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ETHIOPIAN 2014 MEDICAL MISSION EXPERIENCE – Glen A. Barden, M.D., Lakeland, Florida.

The wide array of orthopaedic problems seen, and treated is presented. These include complex trauma, untreated tumors, and infections. Previous work at the MCM (Korean) Hospital in Addis Ababa, Ethiopia on three occasions gave an opportunity to be a part of the system, medically, and culturally. Limitations of one's usefulness in this role are reviewed. Negative components are present, which include lack of generally used equipment, lack of fracture fixation inventory, and support staff-follow through. However, there are many the positive aspects, which bring considerable satisfaction. These are: providing patient care; teaching residents, plus medical students; and developing lasting friendships with others serving in varying capacities. Encouragement for service in this type role is emphasized.

TOTAL HIP ARTHROPLASTY VIA AN ANTERIOR APPROACH PROVIDED IMPROVED EARLY FUNCTIONAL RECOVERY WHEN COMPARED TO THE POSTERIOR APPROACH: PRELIMINARY RESULTS OF A RANDOMIZED TRIAL, Christian P. Christensen, MD & Cale Jacobs, PhD, Lexington, Kentucky

Introduction: The anterior approach has become an increasingly popular total hip arthroplasty (THA) technique due in large part to the perceived improvements in early functional recovery. While these improvements have been demonstrated when compared to lateral approaches, subjective and objective measures of postoperative function have not been compared between the anterior and posterior approaches. We then questioned whether the functional recovery during the early postoperative period is improved when using an anterior approach than a posterior approach. We hypothesized that the anterior approach would result in significantly earlier ability to discontinue use of an assistive ambulatory device, greater subjective outcome scores, and superior instrumented measures of function during the early postoperative period.

Methods: A priori power analysis was performed to determine the sample size for this study, with the time to discontinued use of an assistive ambulatory device as the primary outcome variable. Previous authors have independently reported that the time to discontinued use of an assistive device with a mini-posterior approach was 28.5 days

and 16.8 days with an anterior approach. Assuming variability of 16.6 days as reported by Della Valle et al.(CORR, 2010), a sample size of 26 THAs per group would be 80% powered to detect group differences of this magnitude (G*Power, version 3.1.3). To date, 33 patients (36 THAs) have volunteered to participate in this IRB-approved protocol, with 19 patients (21 THAs) having completed both preoperative and 6-week postoperative data collection. Patients were excluded if they were less than 18 or more than 85 years of age, had been diagnosed with inflammatory or rheumatoid arthritis, had a Body Mass Index (BMI) greater than 40 kg/m^2, or had previously undergone any prior ipsilateral hip surgery including arthroscopic procedures. Patients were then randomly assigned to have either anterior or posterior THA. All procedures were performed by a single board-certified orthopaedic surgeon that has performed more than 2,000 posterior THAs and 400 anterior THAs. Patient function was assessed prior to surgery and at each patient's 6-week postoperative follow-up visit. Patient-reported outcome tools included modified Harris Hip Scores (HHS) with Pain (PS) and Function (FS) subcomponent scores, the Lower Extremity Function Scale (LEFS), Single Assessment Numeric Evaluation (SANE) and the SF-12 Mental and Physical Scores. A dual force platform (Bertec, Columbus, OH) was used to collect force data as patients performed a sit-to-stand maneuver. For the sit-to-stand test, patients were asked to rise from a chair with seat height of 45.7 cm (18") and then stay as motionless as possible for 5 to 10 s, and were allowed to use arm rests if necessary. Patients performed two to three trials and force data were collected for each limb at a sampling rate of 1000 Hz and later filtered using a fourth order Butterworth filter. The mean maximum force (N) generated by each limb and mean sway velocity (cm/s) were calculated for the two to three trials of the sit-to-stand test. Patients were also asked to perform a timed-up-and-go test. For this timed test, the force platform was used to calculate the time necessary to complete the test, with the chair being placed directly on the platform. Time began when the chair was unweighted and stopped when the patient sat back down on the chair. Patient-reported outcomes, max force of the involved limb when rising from a chair, sway velocity, and timed-up-and-go data were compared between the anterior and posterior THA groups using 2 x 2 mixed model ANOVAs (group x time). In addition to the patient-reported outcome scores and instrumented measures of patient function, we also recorded the duration of hospital stay and number of days to discontinued use of an assistive ambulatory device which were compared between groups using two-tailed independent t-tests. All analyses were performed using SPSS Statistics v21 (IBM, Armonk, NJ) with $p < 0.05$ considered statistically significant.

Results: The two groups did not differ in age, sex, or BMI. The anterior THA group demonstrated a significantly shorter length of hospital stay (1.5±0.6 days vs. 2.3±1.1 days, $p = 0.01$) with an earlier ability to discontinue use of an assistive ambulatory device (31.5±21.0 days vs. 46.1±18.8 days, $p = 0.04$). Regardless of group, HHS, PS, FS, LEFS, and SANE scores as well as the force generated when rising from a chair significantly improved between the preoperative and 6-week postoperative time points. The anterior hip group demonstrated significantly greater HHS ($p = 0.046$) and LEFS scores ($p = 0.04$), but the groups did not differ in PS, FS, SANE, SF12 Mental or Physical Score. Max force of the involved limb when rising from a chair significantly improved for both groups after surgery, with the anterior hip group having greater force values ($p = 0.03$).

