7:00 am

Medial Double as an Alternative to Triple Arthrodesis
Thomas H. Lee, MD
Westerville, Ohio

Although excellent for correction of deformity, the triple arthrodesis can have complications associated with wound healing and lateral column malunion/nonunion. The greater the deformity, the more common these adverse events may occur. By utilizing a single medial incision to fuse only the talonavicular and subtalar joint, the Medial Double technique minimizes several soft tissue complications. In addition, the calcaneocuboid joint is left to remain flexible and thereby avoiding complications of overload or malunion.

The video technique will review the surgical approach as well as tips and pearls to accomplish an efficient and successful alternative to the triple arthrodesis.
End stage ankle and hindfoot arthritis can often be accompanied by considerable deformity and structural bone loss. These patients present challenges for the orthopaedic surgeon faced with the need to provide reconstructive options for these difficult to treat problems. In addition, bone loss in many of these cases leads to a limb length discrepancy following an otherwise successful tibiotalocalcaneal (TTC) fusion. For these reasons, a novel technique is demonstrated in which TTC fusion is accomplished with the aide of femoral head and acetabular reamers with insertion of a femoral head allograft to avoid significant shortening of the limb, restore structural integrity to the ankle and hindfoot, and allow for significant deformity correction. This technique is most useful in severe fixed deformity and in those patients with considerable bone loss around the talus as seen in cases of AVN or failed total ankle replacement.

Technique Summary:

1. Lateral approach with fibular osteotomy
2. Soft tissue release if necessary to correct deformity (TAL, etc)
3. Ankle/hindfoot brought into neutral dorsiflexion
4. Acetabular reamer utilized to establish cup for femoral head implantation (save reamings for graft)
5. Femoral head preparation using femoral head reamers (Depuy)
6. Ream same size with acetabular and femoral head reamers to create press fit (usually 38-42mm)
7. Further prepare femoral head allograft with fenestrations and feathering
8. Place femoral head into reamed defect and impact with mallet
9. Remove excess bone from the neck in line with tibia
10. Bone graft using reamings around femoral head implant
11. Fix entire construct with blade plate or retrograde nail with compression.
Z Cut Calcaneal Osteotomy
Keith L. Wapner, MD
Philadelphia, Pennsylvania

Technique

- Step cut through the Calcaneus
- Robert Vander Greind – AOFAS Toronto 2007
- Modified to avoid need for allograft, internal fixation, avoid dorsal displacement, and get bone to bone healing
7:30 am
Paper Session #6:
Flat Foot #1

Moderators:
Donald R. Bohay, MD
Grand Rapids, Michigan

Frederick R. Lemley, MD
Syracuse, New York

Plantar Forces in FHL vs. FDL Transfer in Adult Acquired Flatfoot Deformity

Presenting Author:   E. Meade Spratley, MS
Richmond, Virginia

Additional Authors:   John M. Arnold, MD; John R. Owen, MS, PE; Christopher D. Glezos, BS;
Jennifer S. Wayne, PhD; Robert S. Adelaar, MD

Summary
FHL and FDL tendon transfers are used to augment PTT function in AAFD. The decision to tenodese following transfer to reduce toe flexion morbidity remains controversial. This study simulated stance loading in cadaveric lower legs for intact, transferred, and transfer+tenodesed states while measuring forefoot plantar force. FHL and FDL transfer reduced flexion force of the great and lesser toes, respectively. Tenodesis of the transferred stump improved associated toe flexion force, however FHL transfer was more effective.

Introduction
Flexor hallucis longus (FHL) and flexor digitorum longus (FDL) tendon transfers are frequently used to augment deficient posterior tibial tendon (PTT) function in stage II adult acquired flatfoot deformity (AAFD). [1] FHL transfer has been preferred given that its physiologic cross-sectional area is twice that of the FDL, though biomechanical data demonstrating improved surgical outcome remains inconclusive. [1–3] Loss of toe flexion force with tendon transfer has also been noted, though the clinical significance of this is unclear. [4,5] The decision to tenodese the stump of the transferred tendon to restore this force remains controversial particularly because of the increased risk to neurovascular structures in the medial arch. [6] The aim of this study was to quantify changes in plantar force in the great and lesser toes following tendon transfer with and without tenodesis in order to assess the ability of tenodesis to restore lost plantar force.

Methods
Using a previously developed loading frame, 10 matched pairs of cadaveric lower extremities were loaded under a static 100lb axial force through the tibia. [7] Soft-tissue activation was approximated through a 100lb Achilles force, as well as 10lb and 6lb loads to the FHL and FDL, respectively. [8] Specimens were first tested intact, then with one of the two tendon transfers, and finally with both transfer and tenodesis. For each state, plantar force in 5 forefoot regions was assessed as described previously. [7] These regions were the great toe (R1), the lesser toes (R2), the distal 1st metatarsal (R3), the distal 2nd metatarsal (R4), and distal metatarsals 3-5 (R5).
Results
There was a decrease in flexion force from intact for the great toe (R1) (p<0.01) and lesser toes (R2) (p<0.001) for FHL and FDL transfers, respectively (Figure). Tenodesis demonstrated an ability to restore flexion force in the great (p<0.05) and lesser (p<0.01) toes over transfer alone for FHL and FDL, respectively. Great toe flexion force following FHL transfer with tenodesis was not significantly less than intact (p>0.7). Additionally, FHL transfer resulted in an increase in forefoot loading (R3-R5) over intact (p<0.05). This increase was disproportionately distributed to the medial forefoot with increases of 22.4%, 18.4%, and 8.6% for R3-R5, respectively.

Conclusion
Summary

Intraoperative positioning of the hindfoot is generally made by visual means which is imprecise. Therefore a novel hindfoot alignment guide (HA-Guide) has been developed. After testing in saw bones and anatomy lab, the HA-guide has then been used in 11 complex cases with simultaneous correction of supramalleolar, tibio-talar and inframalleolar alignment. In 10/11 cases the desired position could be achieved. This study describes the development and clinical use of the first hindfoot alignment guide of the world.

Introduction

Intraoperative positioning of the hindfoot is generally made by visual means. This resulted in the wrong varus/valgus position by 10 degrees and a relatively large standard deviation of 8 degrees. Such a lack of precision would not be acceptable in surgery around the hip or knee. Furthermore, the hindfoot alignment also influences the short- and long term clinical outcome of foot and ankle surgery. Therefore new means are needed to improve the precision of intraoperative hindfoot positioning. So far navigation and intraoperative pedobarography have been advocated. However, these methods are expensive and normative data is lacking. We were therefore seeking a hindfoot alignment-guide as simple and easy to use as an alignment rod in total knee surgery.

