any web reconstruction, the use of full-thickness skin grafts is time-consuming and often associated with graft contraction, web creep, partial graft loss, hyperpigmentation, hair growth following puberty, and hypertrophic scarring (**2**). This study describes the use of a bilobed flap for formation of web spaces in the treatment of syndactyly release, which decreases the graft need and also avoids the use of skin grafting in syndactyly release and in web reconstruction cases. The present technique was developed based on a concept for the beneficial use of the dorsal hand skin by lowering or eliminating the need for a skin graft.

Methods: A retrospective review of this procedure was performed for 15 web space reconstructions. Patients were aged 20 to 23 years. The mean follow-up period was 7–12 months (mean 7±3.2). The operations were performed for the beneficial use of the dorsal hand skin by lowering the need for a skin graft. The flap was on the dorsum of the hand and proximal phalanx, and was used for web formation.

Results: Surgery was completed without skin grafting in nine cases of 14 web spaces; two of them were complex/complete, and two of them were simple/complete syndactylies. We used a skin graft in one patient because of triangular flap necrosis in a second operation. The use of a bilobed flap allowed the construction of web spaces, providing satisfactory cosmetic outcomes.

No partial necrosis or complications were observed in bilobed flaps. No secondary correction was needed during the follow-up period.

Conclusion: We conclude that the bilobed flap can effectively be used in the treatment of primary and secondary syndactyly cases for web formation and reconstruction, especially in an adult population in which the skin on the dorsum of the hand is more pliable; thus, you may be able to avoid problems related to the skin graft.

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P148. Preoperative EKG Testing in Non-syndromic Children with Hand Syndactyly

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Introduction: The risk of sudden cardiac events in patients with Timothy syndrome, a rare and fatal condition characterized by hand syndactyly and a prolonged QT interval on EKG, has led to recommendations for preoperative EKG's for all patients undergoing syndactyly release. We hypothesize that the rarity and presentation of this disorder, along with the additional charges associated with testing, do not support mandates for EKG screening in all children referred for surgery.

Materials & Methods: This retrospective study reviewed the records of syndactyly patients treated by a hand surgeon at our institution from 2007-2013. Non-syndromic, healthy children with hand syndactyly referred for surgery were included. As per institutional policy, all underwent preoperative screening EKG's. Medical records were reviewed for demographics, presentation, EKG results, and operative findings. Median age at the time of EKG and surgery were calculated. Frequency distributions were also calculated for: gender, side affected, EKG result, and clinical finding. Mean patient charge for EKG was calculated.

Results: One hundred twenty-eight non-syndromic syndactyly patients were identified. The majority was male (71.9%), and the mean ages at time of EKG and syndactyly release were roughly 1 year. Most patients (93.8%) had normal EKG results, with 1 patient receiving a diagnosis of prolonged QT. One-third of patients with normal EKG results had a false-positive, and 50% of patients with an initial abnormal result were later found normal. No patient met the QT threshold for Timothy syndrome, and all patients were cleared for surgery. The mean patient charge for EKG testing was roughly $180.00.

Conclusions: In an effort to improve patient safety, preoperative EKG testing has been advocated for all children undergoing syndactyly release to rule out Timothy syndrome. Though rare, life threatening arrhythmias have been documented during syndactyly release in undiagnosed patients. Most cases, however, are diagnosed during the first months of life, before the typical age of surgery, and often present with craniofacial and neurocognitive anomalies. Analysis of our institutional experience failed to yield an instance of Timothy syndrome over a 7 year period. Although costs for screening EKG tests are relatively low, additional costs due to false-positive EKG findings, and provider and parent time should also be considered. In an era of increasing mandates to improve patient safety yet decrease healthcare costs, insufficient evidence exists to support routine EKG testing for all children referred for syndactyly release. Further research needs to be conducted to develop more robust screening criteria.

P149. Ethical and Educational Considerations in Coding Hand Surgeries

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Purpose: To assess treatment coding knowledge and practices among residents, fellows, and attending hand surgeons.

Methods: Through the use of 6 hypothetical cases, a coding survey was developed to assess coding knowledge and practices. This survey was emailed to residents, fellows, and attending hand surgeons. Additionally, 2 professional coders were asked to code these cases

Results: Seventy-one participants completed the survey out of 134 people to whom the survey was sent (response rate = 53%). We observed marked disparity in codes chosen among surgeons and among professional coders.

Conclusion: The results of this study indicate that coding knowledge, not just ethical application thereof, played a major role in coding procedures accurately. Surgical coding is an essential part of a hand surgeon's practice and is not well learned during residency or fellowship. While ethical issues such as deliberate unbundling and upcoding may play a role in inaccurate coding, lack of knowledge among surgeons and coders plays a major role as well.

Clinical Relevance: Coding plays a critical role in every hand surgery practice. The inconstancies among those polled in this study reveals that an increase in education on coding during training and improvement in the clarity and consistency of the Current Procedural Terminology coding rules themselves are needed.

Discussion and Clinical Relevance: In this study 21.4% of the lunates relied on nutrient vessels entering exclusively from volar or dorsal. Surgical intervention using a volar approach is advised ulnar of the proximal-distal midline to prevent risk of vascular damage. A dorsal surgical approach is advised radial from the proximal-distal midline directed slightly to proximal (fig 2). These quadrants have the least amount of vessels and are only supplying a small portion of the lunate. These findings will help minimizing iatrogenic avascular necrosis of the lunate bone by respecting the osseous blood supply of the lunate bone, and changing our surgical approach accordingly.

P150. Routine Use of Locking Shaft Screws is Not Necessary in Volar Plate Fixation of Distal Radius Fractures

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Background: Volar plate fixation is a common method of treatment for distal radius fractures. Many implants are designed such that there is the option to use locking screws in the shaft portion of the plate. One indication for the use of locking plates is poor bone quality, and there is a high incidence of low bone mineral density in patients who sustain distal radius fractures. The indications for the use of locking shaft screws are not well defined. Our hypothesis is that the routine use of locking screws in the shaft portion of volar plates is not required to maintain reduction or to prevent hardware failure.

Methods: A retrospective review was performed of all patients over age 50 over a 2 year period that underwent volar plate fixation using an implant with non-locking shaft screws for a distal radius fracture. Patients were permitted to perform early range of motion exercises. Radiographs were examined and measurements obtained to assess maintenance of reduction and incidence of hardware failure. Patients were excluded from analysis if locking shaft screws were utilized or if follow-up was inadequate.

Results: There were 47 patients who met the inclusion criteria. The average age was 62 years (range: 50-79 yo). There were 33 men and 14 women. The average length of followup was 24.4 weeks. The implant used incorporates 3.5 mm shaft screws in 39 patients, and 2.4 mm shaft screws 18 patients. All patients healed within acceptable radiographic parameters (mean volar tilt = 5.4°, mean radial inclination = 21.5°, mean radial height = 11.5°). There were no instances of hardware failure.

Conclusion: Distal radius fractures frequently occur in patients with low bone mineral density. Non-locking, bicortically placed shaft screws provide adequate stability to allow for early range of motion without loss of reduction or hardware failure. The routine use of locking screws in the shaft portion of volar plates does not appear justified.

P151. When Should the Hourglass-like Constrictions of the Anterior Interosseous Berve be Operated? The Relationship between the Timing of Operation and the Post-operative Functional Recovery

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Objective: The suspected cause of spontaneous anterior interosseous nerve (AIN) palsy has been reported as neuralgic amyotrophy, isolated neuritis, entrapment neuropathy or an hourglass-like fascicular constriction of AIN within the main trunk of the median nerve.

We have been performing surgical treatments for those who do not show any sign of recovery within 3 to 6 months from onset, but the timing for surgical treatment still remains controversial. The purpose of our study is to investigate the relationship between the timing for surgical treatment and the functional recovery.

Method: 19 cases (17 patients) of AIN either presenting complete paralysis of the flexor digitorum longus (FPL) or flexor digitorum profundus (FDP) of the index finger were studied. The patients consisted of 7 males and 10 females with the average age of 43 years old (21 to 58). Ten cases were treated surgically by exposing the median nerve from 10 cm above the elbow to the arcade of flexor digitorum superficialis, followed by interfascicular neurolysis of the AIN fasciculi within the main trunk of the median nerve under the microscope. The cases consisted of 6 patients with complete paralysis of both FPL and FDP, 3 with complete paralysis of FPL and one with complete paralysis of FDP. Nine cases who refused surgical treatment were treated conservatively showing paralysis for both FPL and FDP in 3 case, FPL in one case and FDP in 5 cases.