Discussion: The anterior approach consistently resulted in significantly shorter hospital stays and superior early functional improvement. Other recently published studies also reported early functional benefit with the anterior approach, but that little differences were noted at six to 12 months. While the functional benefit of using the anterior approach over the posterior approach may be transient, patients may benefit from the significantly shorter hospital stay and potentially reduced risk of dislocation.

BONE MORPHOGENETIC PROTEIN (BMP)-7 FOR THE TREATMENT OF SKELETAL DEFECTS, NONUNIONS AND OSTEONECROSIS, Zoe H. Dailiana, Marianthi Papanagiotou, Konstantinos N. Malizos, Department of Orthopaedic Surgery, Faculty of Medicine, University of Thessalia, Larissa, Greece

Introduction: Treatment of critical-size skeletal defects, nonunions, and avascular necrosis (AVN) of the femoral head, is a demanding process often requiring several procedures with uncertain outcome. Several growth factors such as Bone Morphogenetic Proteins (BMPs) have been used to enhance this healing process.

Objectives: The aim of this study is to evaluate the efficacy and potential complications after BMP-7 application in critical-size skeletal defects, nonunions and AVN of the femoral head.

Methods: BMP-7 was applied combined with bone graft in 96 defects or nonunions of 93 patients and in 7 pre-collapse femoral heads in 6 patients with AVN (5 femoral heads were stage II, and 2 were stage III according to Steinberg classification). The defects were located in femur (38), humerus (12), tibia (42) and forearm (4), while 32 defects were septic. The vast majority (93/96) has undergone 1-11 (mean 2) previous failed surgery. The evaluation of consolidation was clinical and radiographic, and the density of the formed callus was calculated and compared with that of the normal bone with the use of quantitative CT (QCT) method. Finally all intra- or post-operative complications associated with the BMP-7 application were recorded.

Results: A. Skeletal defects group: Eighty-nine patients (92 defects) completed the minimum follow up period of 3 years: 75/92 defects healed with no need for further operations, while further surgery (1-3 procedures) was required in 17 defects (13/17 septic). According to QCT callus bone densities were almost equal to healthy bone. No intraoperative complications were noted, while during the immediate postoperative period, local complications associated with the BMP-7 were recorded in two patients (extensive soft tissue oedema, and serroma). In both cases, complication resolved with no need for further procedure. No other serious complications were noted during the 3-year follow up period, with the exception of heterotopic bone formation (observed radiographically) in 16 patients. **B. AVN group:** The mean follow-up of the AVN patients was 4 (2-5.5) years. Signs of consolidation were apparent from the third post-operative month, while a marked improvement of function (mean HHS increase of 49.2) and decrease of pain level (mean VAS decrease of 5) was noted in five hips at the latest follow-up. The sphericity of the femoral head was retained in 5 out of 7 in the latest follow up. Further surgery required only in one patient (two hips) one year post-operatively. Quantitative-CT evaluation revealed similar densities between affected and normal bone. No serious complications were noted, with the exception of heterotopic ossification, observed in four hips, without compromising the clinical outcome.

Conclusion: Use of BMP -7 proved beneficial for the treatment of skeletal defects and nonunions with a success rate reaching at 93.3% for the aseptic and 59.4% for the septic cases. For femoral head osteonecrosis AFG/BMP-7 combination prevented collapse in the majority of cases (5/7), while the operative time and post-operative rehabilitation period were shorter when compared with free vascularized fibular graft technique. A low rate (2%) of immediate and a higher rate (16.6%) of late onset (heterotopic bone formation) complications is associated with BMPs use, although none of the aforementioned complications compromised the final clinical outcome.

ARTHROPATHY OF DOWN SYNDROME, David M Drvaric MD, Springfield, Massachusetts

Down syndrome occurs in 1 in 660 newborns. The orthopaedic aspects of the condition are well recognized. However, arthritis is frequently underdiagnosed or overlooked.

This presentation will highlight a case report of an 11 year old boy presenting with foot pain. His treatment course will be highlighted. A review of the current literature will be presented.

In summary, arthritis in Down syndrome is approximately three times as common as juvenile idiopathic arthritis in other children but is often underdiagnosed. Morning stiffness is the key clinical sign. Slit lamp evaluation is recommended. The treatment course is often prolonged.