Methods

A completely novel hindfoot alignment guide (HA-Guide) has been developed. This HA-guide projects the mechanical axis from the tibia (or whole leg) down to the heel similar to an alignment rod used in total knee surgery. The HA-guide enables to position the hindfoot in the desired varus/valgus position in the frontal plane (neutral for joint preserving surgery and total ankle replacement [TAR], 10 degrees valgus for ankle arthrodesis) and also the foot in plantigrade position in the lateral plane. The HA-guide has been tested in saw bones and the author's university anatomy lab during eighth months and modifications were made. The HA-guide has then been used intraoperatively from May-November 2011 in 11 complex cases with simultaneous correction of the supramalleolar, tibio-talar and inframalleolar alignment: TAR with supra- and inframalleolar osteotomy/arthrodesis (2), TAR with inframalleolar osteotomy (3), supra- and inframalleolar osteotomy (3), pantalar arthrodesis in Charcot foot (1), subtalar arthrodesis with calcaneal and midfoot osteotomy (1), ankle arthrodesis in severe equinus foot (1). Pre- and postoperatively weight bearing hindfoot alignment radiographs according to Saltzman were taken and the position measured. The use of the HA-guide during the operation involved two additional radiographs with the fluoroscan which lasted about 1-2 minutes.

Results

In 10/11 cases the desired position could be achieved. In 3 cases, the planned calcaneal osteotomy could be avoided because the use of the HA-guide revealed an already sufficient correction. On the other hand side, in 3 cases the HA-guide revealed the need for unplanned additional calcaneal osteotomies. In one case the postoperative Saltzman view revealed too much valgus in a TAR despite the use of the HA-guide. This was probably due to a malrotation of the guide in relation to the radiographic direction of the fluoroscan.
Conclusion
This study describes the development and clinical use of the first hindfoot alignment guide of the world. This HA-guide helps to improve the alignment of the hindfoot intraoperatively to the desired position with a greater precision than just visual means. The HA-guide is especially useful for combined supra-, tibio-talar and inframalleolar alignment corrections were besides preoperative planning the decision for the need and amount of a simultaneous osteotomy needs to be evaluated intraoperatively.
Comparison of Plantar Pressures between Controls and Flatfoot Patients Using Supine, Standing and Walking Measurements

Presenting Author: Scott J. Ellis, MD
New York, New York

Additional Authors: Haydee Brown; Benjamin Williams, BS; Jeremy Chan, BS; Elizabeth Young, BS; Howard Hillstrom, PhD; Jonathan T. Deland, MD

Summary
Significant differences in plantar pressure parameters between flatfoot and control patients could be detected during walking, but not standing or supine with a previously designed jig. These findings suggest that obtaining meaningful information intraoperatively to help guide surgical decisions is not likely without applying loads that are impractical or that could damage the foot. Other plantar pressure devices must be assessed and strict criteria developed before they can be used in the operating room.

Introduction
Intraoperative plantar pressure systems have the potential to guide surgical decision making, particularly in conditions such as adult acquired flatfoot deformity (AAFD). Such systems have been shown to improve patient outcomes. However, criteria upon which decisions are made and definitions of normal pressure distributions are lacking. We have previously designed a jig to assess supine plantar pressures and have proven its accuracy and reliability. The purpose of this study was to compare plantar pressures between flatfoot patients and normal controls to see if the system could detect differences and to compare supine measurements to walking and standing which ultimately determine clinical outcome.

Methods
Ten patients with flexible AAFD (stage II) scheduled to undergo surgical reconstruction (mean age 52.2 ± 10.0 years) were compared to ten patients (twenty feet) without any foot or ankle pathology (mean age 27.2 ± 5.7 years). Radiographic parameters were assessed to confirm differences between the groups. Supine plantar pressures were then assessed supine using the previously designed jig and a custom, Pliance sensor array (Novel, Munich, Germany) and then standing and walking with the EMED-XT sensor array (Novel). Contact area, maximum force (MF), and peak pressure (PP) were compared at 12 difference anatomical regions. Radiographic and plantar pressures were compared between the two groups for supine, standing, and walking test conditions with a Wilcoxon rank sum test. Differences between test conditions were evaluated with two way mixed ANOVA along with post hoc t-tests.

Results
Radiographic analysis demonstrated significant differences between the flatfoot and control for both the lateral first talo-metatarsal angle (p < 0.001), AP talonavicular coverage angle (p = 0.005), AP first talo-metatarsal angle (p = 0.004), and hindfoot moment arm (p = 0.001). No differences were detected for contact area between the groups. The flatfoot patients had significantly increased MF and PP for the medial midfoot and medial forefoot parameters for walking. During stance, no significant differences were found for any of the parameters. With the supine apparatus, only increased medial and lateral hindfoot MF and PP were found in the flatfoot group (Table 1). Significant differences were found for parameters at all anatomical regions between the supine, standing, and walking test conditions (p < 0.001).
Conclusion
The differences between test conditions indicate the differing nature of these musculoskeletal events and may limit inferences that can be drawn from intraoperative pressure assessment. The inability of the supine plantar pressure system in this study to detect differences between flatfoot and control patients suggests that it would not be helpful to guide intraoperative surgical decision making. However, given that differences were found for walking, but not standing (50% bodyweight) also questions the ability other systems to quantitatively guide intraoperative correction because applying such loads are both impractical and potentially damaging to the foot during surgery. Strict criteria for intraoperative decisions, which are currently lacking, must be developed.
Comparison of Deformity with Respect to Talus in Adult Acquired Flatfoot Patients and Controls Using Multi-Planar Weight-Bearing Imaging versus Conventional Radiography

Presenting Author: Amgad M. Haleem, MBBCh, MS (Orth)  
New York, New York

Additional Authors: Elizabeth Young, BS; Helene Pavlov, MD; Eric Bogner, MD; C. Sofka, MD; Nina Geatrakas; Kristi Leggett; Jonathan T. Deland, MD; Scott J. Ellis, MD

Background:
Adult Acquired Flatfoot Deformity (AAFD) varies in location and severity, particularly with respect to the talus. Though conventional, weight-bearing radiographs (XR) have been validated to assess AAFD, their two dimensional nature and the inability to sometimes achieve full weight-bearing during acquisition may limit their ability to define this complex deformity. Three dimensional (multi-planar) weight-bearing imaging (3D-MP) is a novel modality yielding computed tomography (CT)-like images compared to XR, yet with 100% weight-bearing. It requires shorter acquisition time and lower radiation compared to standard CT. The aim of this study is to test the hypotheses that; firstly, 3D-MP localizes deformity with respect to talus in a cohort of AAFD patients compared to controls. Secondly; 3D-MP correlates with XR in assessing radiographic parameters of AAFD.

Materials and Methods:
From 2009 to 2011, XR and 3D-MP of the foot and ankle were obtained for 23 consecutive patients with flexible (Stage II) AAFD (10 males, 13 females, mean age 63±8.3 years) scheduled to undergo reconstruction. Ten consecutive patients who underwent imaging for unrelated forefoot pathology (8 females, 2 males, mean age 48.5±14.3 years) from the same time period served as controls.

Thirteen radiographic parameters on the axial, sagittal, and coronal views of the 3D-MP were compared between the two groups by blinded, musculoskeletal radiologists. Similarly, AP and lateral foot/ankle views on XR were compared between groups for all parameters except lateral gutter distance and talofibular impingement, not possible to assess on XR. Parameters were compared between groups with a Wilcoxon rank sum test (p < 0.05). Correlation between XR and 3D-MP parameters were performed using ICC/Kappa analysis. Values > 0.8 were considered to demonstrate excellent agreement, 0.7 to 0.8 very good agreement and 0.5 to 0.6 good agreement.