Result: Ten patients were operated with the average of 6.2 months after the onset (4 t o13 months). The hourglass like constriction was found in all the cases with the average of 2.5 constrictions per case (1 to 4). The first sign of recovery was observed after 6.2 months with FPL and 2.7 months with FDP. Except for the case who was operated 13 months after the onset, the remaining 9 cases showed good recovery showing at lease MMT 4 for FPL and FDP.

For the conservatively treated cases, 4 cases showed recovery within 6 months from the onset and one case showed recovery after 6 months from the onset. However at the final follow up, 4 cases did not show any sign of recovery.

Conclusion: Our study shows the patients with AIN showing no recovery after 6 months from onset and prolonged surgery from the onset also results in poor functional recovery. Thus AIN should be treated within 6 months from the onset.

P152. A Novel Screening Technique for Carpometacarpal Dislocations

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Introduction: Ulnar-sided CMC joint dislocations account for about 1% of all hand trauma. There is great difficulty in diagnosing these injuries, and more than half of these injuries are missed on initial examination. Current methods of radiographic evaluation are heavily dependent on the quality of radiographs and clinician experience. We hypothesize that measuring the angle between the capitate and the ulnar-sided metacarpal bones will provide a reliable and simple radiographic tool to aid the diagnosis of ulnar-sided CMC dislocations.

Materials & Methods: We retrospectively reviewed all patients who underwent operative procedures for known ulnar-sided CMC dislocations from 2003-2013. Patients who did not have a pre-operative Computed Tomography (CT) scan were excluded. The control group consisted of radiographs for consecutive patients without evidence of bony carpal pathology as determined by attending radiologist.

An Orthopaedic resident identified the contour of the capitate, 4^{th} and 5^{th}metacarpals on plain radiographs. The information regarding the contour of each bone was input into Matlab (MathWorks; Natick, MA), which identified the axis of each bone and calculated the two-dimensional (2D) angle between each metacarpal and the capitate.

To account for the variability in lateral plain radiography, the Digital Imaging and Communications in Medicine (DICOM) information from each patient's CT scan was input into Mimics (Materialise NV; Belgium) to build a three-dimensional (3D) model. The 3D model was used to obtain a sagittal plane image that would represent a 'true lateral' view. The angle between the capitate and lesser metacarpals was calculated on the 3D reconstructions using the same algorithm for the 2D radiographs.

Results: Measurements based on the 2D lateral radiographs showed the control group to have a capitate-5^{th} metacarpal angle of 12^0 compared to 19^0 in the study group ($p<0.05$). When measured using the 3D sagittal reconstructions, the control group measured 21^0 compared to 27^0 in the study group ($p<0.01$). The capitate-4^{th}metacarpal angle measured on 2D lateral x-rays was 10^0 in the control group versus 20^0 in the study group ($p<0.01$). Using the 3D reconstructions, the same angles were measured as 18^0 in the control and 24^0 in the study group ($p<0.05$).

Conclusions: Based on both 2D and 3D measurements, the angle between the capitate and lesser metacarpals proves to be a reliable screening tool for carpometacarpal dislocations. When evaluating post-traumatic hand pain, an increased capitate-metacarpal angle can be an important cue to obtain advanced imaging studies to further evaluate the CMC joints.

P153. Autologous Osteoligamentous Reconstruction of Scaphoid Proximal Pole with Metatarsal Head and Collateral Ligament – Cadaver Anatomic Description of Novel Surgical Technique

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Introduction: Historically, scaphoid nonunion has been surgically treated with vascularized bone graft taken from multiple different anatomic sites including the distal radius, metacarpal, iliac crest and medial femoral condyle. However, none of these grafts fully recapitulates the unique anatomy of the proximal pole of the scaphoid and the attachment of a critical structure—the scapholunate ligament. We present an anatomic study of the use of vascularized second metatarsal head with its collateral ligament as a novel treatment of proximal pole scaphoid nonunion with collapse.

Materials and Methods: Scaphoids and second metatarsal heads were harvested from bilateral upper and lower extremities of 18 fresh frozen cadavers (10 male, 8 female) for a total of 36 scaphoids and 36 second metatarsal heads. The second metatarsal head was harvested with its collateral ligaments and its blood supply from the first dorsal metatarsal artery (FDMA). Measurements of the scaphoid, the scapholunate ligament (SLIL), the second metatarsal head, and collateral ligaments were compared to matched limbs from the same cadaver.

Results: In this study we demonstrated successful reconstruction of the scaphoid proximal pole with a single osteoligamentous vascularized autologous second metatarsal head with its collateral ligament in cadavers as shown in Figure 1. Additionally anatomic measurements revealed that the metatarsal head and collateral ligament are sufficiently similar to the scaphoid proximal pole and the SLIL as shown in Table 1.

Conclusions: This anatomic cadaver study reveals that the metatarsal head with its associated collateral ligament is a well-matched donor to reconstruct the proximal pole of the scaphoid and scapholunate ligament. This novel technique is perfectly suited to treat nonunion of the scaphoid proximal pole with or without avascular necrosis. Although some anatomic differences were observed between donor and recipient tissues, these differences were found to be advantageous from a technical standpoint as they would result in a slightly smaller construct that articulates with the lunate without difficulty.

Figure 1.

Figure 1: Scaphoid reconstruction with vascularized second metatarsal head with k-wire fixation.

Table 1.

Mean Diameter	Scaphoid proximal pole	16.84 +/- 1.68 mm	p<0.001
	Second metatarsal head	15.77 +/- 1.25 mm	
Mean Width	Scapholunate ligament	3.40 +/- 0.86 mm	p<0.001
	Metatarsal collateral ligament	5.14 +/- 0.65 mm	
Mean Thickness	Scapholunate ligament	1.81 +/- 0.49 mm	p<0.001
	Metatarsal collateral ligament	1.07 +/- 0.32 mm	

Table 1. Comparison of measurements diameter, width and thickness of scaphoid proximal pole and SLIL to second metatarsal head and collateral ligament.

P154. Hiradenocarcinoma in the Hand of a Young Women

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Introduction: Hidradenocarcinoma (HAC) is a malignant tumor of the eccrine sweat gland that is rarely seen in the hand. Because of its poor prognosis it should remain in the differential diagnosis when certain clinical and histological features are present. HAC has a high recurrence rate and potential for metastases and death. Numerous cases in older adults have shown significantly poor outcomes. While there is little consensus for therapy, a variety of treatments for the rarely occurring HAC have been attempted. Here we report a unique case of HAC in the hand of an 18 year-old female.

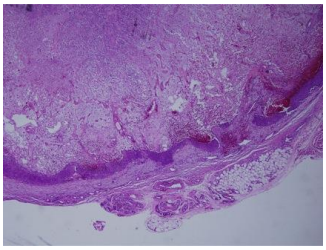
Materials & Methods: An 18 year-old female presented to a local physician with a complaint of a small (5-6 cm in diameter) round mass on the ulnar side of her right palm. Excisional biopsy demonstrated atypical cells, prominent nucleoli, and numerous mitotic figures. The tumor revealed expression of INI1 and high molecular weight cytokeratin, which supported adnexal origin. There was a large area of central necrosis. Because of the high suspicion of malignancy the patient underwent wide excision with clear margins at our institution. A 2mm conduit was used to repair the segmental defect in the ulnar nerve and a flap was rotated to cover the defect (fig 1). Postoperative the patient had limited sensation to the ulnar side of the small finger. The specimen from wide excision was negative upon further pathology and healed within several weeks.

Results: In this case the excised tumor consisted of a fibrous capsule surrounding a rim of polygonal basaloid cells. Other notable observations were; vascular outline, presence of fibrin, centrally located degradation and necrosis, and the presence of adipose and sweat glands in the pericapsular area. The tumor cells had an eosinophilic 'hyaline' type cytoplasm with an eccentric nucleus; mitoses was present but not abundant. Most important was the presence of rare duct-like structures (figure 2). The overall features were that of a sweat gland tumor or hidradenoma which, because of the presence of mitoses and necrosis, was considered a low-grade hidradenocarcinoma.

Conclusions: In this case report we identified histological features of HAC tissue and successfully eradicated affected tissue by wide local excision while preserving hand function. With lack of consensus regarding definitive therapy and poor prognosis with metastasis, the keys to treating HAC include early diagnosis and wide excision.