COMPARISON OF HELICOPTER VERSUS GROUND TRANSPORT FOR THE INTERFACILITY TRANSPORT OF ISOLATED SPINAL INJURY, Norah A. Foster, MD, Dawn M. Elfenbein, MD, Wayne Kelley, Jr., MD, Christopher R. Brown, MD, Carolyn Foley, RN, John E. Scarborough, MD, Steven N. Vaslef, MD, PhD, Mark L. Shapiro, MD, FACS, Durham, North Carolina

BACKGROUND CONTEXT: The use and need of helicopter aeromedical transport systems (HEMSs) in health care today is based on the basic belief that early definitive care improves outcomes. Helicopter aeromedical transport system is perceived to be safer than ground transport (GT) for the interfacility transfer of patients who have sustained spinal injury because of the concern for deterioration of neurologic function if there is a delay in reaching a higher level of care. However, the use of HEMS is facing increasing public scrutiny because of its significantly greater cost and unique risk profile.

PURPOSE: The aim of the study was to determine whether GT for interfacility transfer of patients with spinal injury resulted in less favorable clinical outcomes compared with HEMS.

STUDY DESIGN/SETTING: Retrospective review of all patients transferred to a Level 1 trauma center.

PATIENT SAMPLE: Patients identified from the State Trauma Registry who were initially seen at another hospital with an isolated diagnosis of injury to the spine and then transferred to a Level 1 trauma center over a 2-year period.

OUTCOME MEASURES: Neurologic deterioration, disposition from the emergency department, in-hospital mortality, interfacility transfer time, hospital length of stay, nonroutine discharge, and radiographic evidence of worsening spinal injury.

METHODS: Patients with International Classification of Diseases, Ninth Revision (ICD-9) codes for injury to the spine were selected and records were reviewed for demographics and injury details. All available spine radiographs were reviewed by an orthopedic surgeon blinded to clinical data and transport type. Chi-square and t tests and multivariate linear and logistic regression models were done using STATA version 10.

RESULTS: A total of 274 spine injury patients were included in our analysis, 84 (31%) of whom were transported by HEMS and 190 (69%) by GT. None of the GT patients had any deterioration in neurologic examination nor any detectable alteration in the radiographic appearance of their spine injury attributable to the transportation process. Helicopter aeromedical transport system resulted in significantly less transfer time with an average time of 80 minutes compared with 112 minutes with GT (p!.001). Ultimate disposition included 175 (64%) patients discharged to home, 15 (5%) expired patients, and 84 (31%) discharged to extended care facilities. After adjusting for patient age and Injury Severity Score, the use of GT was not a significant predictor of in-hospital mortality (odds ratio, 1.4; 95% confidence interval, 0.3–5), hospital length of stay (11.2þ1.3 vs. 9.5þ0.8 days, p5.3), or nonroutine discharge (odds ratio, 1.1; 95% confidence interval, 0.5–2.2).

CONCLUSIONS: Ground transport for interfacility transfer of patients with spinal injury appears to be safe and suitable for patients who lack other compelling reasons for HEMS. A prospective analysis of transportation mode in a larger cohort of patients is needed to verify our findings.

PREDICTABILITY OF HAMSTRING TENDON AUTOGRAFT DIAMETER FOR ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION BASED ON PRE-OPERATIVE MAGNETIC RESONANCE IMAGING, Thomas J. Kremen, Jr., M.D., Miltiadis Zgonis, M.D., Emily N. Vinson, M.D., Kathrine Coyner, M.D., William E. Garrett, M.D., Durham, North Carolina

INTRODUCTION: Hamstring tendon autograft (HTA) is a common graft source for anterior cruciate ligament (ACL) reconstruction. Recent literature suggests that HTA's below 8mm in diameter are associated with higher failure rates and poorer outcome scores. Currently, surgeons do not have a reliable user-friendly tool to predict eventual HTA diameter pre-operatively. Thus, we hypothesized that pre-operative pes tendon measurement on MRI would correlate well with intra-operative HTA diameter.

METHODS: Pre-operative 3T MRI scans of 141 patients were measured retrospectively using an axial image located 3cm proximal to the posterior portion of the medial tibial plateau. Gracilis and semitendinosus tendon CSA was measured by a fellowship-trained musculoskeletal radiologist using the DOI tool provided with the standard General Electric PACS imaging software. The radiologist was blinded to the subsequent intra-operative diameter. A linear regression analysis comparing the total CSA as measured on MRI (gracilis CSA added to semitendinosus CSA) to the actual intra-operative HTA diameter was performed resulting in a model of best fit for the

observed data. The probability of observing an intra-operative diameter value of 8.0mm or greater for each total CSA measurement was then calculated based on the assumption that this model is true.

RESULTS: Total CSA correlated well with intra-operative diameter with a correlation coefficient of: R = 0.69. A pre-operative CSA measurement of 27mm or greater was associated with a greater than 95% probability that the intra-operative graft diameter would be 8mm or greater.

CONCLUSION: CSA as assessed on pre-operative MRI correlates well with intra-operative diameter of HTA for ACL reconstruction. A threshold value of 27mm or greater CSA on pre-operative MRI in this series had a greater than 95% probability of resulting in a HTA of 8mm of greater. Pre-operative HTA measurements may significantly contribute to a surgeon's graft choice recommendations and pre-operative patient counseling.