Results:
Statistically significant differences between study and control groups were found on 3D-MP in 6/13 radiographic parameters (p<0.05), notably the sagittal talonavicular angle as well as sagittal and axial first tarso-metatarsal angle (1TMT) (p=0.027, p=0.004 and p=0.003, respectively). However, only one parameter on XR (lateral 1TMT angle) reached significance (p < 0.05). Correlation showed excellent, very good and good agreement between both imaging modalities for three, two and five parameters, respectively.

Conclusion:
These results show that deformity with respect to the talus in AAFD is multifactorial, but was notably seen at the talonavicular joint in the sagittal plane with both modalities. Good to excellent agreement was found between XR and 3D-MP for many parameters, yet more significant differences were found between the flatfoot and control groups for the 3D-MP modality. This implies a potential role for 3D-
MP as a more reliable and informative tool to assess AAFD. However, testing this modality with larger number of study patients and normal controls is still required for further validation.

References:


Could Failure of the Spring Ligament Complex be the Primary Driving Force Behind the Development of the Adult Flatfoot Deformity?

Presenting Author: Geraint R. Williams, MBCHB

Liverpool, United Kingdom

Additional Authors: James Widnall, MBCHB; Paul J. Evans, MBCHB; Simon R. Platt, MBChB FRCS (T and O)

Summary
156 MRI scans were retrospectively analyzed for abnormalities of the spring ligament and tibialis posterior tendon. Lateral weight bearing radiographs of the foot were used to separate patients into planovalgus or normal based on radiographic measurements. Our investigation demonstrates that when the spring ligament and tibialis posterior tendon are assessed independently, spring ligament pathology displays the stronger association (odds ratio of 9.6 vs 2.15 respectively) and possibly greater importance in respect to adult flat foot deformity.

Introduction
The purpose of this study was to demonstrate the relative association of MRI diagnosed spring ligament and tibialis posterior tendon pathology to radiographic evidence of the planovalgus foot deformity.

Methods
156 MRI scans performed on a T1.5 unit between 2008-11 were selected for retrospective analysis. Exclusion criteria included: patients under 18 years, deep infection, prior trauma or surgery to the limb. Scans were interpreted by the lead author and a consultant musculoskeletal radiologist for pathology in relation to the tibialis posterior and spring ligament complex (superio-medial and medio-plantar components). Lateral weight bearing radiographs of the foot were used to separate patients into planovalgus or normal groups based on radiographic measurements. Chi squared (p values) and odds ratio (OR) were employed to test significance (SPSS version 17.0).

Results
96 females, 60 male scans, mean patient age 46 years (range, 18-86) comprised the final analysis. Overall prevalence of MRI diagnosed spring ligament and tibialis posterior pathology was 27% and 19% (40 and 30 of 156) respectively. MRI spring ligament abnormalities were strongly associated with radiographic flat foot deformity: talar first metatarsal (Meary’s angle) ≥ 5° OR 9.6 (p = 0.001), ≤ 20° calcaneal pitch OR 2.74 (p = 0.006) and ≥ 45° talocalcaneal angle OR 2.24 (p = 0.029). MRI evidence of tibialis posterior tendon pathology (Conti classification I, II or III) was also associated with radiographic evidence of flat foot deformity although this failed to reach statistical significance: talar first metatarsal (Meary’s angle) ≥ 5° OR 2.15 (p = 0.06), ≤ 20° calcaneal pitch OR 1.29 (p = 0.54) and ≥ 45° talocalcaneal angle OR 1.92 (p = 0.11).
Conclusion
Our investigation demonstrates that when the spring ligament and tibialis posterior tendon are assessed independently, spring ligament pathology displays the stronger association (odds ratio of 9.6 vs 2.15 respectively) and possibly greater importance in respect to adult flat foot deformity.
Coronal Plane Subtalar Joint Axis in Patients with Symptomatic Peritalar Subluxation

Presenting Author: Kelly L. Apostle, MD  
Seattle, Washington  

Additional Author: Bruce J. Sangeorzan, MD

Summary
The current study investigated a possible anatomic etiology to subluxation at the subtalar joint in patients with peritalar subluxation (PTS). Coronal plane subtalar joint axis (STJA) on simulated weight bearing CT scan in patients with symptomatic PTS was compared to normal controls. It was observed that patients with symptomatic PTS had a statistically significant increased valgus STJA. The minimum and maximum STJA angle and the progression from anterior to posterior along the posterior facet was also significantly more valgus.

Introduction
Peritalar subluxation (PTS) encompasses a wide spectrum of foot deformities and symptoms. It is largely accepted that the acquired planovalgus deformity develops as a consequence of many factors acting on the aging foot and ankle complex. However a comprehensive understanding of the etiology of PTS remains poorly understood. The aim of the current study was to investigate a possible underlying anatomic predisposition that facilitates subluxation at the subtalar joint.

Methods
A 2-year review of patients undergoing surgery for symptomatic PTS that had a simulated weight bearing CT (SWBCT) scans was performed. A control group of SWBCT scans in asymptomatic patients with normal radiographic foot alignment was used for comparison. Patient demographics were reviewed. Patients were excluded if they had a diagnosis other than acquired peritalar subluxation, were skeletally immature, had advanced subtalar arthritis, had misalignment of tibial plafond > 5 degrees or varus or valgus tilt of the talus in the mortise. SWBCT scans were reviewed to determine the mean coronal STJA as well as the trend from anterior to posterior across the posterior facet.

Results
Twelve feet in 11 patients with symptomatic PTS were compared to 10 controls. The study group consisted of 7 males and 5 females. The mean age was 59 (range 15-83) and the mean BMI was 29.6 +/- 7.0. The mean STJA in patients with PTS was 18.4 degrees valgus compared to 4.1 degrees valgus in normal controls, this finding was statistically significant (p < 0.001). The progression of the STJA from anterior to posterior across the posterior facet of the subtalar joint was reviewed. The PTS group had a more valgus orientation at the anterior limit of the posterior facet and progressed into further valgus towards the posterior limit of the posterior facet compared to normal controls which began in varus and made a less pronounced transition towards valgus at the posterior limit of the joint.

Conclusion
Patients with PTS have an increased valgus STJA angle as compared to normal controls. This provides an anatomic predisposition to posterolateral subluxation of the calcaneus and adds to the understanding of the etiology of PTS. This finding should be considered when planning surgical intervention for symptomatic PTS.
8:05 am

The Effects of First Ray Instability on Midfoot Joint Forces and Forefoot Ground Force Distribution: A Cadaveric Study

Presenting Author: John C. Tanner, III, MD
Grand Rapids, Michigan

Additional Authors: Travis Burgers, PhD; Cameron G. Patthanacharoenphon, MD; Matthew Dubiel, BS; James Mason, PhD; Donald R. Bohay, MD; John G. Anderson, MD

Summary:
This is a prospective biomechanical cadaveric study looking at the effects of destabilization of the first ray by transecting ligaments around the medial cuneiform. We found that destabilization of the first ray shifts forefoot force lateral while increasing peak forces in the 1st NC joint.