Figure 1

Figure 2



P155. Scapholunate Advanced Collapse – A Case Control Study

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Introduction: Scapholunate advanced collapse (SLAC) is a common condition seen in hand surgery. Despite this, very little data exists regarding the etiology or demographics of patients with SLAC wrist pattern. We performed a case control study to identify demographics and risk factors for patients undergoing operative treatment of scapholunate advanced collapse.

Materials & Methods: Institutional Research Ethics Board approval was obtained. One-hundred sixty-three charts were reviewed for all patients undergoing proximal row carpectomy, four corner fusion, total wrist fusion, and total wrist arthroplasty at a single institution between January 1, 2008 and January 1, 2013. Sixty-one patients were identified with the diagnosis of scapholunate advanced collapse (SLAC). For the control group, sixty-one patients from the same institution and time period were randomly chosen from all patients undergoing ligament reconstruction tendon interposition for carpometacarpal osteoarthritis (CMC OA). The following data were collected for the SLAC and CMC OA group: age, gender, history of traumatic injury, history of manual labour, duration of symptoms, and dominant hand involvement. Pearson Chi-square tests for proportion data and independent samples t-test for continuous variables were performed to determine differences between groups ($P<0.05$).

Results: Patients with SLAC wrist were more likely to be male (80.3% vs 31.1%; $p<0.05$), have a history of a traumatic injury (69.5% vs 25.9%, $p<0.05$), have a longer symptom duration (10.3±13.3 vs 3.5±2.5 years, $p<0.05$), and be involved in a manual labour job (49.0% vs 19.6%, $p<0.05$) compared to patients with CMC OA. There was no difference in mean age (53.1±10.4 vs 58.3 ± 9.8; p=.966) or dominant hand involvement (48.2% vs 53.6%; p=0.706) between SLAC and CMC OA, respectively.

Conclusion: Patients with SLAC wrist are more likely to be male, have a history of a traumatic injury, and be involved in a manual labour profession compared to patients with CMC OA. This data helps to characterize the epidemiology of patient undergoing procedures for SLAC wrist and its association with a past history of a traumatic event.

P156. The Use of an iPad to Evaluate Patient-Reported Functional Outcome Measures in Hand Surgery

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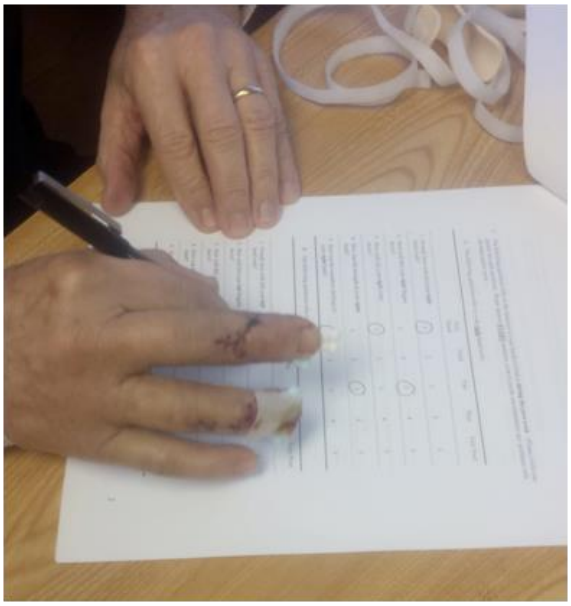
Introduction: Accurate and efficient patient-reported outcome data collection is critical for assessment of surgical outcomes. Traditional pen and paper data collection is time, labor, and resource intensive, and possibly even more strenuous for patients presenting with hand and upper extremity ailments. An iPad-based system offers potential for improved usability and thus fewer omissions compared to a traditional pen and paper system. Our purpose was to evaluate the feasibility of collecting patient-reported outcome measures using an iPad for two different questionnaires.

Methods: 200 total patients were randomized to complete one of two questionnaires using either an iPad or pen and paper. The Michigan Hand Questionnaire (MHQ) and QuickDASH questionnaires were administered using either an iPad or pen and paper with 50 patients in each group. Identical content and verbal/written instructions were given. Questionnaires were analyzed to identify differences in patient preference for future questionnaire format, questionnaire completion, number of omissions, ease of use, and time to completion between iPad and pen and paper groups for both questionnaires.

Results: The proportion of patients who preferred the given questionnaire delivery method again was significantly higher the iPad group compared to the pen and paper group for the MHQ (93.9% vs 47.9%;$p<0.001$) and QuickDASH (90.0% vs 58.3%;$p<0.001$) questionnaires. A higher proportion of the iPad group found questionnaires physically "very easy" to complete compared to pen and paper for MHQ (72% vs 56%; $p=0.098$), though not for QuickDASH (76% vs 70%;$p=0.504$). The iPad group was associated with fewer omissions compared to pen and paper for the MHQ (0.4 vs 2.0;$p=0.124$) and QuickDASH (0.0 vs 0.2;$p=0.025$). The iPad group was associated with a higher proportion of scorable questionnaires using the MHQ (98% vs 90%;$p=0.095$) and QuickDASH (100% vs 94%;$p=0.083$) questionnaires. Time to completion was similar for the MHQ questionnaire, but was significantly longer for the QuickDASH questionnaire using the iPad compared to pen and paper (3.3 vs 2.5 minutes;$p=0.012$).

Discussion: iPad users overwhelmingly preferred to use an iPad again compared to pen and paper users preferring to use pen and paper again. The longer questionnaire (MHQ) resulted in appreciable ease of use differences in favor of the iPad (Figure 1) with a similar time to completion. The iPad was associated with lower number of omissions and more scorable questionnaires. The use of an iPad is an efficient and preferable questionnaire format for longer patient-reported outcomes questionnaires in a high-volume hand and upper extremity practice setting.



P157. Treatment of Elbow Osteomyelitis with an Interposition Arthroplasty Utilizing Free Muscle Flaps

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Introduction: Osteomyelitis of the elbow may be a complex clinical problem. Treatment goals include the eradication of infection and preservation of maximal joint function. Bony debridement maybe necessary in addition to elbow joint arthroplasty. The use of synthetic material or allograft as the arthroplasty material may be contraindicated in the setting of infection. The use of free muscle transfer as an arthroplasty medium has not previously been well described.

Methods: We illustrate the cases of two patients who developed recurrent osteomyelitis of the right elbow, necessitating extensive bony debridement by the orthopedic surgery team. Reconstruction arthroplasty was performed using a free rectus abdominis muscle flap in one case and a free gracilis muscle flap in the other to serve as a source of biologically active, wellvascularized arthroplasty medium in the presence of ongoing infection.

Results: Successful free muscle flap arthroplasties were performed. External fixation and physical therapy were implemented post-operatively. Both patients had resolution of osteomyelitis and improving functional use of the elbow for activities of daily living.

Conclusion: Elbow arthroplasty in the setting of active infection may be accomplished by means of free tissue muscle transfer. Elimination of infection and acceptable joint function may be possible with this form of reconstruction. This series illustrates a novel method of reconstruction of chronic elbow osteomyelitis after bony debridement.

P158. Outpatient and Surgical Case Volume Before and After Adoption of an Electronic Medical Record System

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Introduction: The Patient Protection and Affordable Care Act of 2010 includes an incentive program to encourage physicians to implement an electronic medical record system (EMR) in their practice. Little data exists regarding the effect of EMRs on practice efficiency. Our study is designed to assess outpatient visits per day and surgical cases per day before and after adoption of an EMR.

Methods: The records of six orthopaedic surgeons practicing in a Level 1 academic center were reviewed to assess the number of outpatient visits and surgical cases before and after adoption of an electronic medical record system. The practice implemented the EMR in July 2013. In order to control for the learning curve of adopting an EMR and to counter any effect of seasonal variation on patient volume, we collected data from October through March of both the year before (10/2012-4/2013) and after (10/2013-4/2014) implementation of the EMR. A paired-sample t-test was performed to determine if the EMR had a significant effect on the number of outpatient visits per office day or surgical cases per operative day during the study period.

Results: All surgeons were able to see an increased number of patients per office day (range: 0.3% to 15.8%). Four physicians had an increase in surgical cases per operative day between 18.7% and 42.1%. As a whole, the practice was able to see a significant increase in the number of outpatients per office day ($p = 0.047$) while the increase in surgical cases per operative day approached significance ($p = 0.061$) (Tables 1 and 2).

Conclusion: Following the adoption of an electronic medical record, our practice was able to see a significantly greater number of patients per day in the outpatient office and saw an increase in surgical cases per operative day.