PERCENT BODY FAT MORE ASSOCIATED WITH PERIOPERATIVE RISKS AFTER TOTAL JOINT ARTHROPLASTY THAN BODY MASS INDEX, Ledford CK, Ruberte Thiele RA, Appleton JS Jr, Butler RJ, Wellman SS, Attarian DE, Queen RM, Bolognesi MP

Understanding the impact of obesity on elective total joint arthroplasty (TJA) remains critical. Perioperative outcomes were reviewed in 316 patients undergoing primary TJA. Higher percent body fat (PBF) was associated with postoperative blood transfusion, increased hospital length of stay (LOS) >3days, and discharge to an extended care facility while no significant differences existed for BMI. Additionally, PBF of 43.5 was associated with a 2.4× greater likelihood of blood transfusion, PBF of 36.5 with a 1.9× greater likelihood for LOS >3days, and PBF of 36.0 with a 1.4× greater likelihood for discharge to an extended care facility. PBF may be a more effective measure than BMI to use in screening for perioperative risks and acute outcomes associated with obese total joint patients.

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ALLOGRAFTS IN FOOT AND ANKLE SURGERY: A CRITICAL ANALYSIS REVIEW, John S Lewis Jr, Samuel B Adams, James A. Nunley, Mark E. Easley, Durham, North Carolina

With the advent of modern tissue-processing and rigorous donor-screening techniques, the use of allograft tissue in reconstructive procedures in foot and ankle surgery has steadily increased. Allografts can be used to correct deformity, to fill bone or osteochondral voids, to provide collagen in massive unreconstructable tendon defects, and, in many cases, to provide a salvage option when no other viable surgical alternative exists. A review of the available data suggests that allograft transplantation can result in predictable relief of pain and restoration of functional capacity in many difficult surgical salvage scenarios. However, the quality of the data is only fair, and better evidence is needed to support the extensive use of allograft transplantation in foot and ankle surgery.

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RADIATION EXPOSURE DURING FIXATION OF PEDIATRIC SUPRACONDYLAR HUMERUS FRACTURES: ARE LEAD SHIELDS IMPORTANT?, Gregory A, Mencio, M.D., Nashville, Tennessee

Purpose: The intensity of radiation decreases with the square of the distance from the radiation source, however, the radiosensitive organs of children may be at risk during fluoroscopic guided extremity procedures. Our goal was to quantify the radiation dose at the thyroid and gonads during fixation of supracondylar humerus fractures and to delineate the need for lead shielding.

Methods: A prospective study of radiation exposure during percutaneous fixation of supracondylar humerus fractures was performed over a 2 month period. The c-arm image intensifier was used as the operating table and patients were shielded with lead. Radiation dosimeters were positioned over the thyroid and gonadal shields. Fluoroscopy times were recorded, doses were calculated, and the radiation dosimeters were analyzed. To assure that the prospective cohort was representative of age, gender, weight, fracture and fluoroscopy time, these parameters from the prospective cohort (n=18) were compared to a 12 month retrospective cohort in which dosimetry was not performed (n=163).

Results: The prospective cohort dosimeters measured minimal radiation indicating equivalent doses of less than 0.01 mSv. The data from the prospective and retrospective cohorts are presented in the table below. There were no significant differences between the cohorts.

Conclusion: The equivalent dose to the thyroid and gonads during fluoroscopic assisted fixation of supracondylar humerus fractures is minimal and approximates background radiation. The smaller prospective cohort had similar fluoroscopy times and radiation doses as the larger retrospective cohort, suggesting that the dosimeter measurements are representative.

Significance: The radiation dose to the patient's radiosensitive organs during fixation of supracondylar humerus fractures is minimal. Shielding of radiosensitive organs may still be appropriate to minimize radiation exposure, particularly if longer fluoroscopy times are anticipated and in younger patients where the radiosensitive organ to radiation source distance is reduced.

	Prospective Cohort (n=18)	Retrospective Cohort (n=163)	p value
Age (years)	4.9 (1.9 – 9.5)	5.5 (0.02 – 13.7)	0.27
Weight (kg)	21.4 (13 – 34)	21.6 (2.0 – 72)	0.92
Type 2 / Type 3 fractures	8 / 10	60 / 63	0.55
Fluoroscopy Time (s)	65.0 (25 - 168)	74.1 (10 - 289)	0.36
Absorbed Skin Dose at Elbow (mGy)	9.4 (3.7 - 24.4)	10.7 (1.5 - 41.9)	0.36
Equivalent Dose at Elbow (mSv)	0.11 (0.04 - 0.26)	0.13 (0.01 - 1.39)	0.16
Equivalent Dose at Thyroid / Gonads (mSv)	< 0.01	NA	NA

RADIAL NERVE LACERATION FOLLOWING ELBOW ARTHROSCOPY, Moheb Moneim, MD, Albuquerque, New Mexico

Neurological complications following elbow arthroscopy have been reported as infrequent and transient. The radial nerve is especially vulnerable because it can be within 3 mm of the cannula during an anterolateral postal. We are reporting on a case of radial nerve laceration that involved only the posterior Interosseous nerve branch that we treated with nerve grafting with complete recovery.