Introduction:
The motivation for this study is the clinical observation that patients with first ray instability develop arthritis in a predictable pattern in the midfoot. Cartilage wear is typically seen in the dorsal and medial in the 1st naviculocuneiform (NC) joint and dorsally in the 2nd tarsometatarsal (TMT) joint. It is the senior author's belief that intercuneiform instability plays an important role in the development of this pattern. This study is an attempt to quantify that effect of intercuneiform and 1st ray instability in a cadaveric model.

Methods:
Eleven fresh frozen human cadaver leg specimens were tested. All specimens were sectioned at the mid tibia level and muscle tendons were dissected out and tensioned with a weight and pulley system to simulate muscle forces. The specimens were mounted in a dynamic compression testing machine (Test Resources) and cyclical compressive forces applied. A foot sensor (TekScan) recorded the ground reaction forces and paddle sensors (TekScan) measured joint forces in the 1st NC joint and the 2nd TMT joint. The sequential transection of ligaments around the medial cuneiform was performed to destabilize the first ray, with data collected after each dissection. Specifically, the dorsal intercuneiform ligament was transected, followed by the plantar intercuneiform ligament, followed by the intermetatarsal ligaments and the plantar NC ligament. Foot sensor data was collected as force applied to the 1st ray forefoot and lateral forefoot. This was analyzed both as total force, and
percentage of forefoot force. The joint sensor data was collected as the maximum force measured in a four-pixel area (~2mm x 2mm). Data from all eleven specimens was averaged for our results.

**Results:**
The measured peak force in the 1st NC joint increased by 84% with sequential destabilization of the first ray and reached a maximum value with the plantar NC ligament intact (p=0.02). The measured peak force in the 2nd TMT joint increased slightly then decreased with sequential destabilization of the first ray. This result was not statistically significant. Destabilization of the first ray decreased the force transmitted to the medial forefoot in 10 of 11 test samples. On average, the total force to the first ray forefoot decreased by 29%. This result was not statistically significant (p=0.25).

**Conclusion:**
In a cadaveric model, destabilization of the first ray increases the peak force in the 1st NC joint. In the forefoot, a trend was seen towards decreased force transmission to the first ray, but this trend was not statistically significant.
Unilateral Hallux Valgus: Is it True Unilaterality or Does it Progress to Bilateral Deformity?

Presenting Author: Hyuk Jegal, MD
Seoul, South Korea

Additional Authors: Kiwon Young, MD; Young Uk Park, MD; Kyung-tai Lee, MD, PhD
Jin-su Kim, MD, PhD

Summary
This study was undertaken to determine whether unilateral hallux valgus deformity progresses unilaterally, and to evaluate the demographics, etiologies, and radiographic findings associated with symptomatic unilateral hallux valgus deformities. The frequency of unilateral symptomatic hallux valgus was found to be 2.5%, and significant differences were found between the deformed and unchanged groups in terms of age of onset, metatarsal head shape, HVA.

Introduction
This study was undertaken to determine whether unilateral hallux valgus deformity progresses unilaterally, and to evaluate the demographics, etiologies, and radiographic findings associated with symptomatic unilateral hallux valgus deformities.

Methods
Patients treated for a hallux valgus deformity between January 2004 and December 2008 were identified, and of these, 39 patients with unilateral deformities were enrolled. The definition of unilateral hallux valgus was a hallux valgus angle (HVA) of the normal foot of less than 20 degrees and difference in intermetatarsal angle (IMA) between sides of over 5 degrees and a HVA difference of over 10 degrees. Progressions of deformities in normal feet were evaluated at last follow up visits, and the clinical information, and radiographic measurements of those with a deformed normal foot or an unchanged normal foot were compared.

Results
958 patients (1619 cases) underwent corrective surgery during the period mentioned above. 661 patients (1322 cases) underwent bilateral surgery for bilateral deformities, and 297 underwent unilateral surgery. Of these 297, 40 patients (4.17%) had a unilateral hallux valgus deformity on preoperative radiographs. The mean length of follow up was 48 months (range, 18 – 76 months). One patient died of a cardiac problem, and thus, was lost to follow up. Twenty-four cases had no deformity of the normal foot at last follow-up visits (the unchanged group), but 15 cases had developed hallux valgus deformity (the deformed group). No significant intergroup differences were found in terms of metatarsus adductus angle (MAA) (p=0.409), Meary angle (p=0.460), talocalcaneal angle (TCA) (p=0.633), or calcaneal pitch angle (CPA) (p=0.965). However, members of the deformed group were significantly younger at disease onset (p=0.02), exhibited a curved first metatarsal head (p=0.03), and had a larger initial HVA (p<0.01).
**Conclusion**

The frequency of unilateral symptomatic hallux valgus was found to be 2.5%, and significant differences were found between the deformed and unchanged groups in terms of age of onset, metatarsal head shape, HVA.
Complications and Revisions after Proximal Osteotomies with Plate Fixation for Severe Hallux Valgus Deformities

Presenting Author: Emilio Wagner, MD  
Santiago, Chile  
Additional Authors: Cristian A. Ortiz, MD; Andres Keller, MD; Pablo Mococain, MD; Ignacio Villalon, MD; Francisco Garcia, MD; Tomas Echeverria

Summary
The POSCOW technique is reliable in correcting severe hallux valgus deformities. Achieving a good compression at the osteotomy site, and using a medial plate are factors of paramount importance in order to avoid complications.

Introduction
Proximal metatarsal osteotomies are generally recommended for severe hallux valgus deformities. Their main disadvantages are the instability with consequent risk of Malunion and the increase in the distal metatarsal articular angle (DMAA). A modified proximal metatarsal osteotomy with a lateral closing wedge and lateral translation (POSCOW) with plate fixation was designed to address these issues. The objective of this study is to report our complications and revisions on the long term results of the POSCOW osteotomy for severe hallux valgus deformities.

Methods
Ninety-six patients, 140 feet, average age 58.6 years, were operated between March 2006 and December 2009, aver. The average preoperative AOFAS score was 50 points, intermetatarsal angle (IMTT) 16.3 degrees, metatarsophalangeal angle (MTP) 34.8 degrees. A POSCOW osteotomy was performed and fixed with an angular stable 2.7 mm plate. Postoperative weight bearing as tolerated was allowed. The radiological measurements, AOFAS score, subjective satisfaction scale, time to bone healing, need of Akin osteotomy are reported, as well as any complication such as postoperative shortening, loss of correction, hallux varus, revisions, fusions, and removal of hardware.

Results
There was 88% satisfaction, with 13 patients reporting minor reservations due to postoperative edema, and 4 patients with major reservations. The AOFAS score improved to 94 points. The postoperative IMTT angle was 4.7 degrees, and the MTP angle was 8.7 degrees. The time to bone healing was on average 9 weeks. An Akin osteotomy was performed in 50 feet. The average shortening of the first metatarsal bone was 1.4 mm, the DMAA increased in 6.6 degrees. There was a mild loss of correction in 9 feet (6.4%), and a loss needing revision in 15 feet (10%). Hallux varus was observed in 3 cases (2%). Revisions for recurrence were treated with a chevron osteotomy in 5 cases, biplanar chevron in 5 cases, and an akin osteotomy in 5 cases. Two feet were fused at the metatarsophalangeal joint due to persistent pain. Hardware removal was performed in 19 cases (13%).