Surgeon A	2012-2013	2013-2014	Delta (%)
Total Outpatient Visits	2450	2437	-0.5%
Total Outpatient Days	60.5	60	-0.8%
Outpatient Visits/Day	40.5	40.62	0.3%
Total Surgical Cases	302	306	1.3%
Total Surgical Days	48.5	49.5	2.1%
Surgical Cases/Day	6.23	6.18	-0.7%

Surgeon D	2012-2013	2013-2014	Delta (%)
Total Outpatient Visits	2578	2825	9.6%
Total Outpatient Days	68	68.5	0.7%
Outpatient Visits/Day	37.91	41.24	8.8%
Total Surgical Cases	155	195	25.8%
Total Surgical Days	45.5	44	-3.3%
Surgical Cases/Day	3.41	4.43	30.1%

Surgeon B	2012-2013	2013-2014	Delta (%)
Total Outpatient Visits	2230	2081	-6.7%
Total Outpatient Days	60	54	-10.0%
Outpatient Visits/Day	37.17	38.54	3.7%
Total Surgical Cases	208	234	12.5%
Total Surgical Days	57.5	54.5	-5.2%
Surgical Cases/Day	3.62	4.29	18.7%

Surgeon E	2012-2013	2013-2014	Delta (%)
Total Outpatient Visits	1587	1784	12.4%
Total Outpatient Days	50	55	10.0%
Outpatient Visits/Day	31.74	32.44	2.2%
Total Surgical Cases	182	170	-6.6%
Total Surgical Days	63	60.5	-4.0%
Surgical Cases/Day	2.89	2.81	-2.7%

Surgeon C	2012-2013	2013-2014	Delta (%)
Total Outpatient Visits	1365	1802	32.0%
Total Outpatient Days	57	65	14.0%
Outpatient Visits/Day	23.95	27.72	15.8%
Total Surgical Cases	49	80	63.3%
Total Surgical Days	31	41	32.3%
Surgical Cases/Day	1.58	1.95	23.4%

Surgeon F	2012-2013	2013-2014	Delta (%)
Total Outpatient Visits	1220	1305	7.0%
Total Outpatient Days	40	42	5.0%
Outpatient Visits/Day	30.5	31.07	1.9%
Total Surgical Cases	56	86	53.6%
Total Surgical Days	37	40	8.1%
Surgical Cases/Day	1.51	2.15	42.1%

Table 1: Outpatient Visits and Surgical Cases per Physician

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval		t	df	Sig. (2-tailed)
				Lower	Upper			
Outpatient Visits Per Day After EMR vs Prior to EMR	1.64	1.54	0.63	0.03	3.26	2.62	5.00	0.047
Surgical Cases Per Day After EMR vs Prior to EMR	0.43	0.43	0.18	-0.03	0.88	2.42	5.00	0.061

Table 2: Paired Samples T-Test of Patient Throughput After EMR vs. Prior to EMR

P159. Anatomical Basis and Clinical Application of Synovial Flaps in the Wrist and Distal Forearm

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Twenty fresh cadaver upper extremities were injected with microfil in order to analyze the arterial anatomy, flap dimensions and arc of rotation of the flexor tendon synovium mobilized as a flap suitable for coverage of the median nerve at the wrist. Our dissections demonstrated that the flexor tendon synovium surrounding both the superficial and deep flexors is supplied by discrete pedicles from the major blood vessels of wrist and palm. Both radial and ulnar based flaps have a reliable arterial supply and are clinically useful for providing coverage in the wrist and distal forearm. We describe a series of 18 patients in whom we used the flexor tendon synovial flap to solve complex reconstructive problems involving the median nerve in this region, all of whom healed satisfactorily. Of thirteen patients treated for post-traumatic median nerve neuromas, all but two had significant resolution of symptoms. When used as a vascularized flap, the flexor tendon synovium provides adequate protection of the median nerve. Flap dimensions and vascularity of this tissue render it a suitable local flap option when performing reoperative surgery on the median nerve.

P160. Relationship Between Smoking and Outcomes After Cubital Tunnel Release

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Introduction: Several sources of literature draw a connection between cigarette smoking and cubital tunnel syndrome. One comparison study demonstrated worse outcomes in smokers treated with transmuscular transposition of the ulnar nerve. Despite this, very little is known about the effects that smoking might have on patients who undergo ulnar nerve decompression at the elbow. The purpose of our study is to evaluate outcomes in patients treated with ulnar nerve decompression, and determine if a smoking history at the time of surgery affected improvement.

Materials and Methods: Our study used a survey developed from the comparison article with additional questions based on outcome measures from supportive literature. Focus questions of our survey ask a patient about their post-operative improvement including sensation, strength, and pain scores. A thorough smoking history was also obtained. Patients treated with cubital tunnel surgery were gathered from a 10-year period with follow-up of at least 2 years. 1,366 surveys were mailed to former patients. 247 surveys with adequate information were returned, representing 227 patients.

Results: The results of our study show a demographic comparison between smoking and non-smoking groups with no difference in age, mean follow-up, sex, body mass index, workers compensation history, and diabetes. Pre-operative symptoms of small finger pain, tingling, and numbness demonstrate that patients who smoked at surgery were more likely to relate symptoms of pain than their non-smoking counterparts. They also reported paresthetic symptoms more commonly, although these are not statistically significant. Findings in post-operative symptoms demonstrate that non-smoking patients generally report more favorable improvement in sensation, strength and pain however these findings are not statistically significant.

Further evaluation compares outcomes in smoking patients between simple decompression and transposition surgeries. No statistical difference exists between the groups in regards to age, follow-up, sex, dominant hand, BMI, workers compensation and diabetes. No difference in symptoms is observed between groups pre-operatively. Findings in post-operative symptoms of smokers show no statistical significance favor of in situ or transposition surgery.

Conclusions: At the conclusion of this study we find no statistically significant difference in outcomes after ulnar nerve decompression surgery in smokers and non-smokers. Although statistical significance is not found, some observational differences are seen that may have clinical implications. Finally, among smokers, surgical decompression type was not different suggesting that any variations in outcomes are likely not related to simple decompression versus transposition.

P161. Results of Operative Intervention for Post-Traumatic Finger Stiffness

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Introduction: Surgical treatment of post-traumatic finger stiffness can be challenging, and there is a paucity of data in the literature regarding outcomes of operative intervention for this common clinical problem. We hypothesized that the results of tenolysis and joint contracture release for post-traumatic digital stiffness are suboptimal.

Materials & Methods: Using our surgical database, we retrospectively identified all patients over a three year period who underwent an operative procedure to improve post-traumatic finger stiffness. We included only patients who were undergoing soft tissue procedures (tenolysis, capsular releases) without bony reconstruction. Patients requiring concomitant malunion correction were excluded. Nineteen patients met inclusion criteria. Procedures performed included metacarpophalangeal joint capsulectomy (n=10), proximal interphalangeal joint capsulectomy (n=12) flexor tenolysis (n=8), extensor tenolysis (n=17), and hardware removal (n =9). We collected demographic data including age, initial diagnosis and treatment, health history, and workers compensation status. We recorded the number of days between surgical release and initiation of therapy. Total Active Motion (TAM) was recorded prior to surgical release and at the patient's last follow up. Patients were followed until range of motion plateaued in physical therapy.

Results: The average duration of follow up was 151days. Improvements in TAM after surgical release averaged 42 degrees (range = -30 to 115). Four patients had a net decrease in TAM after release. Patients who started physical therapy within seven days (avg. 2.7 days) of the release improved by an average of 57.3 degrees, whereas those who started physical therapy after seven days (avg. 11.5 days) lost an average of 19.3 degrees (p=0.0002). Patients who had filed a worker's compensation claim improved an average of 9.3 degrees, whereas non worker's compensation patients improved an average of 55.9 degrees (p=0 .0227). Degree of TAM improvement had a very weak correlation with patient age (r=0.09, p=0.35) or preoperative TAM (r=0.35, p=0.05).

Conclusions: Surgical release for stiff fingers can offer modest improvements in select patients, but the overall results of these operations are generally limited. Immediate physical therapy is essential to maximize improvements in TAM postoperatively, and patients who started therapy 7 days after the procedure had significantly lower TAM than those that started within 3 days. Patients involved in worker's compensation claims demonstrated significantly lower TAM improvement after surgical intervention.

