



**AAHS/ASPN/ASRM Joint Outstanding Paper Session
January 16, 2016 – 11:00 AM to 12:00 PM**

AAHS #1 Proximal Interphalangeal Arthroplasty for Osteoarthritis; a Comparison of Silicone, Pyrocarbon and Surface Replacing Arthroplasty

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Hypothesis: Despite the increasing prevalence osteoarthritis (OA), the surgical treatment options for proximal interphalangeal (PIP) joint OA remain arthroplasty and arthrodesis. The purpose of this investigation was to evaluate the results PIP arthroplasty in patients with OA, comparing the outcomes of 3 different implants examining survivorship, patient-related factors and clinical outcomes.

Methods: We performed a review of 169 primary PIP arthroplasties by 8 surgeons in 103 patients for osteoarthritis at our institution from 1998 to 2012. The mean age at surgery was 65 years, BMI 26, with 51% involving the dominant extremity, 84% females, 5% smokers, 2% laborers, and 6% with diabetes mellitus (DM). Implants utilized included 108 pyrocarbon, 53 surface replacing arthroplasties (SRA), and 8 silicone. Patient characteristics were similar between the pyrocarbon, SRA, and silicone groups: age (65, 65, 66), females (84%, 83%, 88%), and DM (4%, 8%, 25%), respectively.

Results: There were 26 revision surgeries performed at a mean 1.3 years postoperatively. The 2, 5 and 10 year survival rates were 88%, 82%, and 80%, respectively. The 5-year survival rates for the pyrocarbon, SRA, and silicone implants were 85%, 77%, and 88% ($p=0.69$), respectively (**Figure 1, Table 1**) silicone (blue), pyrocarbon (red) and SRA (green)). There were 8 intraoperative fractures that complicated the primary arthroplasty. Postoperatively, there were 2 periprosthetic fractures, 4 dislocations, 10 heterotopic ossification, and 7 infections. Silicone implants were associated with an increased infection rate ($p=0.03$). In those unrevised patients, at a mean 5.3 years (2-11) follow-up, pain levels improved from preoperatively to postoperatively ($p<0.01$). PIP total arc of motion did not significantly change from preoperatively (47°) to postoperatively (44°) ($p=0.67$). There also was no significant change in grip ($p=0.34$) or pinch strength ($p=0.32$). There were no significant differences according to implant type regarding pain ($p=0.44$), as well as grip or pinch strength ($p>0.21$). The total arc of PIP motion in the pyrocarbon, SRA, and silicone groups was 42° , 57° , and 42° ($p=0.29$), respectively.

Summary Points: Arthroplasty in the treatment of osteoarthritis with PIP provides predictable pain relief, with preservation of PIP motion, and reasonable medium-term implant survival There were no differences between 3 different types of implants with regards to survival, complications, pain relief or PIP motion.

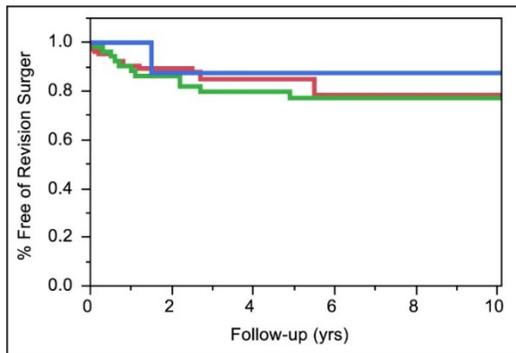


Table 1: Hazard Ratios for Implant Failure in PIP Arthroplasty in OA			
Risk Factor	Hazard Ratio	Confidence Interval	P-Value
Laborer	9.88	0.52 – 55.78	p = 0.10
Female	1.86	0.65 – 7.84	p = 0.27
Age at Surgery	0.98	0.95 – 1.02	p = 0.35
BMI	1.00	0.90 – 1.08	p = 0.96
Varus/Valgus Instability	5.24	1.11 – 93.57	*p = 0.03
Smoker	<0.1	-----	p = 0.37
Diabetes Mellitus	1.32	0.21 – 4.46	p = 0.71
Pyrocarbon	0.81	0.38 – 1.77	p = 0.59
Silicone	0.63	0.04 – 2.99	p = 0.63
SRA	1.36	0.61 – 2.92	p = 0.44
Intraoperative Fracture	2.23	0.36 – 7.56	p = 0.33
Bone Graft	0.88	0.14 – 2.96	p = 0.86
Cemented Implant	0.71	0.17 – 2.03	p = 0.56