***PROPIONIBACTERIUM ACNES* IN SHOULDER SURGERY: FALSE POSITIVE, COMMENSAL ORGANISM, OR PATHOGEN?**, William Mook, M.D., Durham, North Carolina

Background: Propionibacterium acnes has arisen as the most common microorganism identified using culture techniques at the time of revision shoulder arthroplasty. However, there is limited evidence to suggest how frequently false positive cultures occur. This is the first controlled study to prospectively evaluate culture growth from specimens obtained during open shoulder surgery.

Methods: Patients undergoing an open deltopectoral approach to the shoulder were prospectively enrolled. Patients with a history of prior shoulder surgery, or any concern for active or previous shoulder infection were excluded from prospective analysis. Three pericapsular soft tissue samples were taken from the shoulder for bacterial culture and incubated for 14 days. A sterile sponge was also analyzed in parallel with the tissue cultures. All patients had tissue cultures taken at the time of glenohumeral exposure during the study period, including patients who had undergone previous surgery, were also included for retrospective analysis.

Results: 20.5% (24/117) of surgeries yielded at least one culture positive for bacterial growth and 13.0% (7/54) of sterile control specimens also resulted in positive culture growth ($p = 0.234$). P. acnes represented 83.0% (39/47) of all positive cultures at a mean of 10.6 days of incubation. 62.5% (15/24) of patients with at least one positive P. acnes culture growth had no history of previous surgery. Male gender ($p<0.001$) and ≥2 preoperative corticosteroid injections ($p=0.047$) were associated with a higher likelihood of eventual bacterial growth.

Conclusions: Identification of P. acnes is common when culturing tissue obtained during open shoulder surgery and the clinical significance of these positive cultures remains uncertain. Male gender and preoperative corticosteroid injections were associated with a higher likelihood of bacterial culture growth and are risk factors that merit further investigation. The previously reported incidences of positive P. acnes culture results at the time of primary and revision shoulder arthroplasty may be overestimated based on the 13% rate of false positive control specimens identified in our series.

CONCUSSIONS IN THE HIGH SCHOOL ATHLETE: CURRENT CONCEPTS IN MANAGEMENT, Richard S. Moore III and Richard S. Moore Jr. MD, Wilmington, North Carolina

This presentation reviewed the current literature regarding concussion in the adolescent and recent guidelines recommending an individual case based approach to

management. The importance of an adequate period of physical and cognitive rest prior to a graded return to play was discussed, as well as the importance of avoiding a Second Impact Syndrome. The results of a survey of high school varsity athletes were reported. The survey raised concerns for underreporting of injuries by athletes and suboptimal efforts on preseason baseline cognitive testing. Preinjury athlete education was emphasized.

THE PEDICLED RADIAL FOREARM FLAP: APPLICATIONS IN UPPER EXTREMITY RECONSTRUCTION, Richard S. Moore Jr MD, Wilmington, North Carolina

Studies indicate that access to free tissue transfer in the United States is decreasing. The role of the pedicled radial forearm flap in the management of complex soft tissue defects in the upper extremity was reviewed. Indications for radial forearm flap, preoperative clinical assessment of the limb and surgical technique were discussed and a clinical case series presented. The radial forearm flap is a versatile option for coverage of complex soft tissue defects in the upper extremity which does not require advanced microsurgical skills or resources.

CALCANEAL FRACTURES WITH SOFT-TISSUE COMPROMISE TREATED WITH ABDUCTOR HALLUCIS FLAP AND ORIF WITH DUAL-LOCKING PLATES, Mike Romash, Glenn Carwell, Chesapeake, Virginia

Level of Evidence: Retrospective Case Series - Level IV

Introduction Various methods and techniques have been employed to treat calcaneal fractures. However, despite successful surgical fixation, soft tissue complications can occur in up to 27% of patients.[1-7] Many of these complications require subsequent operative procedures including wound debridement, hardware removal, muscle flaps, and amputation.[1-7] The presence of preoperative soft tissue damage, including fracture blisters, may further complicate the postoperative recovery, especially if a blood-filled blister is present.[8-11] Some authors have previously recommended the surgeon to avoid an incision through the fracture blisters and zone of injury.[8-10]

For defects in the foot and ankle and treatment of postoperative complications, the use of intrinsic or free muscle flaps has achieved acceptable results.[12-15] Levin and Nunley discussed various methods to treat soft tissue defects resulting from calcaneal fractures. One such technique was the use of the abductor hallucis flap; although, they discussed this in the context of treating postoperative wound breakdown.[16]

In our literature review, no studies were found that discussed a single-stage procedure with fixation and flap coverage for treatment of calcaneal fractures with preoperative soft tissue compromise. However, some studies reported success with early soft tissue reconstruction[17,18] or single-staged procedures for soft tissue defects in other lower extremity fractures.[19,20] The goal of this retrospective case series report was to assess the outcomes of treating calcaneal fractures complicated by preoperative medial soft tissue defects with open reduction internal fixation and abductor hallucis flap in a single-stage procedure.