P162. Radiographic Findings in Untreated Adults with Thumb Duplication

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Introduction: Thumb duplication is a complex congenital anomaly in which both duplicate parts are often deficient. Surgery for thumb duplication involves removal of the more hypoplastic thumb, reconstruction of a collateral ligament, and reattachment of the thenar musculature with or without transfer of an island flap to improve the contour of the thumb. The most common complications after surgery are recurrence of the axial deformity, joint instability, and decreased range of motion (Patel, 2013). We believe that the decreased range of motion is a consequence of the condition rather than the surgery. The aim of this study was to investigate the radiographic features of the joints in untreated adults with thumb duplication.

Materials and Methods: Twelve hands of 10 adults with thumb duplication were included in the study. The radiographic findings were classified according to the Wassel system. Narrow joint space, intra-articular incongruity, and joint fusion were recorded.

Results: One hand had Wassel type II thumb duplication, three had type III duplication, three had type IV duplication, two had type V duplication, and three had type VII duplication. Radiographic abnormalities were observed in 13 joints, including narrow joint space in 1 metacarpophalangeal (MCP) joint and 1 interphalangeal (IP) joint, joint fusion in 2 MCP joints, and intra-articular incongruity in 4 MCP joints and 5 IP joints (Figure 1).

Discussion: Patients with thumb duplication often have bone, joint, and soft tissue abnormalities. The abnormalities may include collateral ligament deficiencies, abnormal origins and insertions of the flexor and extensor tendons, and attachment of abductor pollicis brevis to the radial thumb. Horrii et al. (1997) reported 10 cases of thumb duplication with a cartilaginous connection between the radial supernumerary digit and the metacarpal bone of the thumb. These cases were similar to our two cases with MCP joint fusion. We believe that thumb duplication with symphalangism may be more common than previously reported. We did not find any previous reports of intra-articular incongruity in the MCP or IP joints of adults with thumb duplication. Considering the radiographic abnormalities observed in this study, we think it is unlikely that patients with thumb duplication will have a full range of motion in both the MCP and IP joints, either before or after reconstructive surgery.

P163. New Surgical Treatment for the Traumatic Mallet Finger

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Aim: Mallet finger deformity is one of the most frequent pathological entities after extensor tendons injuries, which appears as result of the disruption of extensor tendon continuity over the distal interphalangeal joint. Despite the fact that a lot of methods were used in managing this deformity, the treatment of mallet finger is still a much debated subject.

Material and Method: Between 200-2014 we operated for mallet finger deformity 100 fingers in 97 patients. According with Doyle classification, the lesions were of type I in 60 cases, of type II in 19 cases, and of type IV in 21 cases. A swan-neck deformity was associated in 17 fingers. In all these cases we performed a new surgical method by using a dorsal de-epidermised flap reinserted through the bone. The procedure starts by maintaining the DIP joint in 0 degrees of extension by using a Kirschner wire. Then we performe an intra-dermal incision that delimitates a flap on the distal 2/3 of the dorsal aspect of the second phalanx, the distal end of the flap coinciding to the DIP joint; the width of the flap is of 2-3 mm. The flap is de-epithelialised and raised superficial to the tendon. A hole of 1-1.5mm is done at the level of extensor insertion on the distal phalanx. A 4/0 steel thread is passed through the distal end of the dermo-adipose flap and is then passed through the intra-osseous hole and knotted palmary in a tie-over manner. The extensor tendon is sutured with 4/0 absorbable threads to the flap. The skin is closed over the flap. Postoperatively we immobilize only the DIP joint. The Kirschner wire is removed after three weeks, the steel thread after four weeks and the immobilization after five weeks. After that, the DIP joint is gradually weaned from the immobilization. In case of associated swan-neck deformity, we perform a "cross-flap" in the attempt to reconstruct also the Landsmeer ligaments.

Results: The follow-up was of 3-120 months (mean, 10 months). According to Crawford evaluation criteria, we obtained an excellent result in 79 fingers and a good one in 21 fingers. The return to the daily activity was possible after a mean of 21 days (range, 3 to 42 days).

Conclusion: This simple and effective method avoids a prolonged and uncertain immobilization and has a significantly high percent of success. The method uses local resources and avoids the rejection phenomenon related to allograft materials.

P164. A Treatment Algorithm for Scaphoid Fracture Nonunion

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Background: Scaphoid fracture nonunion has been treated with various procedures in order to consolidate the fracture and limit the development of joint degenerative changes. Our protocol for fracture fixation includes open reduction and internal fixation of the fracture with a simple vascularized bone graft technique for proximal fractures, where the risk of avascular necrosis of the proximal pole is high, and a conventional graft for waist fractures.

Methods: All patients treated between 2008 and 2011 for isolated scaphoid fracture nonunions were asked to participate in this prospective study. The patients were divided into 2 groups according to radiographic and CT scans presentation - proximal fracture group or waist fracture group. Clinical and radiographic measures were documented before the operation and at final follow up.

Results: Twenty six patients agreed to participate in the study and 19 of them were available for the final follow up. Of the 19 patients, 13 had waist fracture of which 3 did not heal and 6 had proximal fractures (all healed). We found no significant difference between the proximal and waist fractures, before or after surgery, in DASH score, range of motion or radiographic measures of carpal instability other than a significant difference in wrist extension, after the operation, in comparison with the contralateral wrist (56 degrees and 74 degrees, respectively).

Conclusion: Using this simple algorithm of treating proximal scaphoid fracture nonunions with a simple primary vascularized bone grafts and of waist fracture nonunions with conventional bone graft, we obtained results which are comparable to those presented in literature. This was done without reliance on diagnosis of avascularity with an MRI.

P165. Collagenase Clostridium Histolyticum Outcomes in a Single Unit

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Introduction: Collagenase clostridium histolyticum (CCH) is a recently developed nonsurgical treatment for Dupuytren's disease. The aims of this study were to evaluate outcomes of collagenase in a single hand unit.

Materials & Methods: Finger joint angulation was measured (with a goniometer) before, immediately after and at six week follow up post collagenase treatment in all patients managed in our unit. A standardized collagenase administration and splintage protocol was followed by all physicians.

A validated, Dupuytren's specific patient reported outcome measure (Unite Rhumatologique des Affections de la Main, "URAM") was used to assess subjective hand function before and six weeks after collagenase. A maximum score 45 implies severely disabled hand function while a minimum score 0 implies completely unimpaired function.

Complications of treatment were recorded. To assess cold intolerance, a tenth question was added to the 9-question URAM questionnaire to obtain patients' experience of cold intolerance following CCH treatment.

Results: 76 patients were included. Average age was 66 (range 48-89). 17/76 (22%) were female, and 59/76 (78%) were male.

These 76 patients underwent a total of 101 injections with CCH. Of these, 66 occurred on the right hand, and 35 on the left. The commonest injection site was the little finger PIPJ.

URAM questionnaire responses were received from 49/76 (64%) patients. Mean pre-treatment URAM score (out of a total of 45) was 20.2 (s.d. 10.7, range 2-45). Mean URAM score six weeks post treatment was 5.1 (s.d. 6.6, range 0-27). This difference was statistically significant ($P<0.001$) after analysis using the paired two-tailed Student's T Test.

Mean overall pre treatment joint angle was 54.2 degrees (s.d. 18.2, range 10-100). Mean overall six weeks post treatment joint angle was 11.1 degrees (s.d. 13.9, range 0-60). This difference was statistically significant ($P<0.001$) using the sign test for analysis.

Mean joint angulation improvement between pre treatment with CCH and 6 week follow up was 42.9 degrees (s.d. 18.7). Range was from 5 to 80 degrees improvement.

33 skin tears and 3 haematomas occurred, with all successfully managed conservatively. No patients reported any degree of cold intolerance and no "serious adverse effects" (e.g. tendon rupture) occurred.

Conclusions: Significant improvements in both joint angulation and patient reported outcomes were noted following collagenase treatment, and complication rates were low. No patient reported cold intolerance.

Collagenase is a safe, effective nonsurgical treatment option for Dupuytren's contracture and we advocate it as first line choice in appropriate patients.

P166. Selection of Fusion Position during Total Wrist Arthrodesis- A Simulated Fusion Study using Custom Made Splints

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Introduction: Little data exist regarding the preferred position for total wrist fusion, including relative advantages and disadvantages of each fusion position. In this study we attempted to determine the optimal position for total wrist fusion through a simulated wrist fusion model using custom made splints in different positions on healthy volunteers.