AAHS #2 Are Surgeons Price-Sensitive? A Randomized Controlled Study on Factors Driving Surgeon Implant Selection

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Introduction: Surgical costs are under scrutiny by the public, and healthcare providers are increasingly being held accountable for containing medical costs. Surgical implants are often the largest component of total procedure cost, yet previous studies have revealed that surgeons' knowledge of implant prices is poor. Our study aims to (1) understand the drivers behind implant choice, and (2) assess whether educating surgeons about implant costs affects their implant choices.

Methods: We surveyed 226 orthopaedic surgeons across 6 continents. The survey presented 8 clinical cases of upper extremity fractures with history and radiographs, followed by surgical implant options. Surgeons were randomized to receive either a version that included each implant's average selling price ("price-aware" group), or a version without any mention of price ("price-naïve" group). Surgeons were asked to select a surgical implant and to rank factors affecting implant choice. Six cases offered different classes of implants (eg, Kirschner wires, volar locking plate, or spanning external fixator for a distal radius fracture). Two cases offered different implant models within the same class (eg, volar locking plate implants with fixed or variable angle screws). Descriptive statistics and univariate analyses were performed.

Results: Cost-effectiveness was ranked as the most important factor in implant selection by 19% of price-aware vs 6% of price-naïve respondents. Familiarity with the implant was the most common reason for choosing an implant in both groups (35 vs 46%). Implant selection was similar between price-aware and price-naïve surgeons for cases comparing different classes of implants (p=0.26), but it differed significantly for cases comparing models within the same implant class. When offered different models of distal radius volar locking plates, 25% of price-naïve surgeons selected the most expensive plate vs only 7% of price-aware surgeons (p<0.001). Similarly, the most expensive distal humerus plate was selected by 25% of price-naïve surgeons vs only 13% of price-aware surgeons (p=0.01). On average, price-aware surgeons selected implants that were 9-11% cheaper than price-naïve surgeons.

Conclusions: Although price does not alter a surgeon's decision to use a certain class of implant (eg, locking plate vs external fixator), price awareness does significantly influence surgeons' choice of a specific implant model within a general class (eg, volar locking plates with different features). Merely including prices with a list of implant options increases surgeons' perception that price is important. This implies that a real, untapped opportunity exists to reduce surgical expenditures simply by enhancing surgeons' awareness of implant costs.

ASPN #1 Electrical Stimulation Enhances Axon Regeneration And Functional Recovery Following Cubital Tunnel

Surgery In Humans - A Randomized Controlled Trial

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Introduction: Brief post-surgical electrical stimulation (ES) enhances motor and sensory axonal regeneration in animal models following axotomy and crush injury. Although improved physiological outcomes with ES have also been shown in humans following carpal tunnel release, there was no significant difference in functional recovery compared to those who underwent surgery alone. The underlying reason is that thenar muscle strength only plays a small role in hand dexterity. In contrast, the ulnar nerve innervates the majority of hand muscles and makes a vital contribution to hand strength. In this study, we investigated the hypothesis that ES following cubital tunnel surgery in patients with severe ulnar neuropathy would result in better muscle reinnervation and functional recovery compared to surgery alone.

Methods: Patients with severe axonal loss from ulnar nerve compression at the elbow (McGowan grade III) were randomly

assigned to the treatment or control group in a 2:1 ratio. Those in the control group received cubital tunnel surgery alone, while patients in the treatment group received 1 hour of 20Hz ES following surgery. Stimulation was delivered via two stainless electrodes placed adjacent to the ulnar nerve intraoperatively. Patients were followed yearly for 3 years. At each visit, axonal regeneration was quantified using motor unit number estimation (MUNE) and functional recovery was evaluated using grip strength and key pinch strength. Statistical analysis was performed using non-parametric tests, with statistical significance set at $p < 0.05$.