Materials and Methods Between 2006 and 2012, ten patients with calcaneal

fractures and associated medial soft tissue compromise were treated with open reduction internal fixation (ORIF) and an abductor hallucis muscle flap in a single-stage procedure. The inclusion criteria for this case series encompassed any patient with soft tissue damage associated with a calcaneal fracture. The only exclusion criteria were patients with a calcaneal fracture but no associated soft tissue damage.

Eight patients were males and two were females. The average age was 41.7 ± 13.1. Three patients reported regular tobacco and alcohol use. One patient reported only regular tobacco use, and two patients reported regular alcohol consumption, but no tobacco use. One patient was diabetic (Table 1).

The Sanders classification system was used to assess the severity of the calcaneal fractures. Three fractures were classified as Sanders type II joint depression fractures, three were Sanders type II tongue fractures, two were Sanders type III joint depression fractures, and two were so comminuted they were graded as a "Sanders IV plus" with more than four fracture segments of the posterior facet. Surgery was delayed to allow for swelling to decrease enough for skin wrinkles to be observed constituting a "positive wrinkle sign" (Figure 1).

The primary outcome measurement was whether or not the abductor hallucis flap succeeded or failed. Secondary outcome measurements included occurrence of hallux valgus, postoperative infection, skin graft revisions, and fracture union.

Operative Procedure All operations were performed in the same hospital. In all cases, a single orthopaedic surgeon performed the ORIF, and once fixation was complete, a single plastic surgeon performed the pedicled muscle flap and skin graft.

The necrotic tissue and zone of injury were excised medially leaving a large defect (Figures 2 a-b). ORIF was then completed using a combined medial and lateral approach with dual-locking plates (Figures 3 a-d).[21] Laterally, a small incision technique was used (Figures 3c-d). After fixation was achieved, attention was then turned to the medial aspect of the foot to begin dissection of the abductor halluces (Figure 4a-d). Once the muscle was separated from the insertion point, a non-absorbable suture was used to stabilize the metatarsophalangeal joint of the great toe to prevent valgus deformity from occurring. The dissection of the muscle was continued proximally and then folded posteriorly to fill the void from the excised necrotic tissue and cover the medial plate (Figures 4c-d). The medial plantar artery was conserved to maintain blood flow to the abductor hallucis flap. Finally, a split-thickness skin graft was applied to the medial defect (Figure 5).

Results Surgery was delayed an average of 21.2 ± 3.6 days to obtain a positive "wrinkle sign." Reduction and fixation of the calcaneal fracture was accomplished in all patients. The average follow-up time was 12.39 ± 3.36 months. Two patients are currently being followed, and one was lost to follow-up.

Of the ten abductor hallucis flaps performed, nine succeeded. Two patients required subsequent skin graft revisions due to necrosis, but the muscle flap remained viable in each. These were also the only two patients who had record of immersion of their cast in water. There were no postoperative infections and no reports of hallucis valgus. One patient who used tobacco and alcohol regularly had a nonunion confirmed by CT, and was subsequently lost to follow-up. One patient required a subtalar arthrodesis nearly three years after the original injury and one patient required flexor tenotomies (Table 1).

The one patient whose flap failed had a “Sanders IV plus” depression fracture that was severely displaced. The severity of the fracture necessitated a primary subtalar arthrodesis in addition to the single-staged ORIF and pedicled abductor hallucis flap. He subsequently underwent successful revision using the medial plantar fasciocutaneous flap.[22]

Discussion Performing an ORIF and pedicled flap in a single-staged procedure for calcaneal fractures with soft tissue compromise has many benefits. Excising the zone of injury and fracture blister removes a potential source of postoperative complications including infection, ORIF failure, and the need for secondary operations. Additionally, the defect left from the wide excision provides greater exposure of the fracture site medially, which allows for the small incision technique laterally. This enables the surgeon to avoid large skin flaps. Utilizing the abductor hallucis flap to fill the medial soft tissue defect enhances the blood flow to the area to better facilitate healing and allows for tension-free closure.

Our results seem to suggest this single-staged procedure is an acceptable option to treat patients with Sanders type II and III calcaneal fractures with soft tissue defects. However, it may not be a viable option for more complicated calcaneal fractures. In this study, two patients had calcaneal fractures classified as a “Sanders IV plus”. The only patient whose flap failed was in this group. As previously discussed, this patient also required a primary subtalar arthrodesis due to the severity of his fracture.