Materials and Methods: Twenty healthy volunteers had their wrist immobilized in 6 custom-molded wrist splints to simulate 6 different wrist fusion positions tested: 15° of wrist extension and 0° of radio-ulnar deviation, 0° of wrist extension and 0° of radio-ulnar deviation, 15° of wrist extension and 10° of ulnar deviation, 0° of wrist extension and 10° of ulnar deviation, one splint in 15° extension and 10° radial deviation and 0° extension and 10° radial deviation. Two additional measurements were done in unsplinted wrist and contralateral wrist, prior to splinting. Outcome measures for each splint position included the Jebsen-Taylor hand function test; grip strength and satisfaction score for splint position (1-10). Two-way ANOVA test was used to compare the position and task for the Jebsen Taylor test.

Results: The study included 7 men and 13 women, with an average age of 31 (range: 19-42). Data was normalized to control (unsplinted dominant hand). Two-way ANOVA looking at task and position did not find significant difference between the splinting positions ($p=0.28$). As expected, there was a significant difference in timing of the different tasks ($P<0.001$). There was no interaction between position and task ($P=0.95$). Among the 7 subtests of the Jebsen-Taylor test, there was no significant difference in sub-scores, with respect to splint position ($P=0.31$). One-way ANOVA looking at total JT score and position of splints did not find significant difference between the splinting positions ($p=0.31$).One-way ANOVA for grip strength and satisfaction from splint position did not find significant difference between the splinting positions ($p=0.92$ and 0.98, respectively).

Conclusion: Our data suggests that fusing the wrist in any of the six tested positions does not significantly influence hand function, grip strength or satisfaction. Therefore other considerations such as appearance, vocational and recreational activities can be given priority over the position of fusion.

P167. Monofilament Testing to Detect Subclinical Neuropathy Following Brachial Plexus Blockade – a Prospective Study

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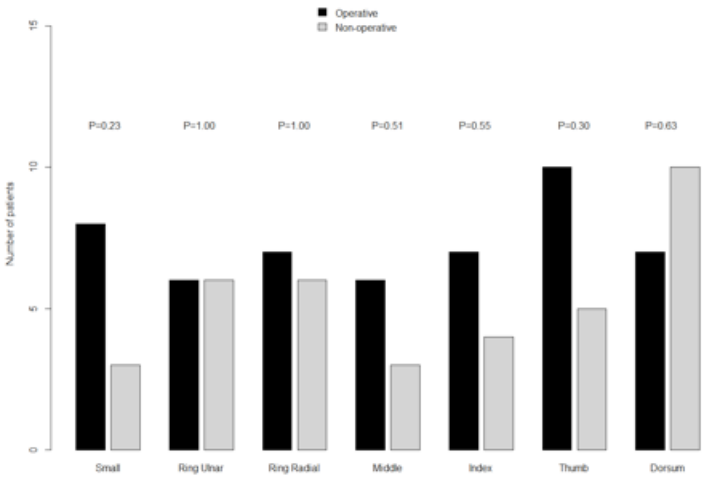
Introduction: Ultrasound guided brachial plexus blocks are commonly used for anesthesia in upper extremity surgical cases. Clinically evident neuropathy following nerve blocks is very rare. We used Semmes-Weinstein monofilament testing, a fine evaluation of sensory alterations, to investigate whether blocks could cause post-operative subclinical neuropathy.

Methods: Fifty-one patients undergoing brachial plexus blockade using ultrasound guided injection of Mepivacaine and Ropivacaine and subsequent upper extremity surgery were included prospectively. Patients undergoing nerve decompression or repair were excluded. The average age of the patients was 47.6 years. There were 37 male and 14 female patients. Thirty-seven patients had infraclavicular blocks and fourteen had supraclavicular blocks. Semmes-Weinstein monofilament testing was performed pre-operatively on the operative and non-operative extremity. At first office follow-up, within the first two weeks, monofilament testing was repeated on both hands. Sensation was tested in seven different areas encompassing the ulnar, median and radial nerve distributions. Pre and post-operative monofilament testing scores were compared.

Results: A two-sided chi-square analysis revealed no statistically significant difference in monofilament sensibility in any nerve or finger distribution when comparing the operative and non-operative extremity.

Conclusion: Brachial plexus blockade does not appear to result in subclinical neuropathy as measured by monofilament testing. It is a safe method of anesthesia for upper extremity surgery.

Figure 1- Patients Demonstrating Diminished Light Touch Sensation Post-Operatively



P168. The Volar Oblique Incision for Flexor-Tendon Surgery

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Background: The surgical approach to the volar structures in the digits must be designed to provide adequate exposure of tendons, vessels, and nerves but also in a way that prevents flexion contracture of the digit as the scar contracts. This is traditionally done using a zig-zag 'Bruner' incision, first described by Dr. Julian M. Bruner in 1967. In this paper, we describe an alternative approach, the Volar Oblique incision, and present a single institutional prospective cohort of patients who have undergone procedures beginning with this approach.

Methods: A prospective cohort study was performed on eight cases that involved a Bruner incision and eight similar cases that involved a volar oblique incision. Patients were asked to return to clinic post-operatively for scar assessment using the Patient and Observer Scar Assessment Scale (POSAS). While in clinic, standard joint measurements were taken to assess for any proximal interphalangeal (PIP) joint contracture.

Results: The average POSAS observer score was significantly higher in the volar oblique group compared to the Bruner group ($p<0.05$). A trend toward significance was seen in POSAS patient scores ($p>0.01$). No significant differences were seen in flexion contracture between the two groups ($p>0.01$).

Conclusions: The volar oblique incision appears to be satisfactory alternative to the classic Bruner incision in hand surgery that requires volar exposure of the digits. Future studies are needed to assess the validity of these findings on a larger scale.

P169. Hand Salvage in a Severe Diabetic Hand Infection

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Introduction: Infections of the potential spaces of the hand are relatively common and best addressed with early recognition, surgical debridement, and appropriate systemic antibiotic therapy. Hand infections in patients with diabetes mellitus are more challenging and portend poorer outcomes and increased morbidity. We present a case of a man with undiagnosed diabetes, with a devastating infection throughout his hand spaces. Ultimately, this was successfully treated with aggressive surgical and antimicrobial therapy, without amputation, and useful function of the patients hand was saved.

Materials & Methods: A 59-year-old right hand-dominant man fell and scraped the dorsum of his left hand on a curb three weeks prior to presentation to our institution. He was transferred to our institution due to redness and drainage. At our medical facility he presented with a dorsal wound, thenar wound, hypothenar wound, and large wound in the 1st webspace (figure 1). In addition he demonstrated undiagnosed, untreated diabetes mellitus upon laboratory tests. An initial debridement was performed removing copious pus from the midpalmer space, thenar and hypothenar spaces, carpal tunnel, guyon's canal, and parona's space (figure 2). The infectious disease service started vancomycin and piperacillin/tazobactam for broad spectrum coverage and he was placed on an insulin drip. Four more operative debridements were conducted on days 3,7,10 and 14 of hospitalization. VAC dressings were applied after the 3rd debridement and changed every 3-4 days thereafter. On hospital day 43, split thickness skin grafting was performed in the thenar space, hypothenar space, 1st webspace, and dorsal hand. Three months after initial presentation, there were no open wounds or signs of remaining infection (figure 3). The hand was fully sensate but stiff.

Results: Hand infections in diabetics treated similarly have shown poorer outcomes over time. Gonzalez et al. retrospectively reviewed 46 hand infections in diabetics. Fifty percent required more than one operation, 39% required some amputation, 5% had subsequent amputation at a proximal level, and 7% resulted in death. We took an approach of aggressive surgical debridement and VAC dressings in combination with tight glucose control, tailored antimicrobial therapy, and optimization of nutrition. In this case the infection was successfully eliminated without amputation and the patient regained useful limited motion.

Conclusions: In cases of diabetic hand infections that place the patient at high risk of morbidity and amputation developing an aggressive all-encompassing treatment plan is crucial for a positive outcome.