Conclusion
The POSCOW technique is reliable in correcting severe hallux valgus deformities. The advantage of adding translation over an oblique plane to a proximal metatarsal osteotomy is that it avoids in some degree the metatarsal shortening seen in every closing wedge osteotomy, and the increase in the DMAA is less compared to classic proximal crescentic osteotomies. An additional advantage of this osteotomy is its possibility of preoperative planning which makes it more predictable. Is a very powerful osteotomy, achieving a high degree of satisfaction. Complications do occur, mainly in the first
30 patients of this series, due to its learning curve. Achieving a good compression at the osteotomy site, and using a medially placed plate are two factors of paramount importance in order to avoid complications.
Plantar Displacement in the Scarf Osteotomy: Correction of Associated Midfoot Collapse through the Windlass Mechanism. A Radiographic Study

Presenting Author: Gillian Jackson, MBChB, MRCS, FRACS (T&O)
Liverpool, UK

Additional Authors: Raef Dahab, MBBS, MS, Mch Orth, FRCS, FRCS Orth; Simon Platt, MBChB, FRCS (T&O)

Summary
The scarf osteotomy for hallux valgus produces both lateral and plantar displacement of the metatarsal head. The increased windlass effect resulting from lowering of the metatarsal head can result in improved arch elevation on weightbearing. This may be beneficial in those with an associated flexible midfoot collapse. This study compares pre and postoperative radiographs in patients who underwent a scarf osteotomy for hallux valgus. In those with an associated midfoot collapse there was a radiological improvement in midfoot alignment post-operatively.

Introduction
Hallux valgus can be associated with midfoot collapse such as a planovalgus deformity or hypermobility of the 1st ray. The scarf osteotomy is a versatile and reproducible procedure for the correction of moderate to severe hallux valgus deformity. The longitudinal cut of the scarf osteotomy is performed parallel to the oblique plantar surface. Lateral displacement of the osteotomy also produces lowering in the sagittal plane. We hypothesised that this lowering of the metatarsal head would result in an increased windlass effect causing arch elevation and hence may result in an improvement in any associated flexible midfoot collapse.

Methods
This study compared anteroposterior (AP) and lateral weightbearing pedal radiographs. All patients had a scarf osteotomy performed for treatment of hallux valgus. The scarf technique, as described by Barouk, was used with lowering of the first metatarsal head. The Maestro cut (shortening modification) was not performed. Pre and postoperative radiographs were analysed for hallux valgus angle, intermetatarsal angle and midfoot alignment in those feet with associated midfoot collapse.

Results
Seventy-four preoperative weightbearing radiographs from 55 consecutive patients were reviewed. Forty-six females and nine males, 35 right and 39 left feet were analysed. Thirty-seven of those feet had evidence of midfoot collapse, defined as a Meary's angle (talo-first metatarsal angle) of greater than four degrees on the lateral radiograph. The level of the midfoot break was 1st tarsometatarsal joint in two feet, naviculocuneiform joint in 29 feet, talonavicular joint in 1 foot and combined in 5 feet. There was no radiological evidence of degenerative change of the midfoot. The hallux valgus correction (improvement in HVA and IMA) was significant (P< 0.05). The lateral talo-first metatarsal angle improved from 6.9 to 4.3 degrees (P<0.05). The AP talo-first metatarsal angle remained unchanged, 7.2 degrees (P>0.05). The talonavicular coverage angle improved from 10.6 to 4 degrees (P<0.05). The AP talo–second metatarsal angle improved from 13.3 to 9.1 degrees (P<0.05). There was no direct correlation found between the amount of hallux valgus correction achieved and the amount of midfoot deformity correction seen.
Conclusion
The findings suggest that the scarf osteotomy can result in an improvement in lateral talo-first metatarsal angle, talonavicular coverage angle and AP talo-second metatarsal angle. The AP talo-first metatarsal angle remained unchanged however its use as a measure of planovalgus is limited in the presence of a hallux valgus deformity and the change in AP talo-second metatarsal angle may be more meaningful. Following this study we would suggest that an accurately performed scarf osteotomy may improve midfoot alignment through the windlass mechanism and on occasion avoid the need for associated midfoot procedures or orthotic use. The study is limited by the sample size and accuracy of the electronic picture archive angular measurements. The midfoot deformities were presumed to be flexible from their radiographic appearance. A cadaveric study could provide further evidence.
Intermediate Follow up of Hallux Valgus Treatment with Scarf Osteotomy

Presenting Author: Jae-hyuck Choi, MD
Dallas, Texas

Additional Authors: Jacob Zide, MD; Jeffrey R. Jockel MD; Gregory M. Neely, MD; James W. Brodsky, MD

Summary
Scarf osteotomy is a reliable technique for treating hallux valgus with minimal complications and low incidence of recurrence.

Introduction
The purpose of this investigation was to evaluate the clinical and radiological results of hallux valgus treatment with a scarf osteotomy.

Methods
From January 2000 to January 2006, 70 cases (66 patients) with hallux valgus were treated with scarf osteotomy. Sixty six patients (70 feet) were followed up for more than five years (mean 97.1; range, 72-144 month) after surgery. Clinically, American Orthopaedic Foot And Ankle Society (AOFAS) score, SF -36 were evaluated and radiologically, hallux valgus angles (HVA), intermetatarsal angles (IMA), interphalangeal angle, tibial sesamoid position (TSP) were measured and evaluated.

Results
Mean age at the time of surgery was 56 (range 38-81), and included 6 male and 64 female. The preoperative mean AOFAS was 55.6 (14~88) (median ± SD) (57 ±15). The postoperative mean AOFAS score was 89 (60~100) points. Median ±SD (90 ±9). (P <0.001)
The preoperative HVA decreased from 31° (12-60) to postoperative 11° (2-25) and the mean IMA from 14° (4-20) to 6° (0-13). The Tibial sesamoid position was corrected from 3 to 0 (p<0.001). ( ) % were completely satisfied with their postoperative results.
There was no nonunion or delayed union, no avascular necrosis, Reoperation was 5 cases (5/70) 7%. 4 cases had symptomatic hardware required screw removal and 1 cases had infection (1%). There was one hallux varus 1 cases. (1%).

Conclusion
Scarf osteotomy is a reliable technique for treating hallux valgus with minimal complications and low incidence of recurrence.
### Long term follow up of hallux valgus treatment with scarf ostectomy

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Successful Arthrodesis of the First Metatarsophalangeal Joint In Patients with Inflammatory and Non-Inflammatory Arthritis: A Comparative Analysis

Presenting Author: Shawn R. Morrow, DO
Westerville, Ohio

Additional Author: Christopher F. Hyer, DPM, MS

Summary
Arthrodesis of the 1st MTP joint has long been a reliable treatment option for end stage arthritis due to Osteoarthritis (OA) or Rheumatoid arthritis (RA). The purpose of this study was to compare a number of demographic and clinical variables between patients with 1st MTP osteoarthritis versus rheumatoid arthritis when arthrodesis was indicated.