There are many weaknesses of this study including the retrospective design, small sample size, lack of a comparison group, and no functional outcome measures. Due to the retrospective design, we were unable to determine if the soft tissue compromise was associated with clear-filled or blood-filled fracture blisters. Varela et al. demonstrated that performing an ORIF in the presence of fracture blisters in general was associated with more complications compared to patients treated with closed reduction.[11] Additional studies have shown that the type of blister may further impact the operative outcome. Strauss et al. found that five patients developed postoperative complications, three of which were in those with blood-filled blisters. One patient with an ankle fracture-dislocation and associated blood-filled blister developed full-thickness skin breakdown, deep infection, and the subsequent need for ankle fusion.[10] Giordano and Koval found that 13% of patients in their study developed complications with blister bed healing, all of which were associated with blood-filled blisters. Most of these complications included full-thickness skin loss requiring split-thickness skin graft. No postoperative wound complications occurred when incisions passed through clear-filled blisters or around blood-filled blisters.[9]

The presence of fracture blisters not only complicates postoperative recovery, but they may also alter treatment options. Giordano and Koval found that due to the presence of fracture blisters, 34% of patients with lower extremity fractures required alternate treatment options rather than the preferred ORIF.[10] Varela et al. found that the presence of fracture blisters affected patient care in 55% of patients undergoing ORIF.[11]

For calcaneal fractures, these issues can be avoided by performing a single-staged procedure with removal the fracture blister itself, including the surrounding zone of injury, performing an ORIF, and filling the defect with a muscle flap. Utilization of the abductor hallucis is convenient for medial soft-tissue defects and provides many

additional benefits.

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Table 1:

Patient	Age	Days surgery delayed	Tobacco use?	Regular Alcohol use?	Sanders Classification	Fx Union	Complication
1	37	23	Yes	No	II, depression	Yes	None
2	44	21	Yes	Yes	III, depression	No	Skin graft revision
3	53	18	No	No	II, depression	Yes	Subtalar arthrodesis
4	70	24	No	No	II, tongue	Yes	None
5	39	19	No	Yes	II, tongue	Yes	None
6	46	28	Yes	Yes	IV +	Yes	Skin graft revision, flexor tenotomy
7	47	20	No	Yes	III, depression	Yes	None
8	21	22	Yes	Yes	II, tongue	Yes	None

9	29	16	No	No	II, depression	Yes	None
10	31	21	No	No	IV +, depression	Yes	Flap failure

AN ALTERNATIVE TREATMENT METHOD FOR CHRONIC ESSEX-LOPRESTI INJURIES, Loukia K. Papatheodorou, MD, Aaron I. Venouziou, MD Dean G. Sotereanos, MD, Pittsburgh, Pennsylvania

We reviewed the results of seven patients with chronic Essex-Lopresti lesions treated with radial head replacement and ulnar shortening osteotomy. Mean patient age was 42.4 years. Five patients had a staged approach and two underwent both procedures simultaneously. At a mean follow up time of 33 months, the mean pain level was significantly reduced. Elbow arc of motion, forearm rotation and wrist arc of motion measurements improved in all patients postoperatively. The mean post-operative Mayo Elbow and Wrist Scores were 82 and 71 points, respectively. The mean ulnar variance was reduced from +8 mm to +3.5 mm postoperatively. This study shows that radial head replacement in combination with ulnar shortening osteotomy can be used as an alternative reconstructive procedure in the case of a complex chronic Essex-Lopresti injury.

ANGULAR DEFORMITIES OF THE LOWER EXTREMITIES IN CHILDREN IN THE DEVELOPING WORLD, Wendelin Schaefer, M.D., Incline Village, Nevada

Several cases of uncommon deformities in the lower extremities are presented. Treatment occurs in less than ideal circumstances and there are occasional complications. Cases include amnionic band syndrome, congenital dislocation of the knees, severe tibia vara in a young adult and missing tibia in chronic osteomyelitis.

EVIDENCE-BASED PROTOCOLS FOR THE INITIAL OUT-PATIENT MANAGEMENT OF COMMON ADULT SPINAL CONDITIONS, David C. Urquia, MD, Augusta, Maine

Spine treatment algorithms have been created by the author for use by the Primary Care network. These cover diagnoses of back and neck pain, lumbar radiculopathy, cervical radiculopathy, lumbar stenosis, cervical stenosis, and vertebral compression fractures. These protocols are designated for acute and subacute spinal conditions.

The relevant supporting literature is reviewed. There is some concern that provider willingness to work from protocols will be limited. Piedmont Society internet survey results also presented, revealing only 18% of membership currently working from out-patient protocols.

SNAC WRIST: A NOVEL METHOD OF TREATMENT WITH VASCULARIZED BONE GRAFT AND DISTAL RADIUS OSTEOTOMY, Konstantinos N. Malizos, Zoe H. Dailiana, Sokratis E. Varitimidis, Vasileios Kontogeorgakos, Larissa, Greece

Purpose: Scaphoid nonunion advanced collapse (SNAC) wrist is the progressive deformity resulting from a neglected scaphoid nonunion with considerable functional deficit. Salvage procedures like intracarpal arthrodesis or proximal row carpectomy are recommended in advanced stages. We present the outcome of an alternative treatment for stage I-III SNAC wrists with the combination of closing-wedge osteotomy of the distal radius and scaphoid reconstruction with vascularized bone graft (VBG).