Figure 1: upon presentation at our medical facility; a) hypothenal wound 2x2 cm; b) thenar wound 2x3 cm; c) dorsal wound 5X7 cm

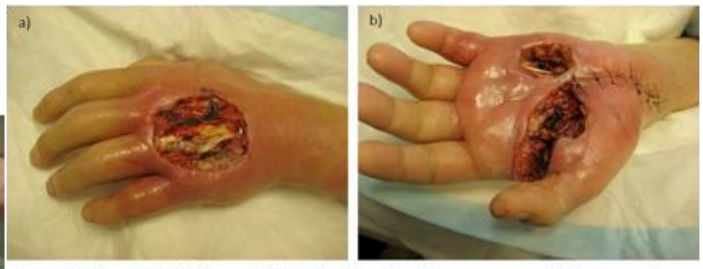

Figure 2: after 1st debridement a) dorsal ulcer debrided to extensors; b) thenar and hypothenar spaces debrided via their ulcers

Figure 3: Three months after initial presentation; a) dorsal space, b) thenar and hypothenar spaces show no signs of infection and have taken to skin grafts. The hand is sensate with limited range of motion, but functional.

P170. Ultrasound Imaging Augments Fluoroscopy in the Surgical Treatment of Distal Radius Fractures: A Cadaveric and Clinical Study

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Introduction: Volarly applied locking plates are one of several current treatment options for displaced fractures of the distal radius. Presently, surgeons use intra-operative depth gauges and fluoroscopy to select and confirm proper screw length. The depressed contour of the dorsal cortex in the extensor compartments along with fracture comminution may limit the accuracy of screw selection. We hypothesized that use of intra-operative ultrasound (US) would be a useful adjunct to fluoroscopy to better image prominent screws.

Materials and Methods: Five cadaveric arms were acquired and ten clinical patients were enrolled. In the cadaveric portion of our study, the extremities were subjected to a free-fall simulated impact using a device of our own design that resulted in fractures of the distal radius with or without ulnar fractures. An open reduction and internal fixation using a volar plate was then performed. Both US and fluoroscopy were used to assess screw tip prominence after which dorsal dissection of the distal radius was performed to determine actual screw prominence. An interclass correlation coefficient (ICC) comparing fluoroscopy and ultrasound to dissection was then calculated. Ten consecutive patients were prospectively enrolled in the clinical study upon presentation with a distal radius fracture judged to require internal fixation. US and fluoroscopic images were obtained after plate and screw placement and prior to wound closure. Data was collected regarding the number and degree of prominent screws identified on US versus fluoroscopy as well as whether intra-operative identification of prominence led to a physician decision to replace prominent screws with ones of shorter length.

Results: In the cadaveric arms, ultrasound correlated more closely to dissection findings than did fluoroscopy. The ICC comparing ultrasound to dissection was high at .73 ($p=.00073$) whereas the interclass correlation coefficient comparing fluoroscopy to dissection was lower at .195 ($p=.23$). In our clinical subjects, US detected prominence of three screws that appeared flush or recessed on fluoroscopy. This led the surgeon to replace the screws with ones that did not protrude.

Conclusions:

• Screws prominent more than 1mm were readily detected on ultrasound however lateral fluoroscopic images failed to detect several prominent screws secondary to the curved dorsal anatomy of the radius and fracture comminution.

• The human studies portion of the project demonstrated that ultrasound provided important additional imaging information in a way that led to replacement of prominent screws.

P171. Hand Injury In The Motorcycle Population- An 11-Year Retrospective Review of Motorcycle Trauma

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Introduction: Motorcycle collisions are a major cause of morbidity and mortality in the United States. From 2001 and 2008, 18% of nonfatal motorcycle injuries involved the arm and hand (CDC). We hypothesize that the mechanism of injury associated with motorcycle trauma predisposes riders to increased upper extremity injuries because of the complexity of multi-focal and multi-level injuries, which is very different from injuries sustained following various types of falls where the nature of bony and ligament injury can be explained by the load bearing and torque dynamics. The goal of this study is to categorize upper extremity injuries associated with motorcycle trauma in order to develop better protective gear for motorcyclists.

Materials & Methods: The study was a retrospective review of a prospectively collected trauma registry at Hahnemann University Hospital (Level 1 trauma center) from 2000 to 2011 of all motorcycle traumas. Data collected included patient demographics, protective device (helmet) use, length of hospital stay, mortality, and type of injury sustained.

Results: A total of 468 Cases of motorcycle collisions were included in the study. Overall, the mean age of motorcycle trauma patients was 35 (15-82), with a male to female ratio of 9:1. There were 16 deaths (3.4%) noted in this study. Twenty-seven percent of motorcyclists (N=133) sustained an injury to their hand (N=133), 5.7% sustained injury to their wrist (N=28), 25.1% sustained injury to their forearm (N=122), 17.9% sustained injury to their elbow (N=87), 6.4% sustained injury to their upper arm (N=31), and 23.5% sustained injury of their shoulder (N=114). Associated hand injuries included 50 fractures of the phalanx or metacarpal bones (30%), 17 (10%) lacerations of the hand, 11 (6.7%) dislocations of a digit, 3 (1.8%) traumatic amputations, and 80 (50%) cases of road rash.

Conclusions: Motorcycle accidents continue to be a source of severe injury. The hand, forearm and shoulder are the most likely upper extremity injuries sustained in motorcycle accidents. Hand and wrist injury are an under appreciated source of morbidity and disability in the motorcyclists following trauma. Injuries sustained from motorcycle trauma to the hands and wrists are unique to the dynamic nature of impact and is often unexplained by traditional mechanisms. Better motorcyclist education, protective gear and motorcycle safety devices need to be developed to decrease the incidence of motorcycle-trauma-related hand injury.

P172. A Novel Use of Meniscus for Small Joint Reconstruction of the Hand

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Background: Small joint arthoplasty of the hand has mixed outcomes and no ideal implant has been developed. Various materials have been used in the past with mixed results. One of the classic reconstruction modalities is the silicone implant however one of the major drawbacks is that up to 40% of implants will break over long term follow up. We suggest a novel approach for small joint reconstruction: using cadaveric meniscus for joint reconstruction. Meniscus is advantageous as it is amenable to a synovial environment, can be revascularized, has a low metabolic demand, and is malleable.

Methods: The senior author reconstructed three metacarpophalangeal and one proximal interphalangeal joint in four patients using cadaveric meniscus from the Musculoskeletal Transplant Foundation. Patient demographic, pre and post operative pain and range of motion data was examined as well as operative technique.

Results: Patient 1 is a 58 year old right hand male artist presenting with monarticular arthritis of the right third MCP joint failing medical treatment. Patient had the MCP joint burred (Figure 1) and meniscus was used to fill the contour defect and sutured with 4-0 mersiline (Figure 2 and 3). The same method was used for Patient 2, a 51 year old orthodontist with previous trauma to the 5th MCP joint. Patient 3, a 38 year old female actress who required reconstruction of the 2nd MCP. Both articular surfaces were debrided and inset with meniscus (Figure 4). Patient 4 is a 52 year old female lawyer with previous history of trauma to the left PIP joint of the 5th digit. Patient had continued deformity of the PIP joint with limited range of flexion to only 60 degrees and significant arthritis (X-ray shown in Figure 5). The patient was found to have a large volar lip of the middle phalanx that was removed and meniscus was then placed into the joint in a similar fashion (Figure 6). All patients underwent early hand therapy and had improvement of pain and range of motion of the affected joint. There were no complications and no revisions necessary.

Conclusion: Multiple modalities have been used to reconstruct the small joints of the hand with mixed results. We believe that meniscus is a viable option for reconstruction to help with motion and pain with the added benefit of malleability, potential for revascularization and resilience

Figure 1:

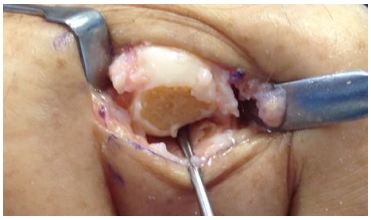

Figure 2:

Figure 3:

Figure 4:

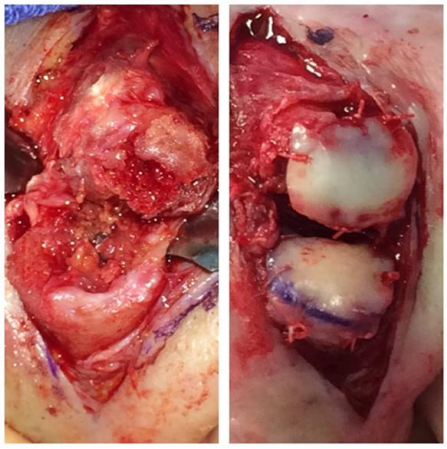

Figure 5:

Figure 6:

P173. Dorsoradial Abductor Pollicis Longus Tendon Capsulodesis for Trapezio-metacarpal Joint Hypermobility

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Introduction: Trapezio-metacarpal (TM) joint ligament hypermobility can result in abnormal thumb kinetics causing chronic pain and post-traumatic arthritis.1 TM joint instability is caused by acute trauma, long-term repetitive motion, early osteoarthritis, or a ligamentous disorder. Physiologic TM joint hypermobility can be found in patients with generalized joint laxity.2 We present a small case series of a novel dorsoradial abductor pollicis longus (APL) tendon capsulodesis for the surgical treatment of TM joint hypermobility.