Introduction
Arthrodesis of the 1st MTP joint has long been a reliable treatment option for end stage arthritis due to Osteoarthritis (OA) or Rheumatoid arthritis (RA). The pathophysiology of these two diseases is different yet both have had relatively high success rates when arthrodesis was indicated. The purpose of this study was to compare a number of demographic and clinical variables between patients with 1st MTP osteoarthritis versus rheumatoid arthritis when arthrodesis was indicated.

Methods
Our institution looked at 61 1st MTP fusion procedures. Thirty seven procedures for the treatment of OA and twenty four procedures for the treatment of RA. A non-parametric Wilcoxon test was utilized to compare demographic and clinical variables between the two groups. Demographic variables included age, sex, body mass index, smoking status, and diabetes status. Clinical variables included fusion rate, time to fusion, and fixation type.

Results
Those subjects with RA had a shorter time to fusion as well as better fusion rates compared to those with OA; however, the differences were not significant. The only demographic or clinical variable that reached significance was age (p-value 0.055). The mean age at time of surgery for OA and RA patients was 57.6 and 64.62 years old, respectively.

Conclusion
End stage Osteoarthritis and Rheumatoid arthritis remain two indications for 1st MTP fusion. These two diseases have different pathological processes, however, other than age, there appears to be no statistical differences in other demographic variables as well as fusion rates and times to fusion.
Salvage of Hemiarthroplasty of the Hallux Metatarsophalangeal Joint with Conversion to Arthrodesis

Presenting Author: David N. Garras, MD
Philadelphia, Pennsylvania

Additional Authors: Joel Durinka, MD; Michael Bercik, MD; Steven M. Raikin, MD

Summary
Eighteen patients underwent conversion from a first MTP hemiarthroplasty to arthrodesis. Clinical and radiographic follow-up at a mean of 4.3 years shows good alignment and consistently excellent outcomes. All patients achieved fusion albeit at longer intervals than expected for primary fusion. Six patients required tricortical iliac crest bone graft for bone defects but most did well with regional cancellous bone graft. Conversion to arthrodesis is a reliably successful method of treating failed hallux MTP hemiarthroplasties.

Introduction
Arthrodesis is currently the most commonly performed surgical procedure for the treatment of severe arthritis of the first metatarsophalangeal joint. Hemiarthroplasty of the first metatarsal has been shown to result in inferior clinical results and higher revision rates. The objective of this study was to compare the long-term clinical outcome of the salvage of first metatarsal hemiarthroplasty with conversion to arthrodesis.

Methods
A series of patients who underwent salvage of the first metatarsal joint hemiarthroplasty with conversion to arthrodesis between 2001 and 2011 were evaluated. Preoperative assessment was evaluated with the visual analog pain (VAP) scale and AOFAS Hallux-Metatarsophalangeal Interphalangeal scoring system (AOFAS-HMI). Postoperative satisfaction was graded via AOFAS-HMI, VAP, and Foot and Ankle Ability Measure (FAAM).

Results
Twenty-one hemiarthroplasties were converted to arthrodesis in 21 patients, 13 women and 8 men. Three patients were lost to followup, leaving 18 patients to be included in the study. Bone graft was obtained from the calcaneus (11) and distal tibia (1). Six patients required tricortical iliac crest bone graft for the treatment of extensive bone loss. At the time of final follow-up (at a mean of 4.3 years), the mean pain score was 0.75 down from 7.8 out of 10 preoperatively. The mean FAAM ADL and sports were 97.3 and 91.3, respectively. The mean AOFAS-HMI improved from 48.7 out of 100 preoperatively to 85.3 out of 90 (modified to exclude first MTP motion). All patients achieved fusion although at a longer interval than primary fusions. Seventeen patients subjectively rated their results as excellent or good, and 1 as fair.

Conclusion
Arthrodesis is more predictable and considered the gold standard for alleviating symptoms and restoring function in patients with first metatarsophalangeal joint degeneration. Conversion from a hemiarthroplasty to arthrodesis shows similar success to primary arthrodesis and can be achieved in the majority of cases with the use of regional bone graft for small defects. However, the time to fusion is longer than that of primary arthrodesis and it may require structural bone graft for augmentation.
8:40 am

2011-2012 Presidential Talk

Judith F. Baumhauer, MD, MPH
Rochester, New York

8:55 am

2012-2013 Presidential Talk

Lew C. Schon, MD
Baltimore, Maryland
The history of polio in America is a fascinating story. As I became interested in the subject, after all I have worked at a hospital originally founded to treat polio, I realized that those who could tell the story were fading with the passage of time. I was fortunate to be able to produce a documentary film about polio, a film which has had a success which surprised us. In this lecture I will recount many of the unique aspects of the era.

Polio had been in civilization as far back as Egyptian times, but only reached epidemic proportions in the early 20th century. Oddly enough, this happened as the environment became more hygienic, and infants and young children were not exposed to the viruses early on when maternal antibodies could reduce the paralytic effects of the disease. The first epidemics occurred in New England, the most devastating hitting New York in the summer of 1917. Soon polio news began to eclipse news of the Great War.

Affected children were often kept out of the public eye, and attitudes of the time were harsh. Hospitals with rough names, like the Hospital for the Ruptured and Crippled, the Newington House and Home for Incurables and others opened to take care of the "cripples". Orthopedic surgery, an infant specialty at the time, rose to the many challenges with innovative tendon and muscle transfers, bone stabilizing arthrodeses, and a multitude of braces and devices.

Franklin Roosevelt, an up and coming national politician, developed polio in his 30's. His condition of almost complete paralysis of the lower extremities was largely hidden from the public throughout his career, which included reaching the Presidency. He devoted great energy to raising money through the March of Dimes to not only care for those afflicted, but to support basic research into the etiology.

A pivotal step in developing a vaccine was the ability to grow virus in tissue culture, a discovery which rewarded Drs. Enders, Weller, and Robbins of Harvard and Children's Hospital with a Nobel prize. Later Salk and Sabin literally battled it out with competing vaccines, one with killed virus and the other with attenuated live virus. Each vaccine has had its day, and currently both are still in use.

Many segments of the film will be shown, including descriptions from many living with the memories of iron lungs, surgeries, and braces. Therapists, physicians, and scientists, fortunately still living, give the background and detail of the times.
10:30 am

New Technique in Treatment of Midportion Achilles Tendinopathy
Presenting Author: Hajo Thermann, MD, PhD
Heidelberg, Germany
Additional Author: Ralph Michael Fischer; Ferzan Suze, MD; Sven Feil

Summary
In this prospective study we present the short-term clinical results of 33 consecutive patients, which were treated with endoscopic debridement of the ventral neovascularized area, the peritendineum and the Achilles tendon itself with completely satisfactory results.

Introduction
Although results of open surgical treatment of Achilles tendon pathologies have been reported to be satisfactory, postoperative complication rates remain high and varying from 4.7% to 11.6%. Open surgical treatment is also associated with a relatively long postoperative rehabilitation period and a delayed patient recovery in terms of full tendon loading activity. A less invasive endoscopic surgical procedure would be a useful alternative to open surgery, in order to minimize the rate of the postoperative complications and enhance postoperative patient recovery. In this prospective study we present the short-term clinical results of a new endoscopic surgical technique for treating chronic painful midportion Achilles tendinopathy.