Methods: Twelve patients with SNAC wrists (stage I: 3, stage II: 7, stage III: 2) treated with a combination of VBG interposition in the scaphoid and distal radius closing-wedge osteotomy were retrospectively reviewed. Data were obtained and analyzed from the radiographs and the pre- and post-operative range of motion, grip-strength, VAS pain score, as well as Mayo and DASH functional scores were assessed.

Results: Follow-up period ranged from 2 to 11 years. All scaphoid nonunions united after 9 (6-12) weeks and all osteotomies united after 8 (6-10) weeks. Although there was radiographic progression of the SNAC stage in 5 of 12 cases, there was major improvement in VAS pain score and in both Mayo and DASH functional scores. The range of motion remained unchanged and grip-strength had a minor improvement. The carpal height was preserved and the dorsal intercalated segmental instability was corrected.

Discussion: Scaphoid reconstruction with VBG combined with closing-wedge distal radius osteotomy is a novel approach to preserve wrist function in cases of SNAC wrist with lasting results. The method offers pain relief and does not compromise the motion of the wrist or the grip-strength as other salvage procedures do.

TUMORS AND TUMOR-LIKE LESIONS MIMICKING CARPAL TUNNEL SYNDROME, Zoe H. Dailiana, Sokratis E. Varitimidis, Vasileios Kontogeorgakos, Konstantinos N. Malizos, Larissa, Greece

Introduction: Tumors and tumor-like lesions in or around the median nerve are uncommon causes of carpal tunnel syndrome (CTS). The purpose of the present study is to highlight the diagnostic approach and point-out the profile of patients with CTS and potential underlying pathology.

Materials and Methods: Twenty-eight patients with 32 affected hands had CTS correlated to a mass in or around the nerve. In 20 hands a palpable mass was present. Diagnostic workup included nerve conduction studies, ultrasound and/or MRI. Pre- and postoperative examination included two-point discrimination (2PD), grip strength, VAS and DASH scores.

Results: Twelve of 28 patients were young (range 9-38 years) and 10 were male. Nerve compression was due to 27 extraneural lesions (8 abnormal muscles, 5 lipomas, 7 tenosynovitis, 4 vascular tumors, 2 ganglia, one Dupuytren's fibromatosis) and 5 intraneural tumors (3 schwannomas, one neurofibroma, one sarcoma). Nerve decompression and excision of extraneural lesions was performed in all cases whereas in intraneural tumors, decompression was followed by excision in most cases and nerve

grafting in one. Mean follow-up was 22 months (12-105). Extra-neural masses were associated with a better outcome than nerve tumors. The mean postoperative VAS/DASH scores were 0.3/16.2 in extraneural lesions and 2.5/22 in intraneural lesions. The 2PD improved gradually in all patients (mean pre- and postoperative: 12 and 5mm). The mean grip strength increased from 28 to 31.3 kg postoperatively.

Conclusions: Although rare, the surgeon should include in the differential diagnosis of CTS the unusual cause of tumors and tumor-like lesions, especially when the patients' profile is not typical (young, male, no repetitive stress or manual labor). In addition, the presence of a palpable mass at the distal forearm or palm dictates the need for imaging studies. The extent, location and aggressiveness of the mass will determine the approach and type of procedure.

CUBITUS VARUS, SNAPPING TRICEPS, ELBOW POSTEROLATERAL ROTATORY INSTABILITY, Vasileios A. Kontogeorgakos, Zoe Dailiana, Sokratis Varitimidis, Konstantinos N. Malizos, Larissa, Greece

Background: Elbow varus is a well-known long term complication of distal humerus fractures in childhood. Rarely, it can be complicated by dynamic conditions such as snapping of triceps tendon or posterior lateral rotatory instability of the elbow.

Case Description: A 17 year old woman presented with right cubitus varus 12°deformity, medial snapping triceps and symptomatic elbow posterolateral rotatory instability. The patient was treated for an extension type supracondylar humeral fracture at the age of 8 years old with open reduction and KW stabilization. During the 16th year of her age, she sustained two posterior elbow dislocations treated with closed reduction and progressive mobilization. The patient was treated with lateral transfer of the medial third of triceps tendon and 6 months later with a distal humerus corrective osteotomy and PLRI ligament reconstruction.

Results: Post-operative plain x-rays displayed correction from 12° varus to 10° valgus. The radial head was realigned to the center of capitellum. On follow up examination at 3 years the patient had painless upper extremity function. There was no loss of ROM of the elbow and the DASH score improved from 17.2 at presentation to 0.9 at last follow up.

Conclusion: Altered mechanics in varus elbow deformity can lead to symptomatic instability of the medial and lateral elbow aspect. Careful imaging and clinical evaluation is important in recognizing the spectrum of complex elbow pathology. A successful surgical treatment protocol is suggested.