Methods: Two patients with painful TM joint hypermobility were treated with a dorsoradial abductor policis longus tendon capsulodesis. Case 1: 16-year-old female high school cheerleader with one-year history of painful non-traumatic hypermobility of her non-dominant thumb. Case 2: 38-year-old male heavy laborer with several year history of painful TM joint instability of his dominant thumb. **Surgical Technique:** The TM joint is approached in a similar method as previously described.3 The APL and extensor pollicis brevis tendons are identified within the first extensor compartment. The capsule is longitudinally incised and a small window is made through the ulnar joint capsule. The smaller slip of APL is divided proximally and passed through the ulnar capsule window. A capsulodesis is performed and the redundant APL tendon is suture anchored to the periosteum of the trapezium. The first TM joint is transfixed with a Kirschner wire and a thumb spica cast is applied for four weeks.

Results: Six-month follow-up for Case 1 demonstrated pain free range of motion at the TM joint and significant improvement in joint stability. One-month follow-up for Case 2 also demonstrated pain free range of motion at the TM joint and significant improvement in joint stability. Case 2 six-month follow-up demonstrated some increased laxity, however, still improved from pre-operative examination.

Conclusions: We propose a novel dorsoradial APL tendon capsulodesis as a surgical treatment for TM joint hypermobility. This technique may not be indicated for patients with heavy manual labor demands.

References:

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P174. Prevalence of Cold Sensitivity in Patients with Hand Pathology

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Introduction: Abnormal cold sensitivity occurs following upper extremity trauma although there is wide variability in the reported prevalence. The purpose of this study was to evaluate the prevalence of cold sensitivity in patients with hand and wrist related diagnoses.

Methods: This study included English speaking adults who were seen at a hand surgery clinic more than 1 month following injury or onset of symptoms. Each patient was asked if cold air or water temperatures provoke pain, discomfort or onset of other cold-related symptoms. Patients who indicated onset of cold-induced symptoms were then asked to identify the source of the cold onset and symptom severity (scale 0-10). Statistical analyses were used to evaluate the relationships between the cold sensitivity and independent variables.

Results: There were 197 patients included: 83 men, 114 women (mean age 49 ± 16 years). There were 98 trauma related and 99 non-trauma related cases. Cold-induced symptoms were reported by 34%. Severe symptoms were reported by 10% of this patient sample. Exposure to cold air was reported as the most common catalyst; the mean severity score was 6.7 ± 2.2. Significantly more patients with traumatic injuries compared to non-trauma diagnoses reported cold-induced symptoms ($p = .04$). There were no significant differences between men vs. women. Using backward linear regression (initial model dependent variables age, sex, time since onset, traumatic injury), the significant predictors of cold symptom severity were trauma ($p = .004$) and time since onset ($p = .003$). Including only the trauma patients in the linear regression, the significant predictor was time since injury ($p = .005$).

Conclusions: Cold-induced symptoms are reported by more than 30% of hand-related diagnoses and 10% report severe symptoms. Exposure of cold air was the most commonly reported trigger of cold-induced symptoms. The significant predictors of cold-induced symptoms are trauma injuries and longer time from injury. This study provides evidence of the common problem of cold sensitivity in patients with hand pathology.

P175. Flexor Digitorum Superficialis Opponensplasty is a Safe and Effective Method of Augmenting Thumb Function in Type II and IIIA Thumb Hypoplasia

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Hypothesis: The method of reconstruction utilized for type II and IIIA thumb hypoplasia varies between individual surgeons and has changed with time. Our preferred method is the FDS ring opponensplasty as it allows creation of thumb opposition as well as collateral ligament reconstruction. We report our outcomes utilizing this procedure.

Methods: We retrospectively reviewed our patients who had undergone an FDS ring opponensplasty with or without collateral reconstruction and were a minimum of 2 years post-operative. The study group consisted of 36 patients and 40 hands. All patients underwent a follow-up clinical examination and therapist assessment including standardized grip and pinch testing as well as outcome measures including Kapandji scores, criterion referenced tasks, and PODCI scores.

Results: Mean age at surgery was 4.9years (Range 2-12.2) with an average follow up of 7.6 years (range 2-16.3). There were 9 Type II thumbs and 31 Type IIIA. 17 were isolated congenital abnormalities and 23 were associated with documented syndromes. All patients underwent a ring FDS opponensplasty and a 4 flap Z-plasty for first web space deepening. The pulley for opposition was FCU in 19 hands and the transverse carpal ligament (TCL) in 21. 36 thumbs had ulnar collateral ligament reconstructions, and 5 of the 36 had combined UCL/RCL stabilizations.
Opposition was assessed using Kapandji testing, with the average score being 8 (range 4-10). Grip and pinch were standardized to published means by age and gender. Grip, lateral pinch and tripod pinch averaged 46%, 49% and 48% of norms respectively. There was a significant difference between Type II and Type IIIA grip (II=60.49%, IIIA=41.97%; p=0.0389) and lateral pinch (II=61.20%, IIIA=45.55; p=0.0191) strengths. All children were able to grasp a small pellet, one inch cube and standard dowel. There was no significant difference between surgical pulleys used. PODCI Global was 90.76 (53-100), PODCI happiness was 87.45 (15-100).

Summary Points: We found the FDS opponensplasty to be an effective method for providing opposition for both type II and IIIA thumb hypoplasia. At follow-up excellent opposition function and PODCI scores were noted, with no difference being related to the type of pulley used. As expected, Type II thumbs had significantly greater grip and pinch strengths when compared to the Type III group.

P176. Anatomic Dorsal and Volar Radioulnar Ligament Reconstruction with Mersilene Augmentation

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Introduction: New anatomic technique to stabilize the distal ulna with a tendon graft augmented with Mersilene tape is an effective treatment for distal radioulnar joint (DRUJ) instability and will be a valuable adjunct to existing described procedures for hand surgeons.

Methods: Twelve patients underwent either anatomic dorsal or volar radioulnar ligament (DRUL and VRUL) reconstruction for unidirectional instability of the distal ulna between 2006 and 2013 by one hand surgeon. Similar to the procedure described by Adams et al, anchoring tunnels were created in the dorsal or volar ulnar corners of the radius. Interference screws were used to secure the Mersilene/tendon graft construct. Both the Mersilene and tendon graft were passed through a tunnel in the ulnar fovea and anchored to the distal ulna. Patients undergoing simultaneous distal radius osteotomy (DRO) and ulnar shortening osteotomy (USO) were included. Retrospective chart review was performed to determine gender, age, workers compensation, ligamentous laxity, mechanism of injury, symptoms, physical examination findings, preoperative and postoperative grip strength and wrist and forearm range of motion, degree and direction of distal ulnar instability, and X-ray and magnetic resonance imaging findings.

Results: Out of 7 patients with volar DRUJ instability, 5 had sustained prior distal radius fractures and of 5 patients with dorsal DRUJ instability, none had sustained a prior distal radius fracture (Two-tailed P-value = 0.0278 with Fischer exact test). Twelve patients had assessment postoperatively by the treating surgeon with follow up ranging from 2 to 11 months (7 months average). Nine patients had no DRUJ instability after the surgery and the remaining 3 had mild instability. Average pain score was 2/10 and all the patients had a pain score of less than 3 with the exception of 1 patient. Performance of USO and DRO in 9/12 patients with DRUL/VRUL reconstruction had no impact on DRUJ stability. Overall, preoperative and postoperative wrist and forearm range of motion was not limited by DRUJ stabilization or adjunctive reconstructive procedures. Despite the high frequency of workers compensation and other psychosocial issues in our cohort, some of our patients returned to their pre-injury occupations, requiring very forceful hand use. Grip strength declined approximately 20% compared to the normal contralateral extremity in patients followed for at least 6 months.

Conclusion: Mersilene/tendon graft composite reconstruction of the DRUL and/or VRUL is a new method for stabilizing the distal ulna and can be combined with DRO, USO, and DRUJ shelfplasty with careful planning.