Methods
33 consecutive patients (25 men and 8 woman, mean age 50.7 years) suffering from chronic painful Achilles tendinopathy were included in this study and were treated with endoscopic debridement of the ventral neovascularized area, the peritendineum and the Achilles tendon. For evaluation, the patients recorded the VISA-A questionnaire, the function of the Achilles tendon and the severity of Achilles tendon pain during tendon loading activity pre and postoperatively in a visual analogue scale (VAS). Patient global satisfaction with the results of the operation was also assessed in a similar manner. Patients were followed-up (FU) direct postoperatively, at 6 weeks, 3 months, 6 months and 1 year, when the last follow-up examination took place.

Results
All patients experienced immediate postoperative pain relief. In terms of Achilles tendon pain, the mean score on the VAS decreased significantly (p<0.05) from 60.0 ± 24.4 preoperatively, to 8.6 ± 12.7 at 1 year. The sole interval without a significantly decrease was between the pre- and direct postoperatively FU (45.6 ± 36.0). In terms of Achilles tendon function, the mean score on the VAS...
increased significantly (p<0.01) from 35.8 ± 23.1 at the preoperative examination to 89.9 ± 14.8 at 1 year, but did as well not increase significantly to direct postoperatively (26.4 ± 25.1). In case of global satisfaction, data shows a significant increase among all FU-intervals. Altogether from 26.5 ± 29.9 preoperatively to 85.9 ± 21.5 at 1 year. The VISA-A score was significantly better (p<0.003) at 1 year FU (86.2 ± 13.4) compared to preoperatively (41.8 ± 21.7). Up to now, no postoperative complications were recorded.

**Conclusion**
The short-term clinical results on patients with chronic painful midportion Achilles tendinopathy, treated with endoscopic debridement of the area of neovascularization outside the ventral part of the Achilles tendon, were completely satisfactory in regard to the recovery of functional aspects.
Evaluation of Ankle Plantarflexion Endurance and Power following Gastrocnemius Recession for Achilles Tendinopathy

Presenting Author: Deborah Nawoczenski, PT, PhD
Rochester, New York

Additional Authors: Josh Tome, MS; Maxwell Cantor, BS; Jason Zlotnicki; Benedict F. DiGiovanni, MD

Summary
Calf endurance and ankle plantarflexor push off power were evaluated during heel raise and stair ascent in 13 patients who underwent gastrocnemius recession for the treatment of recalcitrant Achilles tendinopathy approximately 20 months earlier. Assessment of limb symmetry indicated diminished calf endurance and power in the involved limb at higher step heights. Evaluation of endurance and power may provide a comprehensive biomarker of overall muscle function that may be linked to patients’ self-reported outcomes following gastrocnemius recession.

Introduction
Increased recognition of an isolated gastrocnemius contracture in patients with foot and ankle pathology has generated enthusiasm for selectively reducing tension on the Achilles tendon through a gastrocnemius recession (GR) procedure. Outcome studies to date are encouraging regarding patient satisfaction, pain reduction and return to daily activities. However, functional and recreational activities that require increased muscle endurance and ankle ‘push off’ power (eg. heel raise, climbing stairs, fast walking) present greater challenges. The purpose of this study was to determine the effects of an isolated GR on ankle muscle performance (plantarflexion endurance and power) during heel raise and stair ascent in patients who underwent a unilateral GR for the treatment of recalcitrant Achilles tendinopathy (AT).

Methods
13 patients (mean age: 52.7 ± 7 yrs; BMI 30±4.5; M:F=8:5) with a diagnosis of unilateral AT combined with an isolated gastrocnemius contracture received a GR (Strayer) procedure. Patients were evaluated an average of 20 months (range 12-27 months) post operatively. The control group consisted of 10 subjects (mean age: 53 ± 3 yrs) with overall similar demographics. Self-reported outcomes were assessed using the Foot Ankle Ability Measure (FAAM). Three-dimensional foot kinematics and force data were collected during heel raise and stair ascent. Calf endurance was assessed using the heel raise work test (plantarflexion force x heel height x number of repetitions of single limb heel raises) and a limb symmetry index (LSI) was used to determine the magnitude of side-to-side differences. Peak ankle push off power was assessed at two different step heights. Appropriate t-tests compared differences between involved and uninvolved limbs (patient group), as well as between the involved limb (patient group) and non-dominant limb of the control group.

Results
FAAM scores were 89.7% for activities of daily living subscale and 71% for sports and recreation. Calf endurance was significantly less between involved and uninvolved limbs (1204 ± 909 Joules vs. 1675 ± 585 Joules, respectively, p=.01), as well as between the patients’ involved limb and non-dominant limb of the control group (p=.007). The LSI indicated symmetry deficits of 33% for AT patients compared to 2% limb symmetry differences for controls. (Figure). These deficits exceed normative side-to-side differences (<10%) reported for patients following recovery from Achilles tendon rupture. The ability
to generate push off power during step up was significantly less between involved and uninvolved limbs when patients attempted to step up to a higher step (2.84 N/kg vs. 3.85 N.kg, respectively, p=.04).

**Conclusion**

Although patients may be functioning ‘near normal’ for their activities of daily living, they report difficulty during activities that may be more demanding for the ankle plantarflexors, as noted in FAAM scores for sports and recreation. This study demonstrated deficits in ankle calf endurance and power during heel raises and stair ascent. Assessment of endurance and power may provide a more comprehensive biomarker of overall muscle function that may be linked to patients’ self-reported outcomes following gastrocnemius recession.
A Prospective, Randomised, Controlled Trial to Assess the Efficacy of Whole Blood or Platelets in the Treatment of Chronic Achilles Tendinosis

Presenting Author: Gerard Bourke  
*Sydney, Australia*

Summary
The treatment of chronic Achilles tendinosis remains largely non operative. The use of autologous blood injection remains unproven and controversial. This study demonstrates no improvement in clinical scores when comparing the use of autologous whole blood or buffy coat versus saline and controls in the treatment of chronic Achilles tendinosis. The use of autologous blood injections in the treatment of Achilles tendonosis should be questioned and discontinued until it’s efficacy can be proven.

Introduction
The purpose of this prospective, randomised, double blinded controlled study was to assess the efficacy of whole blood, platelets, and saline in the treatment of chronic Achilles tendinosis. Chronic Achilles tendinosis is a common condition affecting an area approximately 8-10cm above the Achilles tendon and the use of ultrasound guided injection of blood is becoming more popular. This study attempts to determine whether this procedure provides any benefit in the treatment of chronic Achilles tendinosis.

Methods
48 Patients were recruited from foot and ankle specialist clinics and randomized into four groups. All patients were assessed by radiologists experienced in the treatment of Achilles Tendinosis for alternate pathology such as partial tears and insertional Tendinopathy. Blood was drawn from all patients and local anaesthetic instilled into the skin over the affected area of the tendon. The first group received an injection of whole blood under ultrasound guidance into the Achilles Tendon. The second group received an injection of Buffy coat after spinning of the whole blood into its components. The third group received saline and the fourth group had a placebo with no injection into the Achilles tendon. The trial was double blinded so neither the patient nor the referring practitioner had knowledge of which treatment the patient was to undergo. Ultrasound examination of the tendon as well as Visa-A scores were carried out at the time of injection and at twelve weeks.