Results: Twenty-four patients were enrolled in the study: 8 received surgery alone and 16 received surgery and ES. There was no significant difference in demographics between the two groups. At three years following surgery, MUNE was significantly higher in the treatment group (182 ± 25 , mean \pm SE) compared to controls (93 ± 14 , $p < 0.05$). In terms of functional recovery, grip strength was significantly improved in the treatment group (43 ± 3 kg) at 3 years post-operatively compared to controls (39 ± 3 kg, $p < 0.05$). Key pinch strength was also significantly better in the treatment group (5.2 ± 0.5 kg) compared to controls (4.4 ± 0.8 kg, $p < 0.05$).

Conclusions: Our results suggest that post-surgical ES enhances axonal regeneration, muscle reinnervation and functional recovery following cubital tunnel surgery in humans. We propose that ES may be a clinically useful adjunct to surgical decompression for severe ulnar neuropathy, where functional recovery with conventional treatment is poor.

ASPN #2 Neurolysis Outcomes in Leprosy Patients: Prospective Study of Sensory and Motor Changes Following

“Double CRUSH” Decompressions

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Purpose: Since the mid-1950s, for “leprosy,” retrospective case series reported outcomes following decompression of single anatomic sites of compression, and, more recently studies comparing efficacy of steroid versus single surgical site decompression have been reported. The purpose of the present study is to apply, prospectively, concepts developed from the successful treatment of diabetics with neuropathy and multiple sites of chronic nerve compression to patients with leprosy neuropathy.

Methods: Working in the indigenous leprosy area in Guayaquil, Ecuador, a protocol was developed that could be applied prospectively to a cohort of 20 patients with leprosy neuropathy who had been medically treated for infection but who had not received steroid treatment for neuropathy. An IRB-approved protocol was established in which each patient received surgery upon one leg and one arm simultaneously, with the goal of decompressing nerves at multiple anatomic sites of known compression, e.g., median and ulnar nerve at the wrist and elbow, peroneal nerve at knee and lower leg, tibial nerve at the four medial ankle tunnels. A total of 88 nerves were decompressed. Outcomes measured were changes in one and two-point static-touch, muscle strength change by manual motor testing and grip strength, comparison between operated and non operated side, and changes in score of validated “instruments” to measure quality of life, disability and pain (Rand36, Q Dash, and VAS, respectively). Outcome measurements were obtained by someone other than the surgeon at 12 and 24 months post-operatively.

Results: Eighteen of 20 patients returned for post-operative sensory evaluation. There were no post-operative complications. 72% of patients have sensory improvement demonstrated by PSSD testing. 65% of patients returned for motor testing, and 100% reported motor improvement and demonstrated motor testing score of $> 4/5$. 64% of decompressed nerves improved in sensibility: 78% of 18 median nerves, 53% of 17 ulnar nerves, 63% of 16 radial nerves, 71% of 14 common peroneal nerves, and 56% of 16 tibial nerves. Among those patients with completed outcome instruments, quality of life improved, hand disability decreased and pain scores decreased significantly, $p < .05$.

Conclusions: Application of double crush concept to decompression of multiple peripheral nerves is feasible in the

population with leprous neuropathy, and, in this small cohort of patients, gave improvement in sensory and motor function in the majority of patients.

ASRM #1 Correlation between Indocyanine Green (ICG) Patterns and Real-time Elastography Images in Lower Extremity Lymphedema Patients

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Background: ICG lymphography is becoming a popular modality with clear visualization of superficial lymph flows, but unfortunately not available in all institutions. Elastography is a relatively new ultrasonographic technique to evaluate tissue elasticity, which visualize fluid retention as a red region in lymphedema patients. The aim of this study was to evaluate the correlation between elastography and ICG lymphology.

Methods: The study was a retrospective observational study. Thirty-six legs in 18 patients with secondary lower extremities lymphedema (LEL) and 20 legs in 10 healthy volunteers were examined with elastography. Thirty-six legs in 18 secondary LEL patients were examined with ICG lymphography. Elastography was performed on both legs at the following 3 sites: medial thigh (MT), medial leg (ML), and anterior ankle (AA). The area of red region in the subcutaneous tissue demonstrated by elastography was calculated with Image J software (National Institute of Health, Bethesda, MD). ICG lymphography findings were classified into the following 4 patterns: linear (ICG1), splash (ICG2), stardust (ICG3), and diffuse (ICG4) patterns.

Results: As ICG pattern progressed, red region area was likely to increase. There was correlation between ICG patterns and red region area according to the severity at bilateral MT ($r_s = 0.665$), ML ($r_s = 0.623$), AA ($r_s = 0.668$). Significant difference was demonstrated among group means of red region area by analysis of variance (healthy vs. ICG1 vs. ICG2 vs. ICG3 vs. ICG 4: 14.4 ± 5.7 vs. 15.1 ± 10.3 vs. 25.2 ± 6.2 vs. 30.8 ± 9.4 vs. 35.0 ± 2.8 ; $P < 0.001$).

Conclusions: The area of red region in the subcutaneous tissue shown with elastography, which represents fluid, increases with aggravation of lymphedema demonstrated by ICG patterns. Since elastography is performed by ultrasonography which is available in most institutions, elastography could be a useful alternative evaluation for lymphedema severity when ICG lymphography is not available.

Fig.1

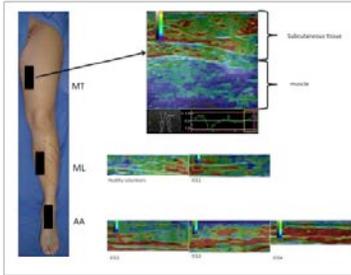
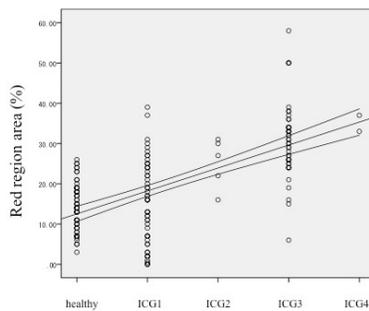


Fig.2



ASRM #2 A Single Institution Experience with 116 Consecutive Free-Flap and Pedicled Phalloplasties

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Introduction: Numerous phalloplasty techniques have been described for the female-to-male transgender population. Three of the most common flaps used today are the radial forearm flap, the anterolateral thigh flap, and the musculocutaneous latissimus dorsi flap. While there has been a large series of radial forearm flaps published in the past, there has not been a large series published in the United States. Also, no large series has been published comparing outcomes of these three flaps.

Materials and Methods: A retrospective review of all female-to-male phalloplasties from April 2013 to June 2015 was done. Complications including total flap loss, partial flap loss, flap take-back, hematomas, urethral strictures, fistulas, and meatal stenosis were reviewed. Outcomes measured included flap survival, sensory return, the ability to urinate through the phallus, and patient satisfaction.

Results: In total, 116 phalloplasties were performed at our institution. These included 71 radial forearm flaps (61%), 43 anterolateral thigh flaps (37%), and 2 musculocutaneous latissimus dorsi flaps (2%).

There were no flap losses (0%) and four partial flap losses (3%). None of the partial losses exceeded 30% of the flap. Five flaps (4%) were re-explored for vascular compromise (three for arterial compromise, two for venous compromise) and all flaps were salvaged. The take-back rate for the first 16 flaps was 19%; the take-back rate for the remaining 100 flaps was 2%. The hematoma rate was 6% (n=7; three donor site hematomas, four groin hematomas). Of the 73 radial forearm flaps, the common femoral or superficial femoral artery were used as recipient vessels (end-to-side) in 71 cases (97%); a side branch was used in two cases (3%). The saphenous vein or a branch off the sapheno-femoral junction was used for all venous anastomoses. Urethral fistula and stenosis rates were 16% and 20% respectively. The rate of meatal stenosis was 5%. Of the radial forearm and ALT flaps that have reached an end-point of nerve regeneration, 99% have had return of tactile sensation; 85% have had return of erogenous sensation. There were no significant differences between the two groups. Neither latissimus musculocutaneous flap patients had return of tactile or erogenous sensation.

Conclusions: To our knowledge, this is the largest presented series of phalloplasties in the United States. This series shows that both the radial forearm and the anterolateral thigh flap (in select patients) can be viable options for an aesthetic and functional phalloplasty with good sensation and low fistula rates compared to other published series.