Results
There was no improvement seen in the treatment arm with either blood or platelets compared to the saline or placebo groups. This was also found when the Visa-A score was disaggregated to the pain and function questions and analysed separately.

Conclusion
The study finds no efficacy in treating chronic Achilles tendinosis with injection of either blood or Buffy coat; therefore this treatment should not be continued. It is both expensive and potentially harmful to the patient and is very labour intensive to the practitioner and health system in general. The use of blood injected into tendons and ligaments is becoming more common place within the community however there is no strong literature to support its use. This study indicates that the use of injected autologous blood cannot be supported in the treatment of chronic Achilles tendinosis.
Surgical Treatment of Insertional Achilles Tendinopathy with or without Flexor Hallucis Longus Tendon Transfer: A Prospective, Randomized, Controlled Trial

Presenting Author: Carroll P. Jones, III, MD, MD
Charlotte, North Carolina

Additional Author: Kenneth J. Hunt, MD; Bruce E. Cohen, MD; W. Hodges Davis, MD; Robert B. Anderson, MD

Summary
Chronic insertional Achilles tendinopathy is a common pathology that can be difficult to manage, particularly in patients over 50 years of age. Many have advocated for the use of FHL tendon transfer to augment decompression and debridement of the Achilles insertion. Preliminary data from our prospective, randomized trial, demonstrates no difference in clinical outcome scores between groups; however, we found greater ankle plantarflexion strength in the FHL augmentation group. Wound complication rates were high, particularly in the FHL transfer group.

Introduction
Chronic insertional Achilles tendinopathy is a common pathology that can be difficult to manage. For patients who fail an appropriate course of non-operative management, several operative techniques have been described. Decompression with debridement has been shown to reduce pain and improve function in younger patients with less severe tendon involvement. However, results have been less reliable in patients over age 50. Due to concerns about persistent pain and functional limitation with decompression alone, some have advocated augmentation with the FHL tendon. However, the benefits of FHL augmentation have not been demonstrated in a controlled trial. We hypothesize that FHL augmentation will be associated with superior clinical outcome scores and greater ankle plantarflexion strength compared with Achilles debridement alone.

Methods
As part of an IRB approved study protocol, all patients greater than 50 years of age who had failed non-operative treatment for chronic insertional Achilles tendinopathy were invited to participate. Patients were randomly assigned to Achilles decompression and debridement alone (Group 1) or Achilles decompression and debridement augmented with FHL transfer (Group 2). Patients followed a standard post-operative protocol, including formal physiotherapy. Outcome measures included: AOFAS Ankle/Hindfoot score, visual analog pain scale (VAS), ankle and hallux plantarflexion strength (measured with Cybex 6000 Isokinetic Dynamometer), and a patient satisfaction survey. Patients were evaluated post-operatively at 6 weeks, 3 months, 6 months, and 1 year. All operative complications were recorded.

Results
A total of 28 enrolled patients had a minimum of one year follow-up, 15 in group 1 and 13 in group 2. The average patient age was 60.7 years. AOFAS ankle/hindfoot scores improved in both groups at 6 months and 1 year with no difference between groups. Activity-related VAS scores improved significantly in both groups, with no difference between groups at 6 months and 1 year. There was greater ankle plantarflexion strength in group 2 at 6 months, and a trend toward greater ankle plantarflexion strength at one year, compared to Group 1 (p=0.07). There was no difference between the two groups in hallux plantarflexion strength pre-op and at 1 year. At one year, 25 of 28 patients (90%) were satisfied with the outcome of their procedure, again with no difference between groups.
Wound complications were found in 35.7% of patients; all wound complications resolved without surgical intervention. There were significantly more wound complications in Group 2 compared to Group 1 (p<0.05).

Conclusion
In this analysis of preliminary data, we found no difference in clinical outcome scores and patient satisfaction when comparing patients treated for chronic insertional Achilles tendinopathy with Achilles debridement alone versus FHL augmentation. However, we found greater ankle plantarflexion strength at 6 months and a trend toward greater ankle plantarflexion strength at 1 year in the FHL augmentation group. Hallux plantarflexion strength was no different between groups at one year. Wound complication rates were high, particularly in the FHL transfer group. Additional patient enrollment and follow-up may further elucidate the potential advantages of FHL transfer.
Treatment of Myotendinous Achilles Ruptures: A Retrospective Study

Presenting Author: Jamal Ahmad, MD  
Philadelphia, Pennsylvania

Additional Authors: Michael Repka, BA; Steven M. Raikin, MD

Summary
There is scant literature regarding Achilles ruptures at the myotendinous junction. The purpose of this study is to examine outcomes from uniform nonsurgical treatment of myotendinous Achilles ruptures. Between 2005 and 2011, thirty patients were treated non-surgically for an acute myotendinous Achilles rupture. All patients experienced full Achilles healing, improved function, and less pain at their latest follow-up. As myotendinous Achilles ruptures are studied further, nonsurgical care should be strongly considered as treatment.

Introduction
The Achilles tendon can be injured acutely in 3 different locations: the mid-substance, distal insertion, and myotendinous junction. While much has been written about mid-substance and insertional Achilles ruptures, there is scant literature regarding myotendinous injuries. The purpose of this study is to retrospectively examine clinical outcomes from uniform nonsurgical treatment of myotendinous Achilles ruptures.

Methods
Between November 2005 and May 2011, thirty patients presented with an acute, complete myotendinous Achilles rupture. The location of the Achilles injury was confirmed on magnetic resonance imaging (MRI) for all patients. All patients were treated non-surgically. This involved 4 weeks of non-weightbearing and then 4 weeks of progressive to full weightbearing in a Bledsoe Achilles boot. Physical therapy was provided for 4 to 6 weeks after this period of immobilization. 21 patients were male and the remaining 9 were female. The patients were aged between 24 and 54 years with the mean age being 40.8 years. 15 patients had the right Achilles myotendinous junction affected while the other 15 had the injury at their left Achilles. Patients were followed up from 7 to 73 months with the mean being 28.0 months.

Results
Full healing of the Achilles’ myotendinous junction was achieved clinically in all 30 patients (100 %). All patients experienced improved function and less pain at their latest follow-up. Mean Foot and Ankle Ability Measures – Activities of Daily Living (FAAM-ADL) increased from 20.2% at the time of initial presentation to 95.2% at the latest follow-up (P<0.05). Mean Visual Analog Scores (VAS) of pain decreased from 8.2 at the time of initial presentation to 1.3 at latest follow-up (P<0.01). 23 (76.7%), 6 (20%), and 1 (3.3%) patient rated their satisfaction as excellent, good, and fair respectively. No patients have developed recurrent myotendinous Achilles ruptures to date.

Conclusion
This study demonstrates that nonsurgical treatment of myotendinous Achilles ruptures results in a high rate of improved patient function and pain relief. Clinical outcomes from treating this type of Achilles injury in this manner have not been previously reported in the orthopaedic literature. As myotendinous Achilles ruptures are studied further, nonsurgical care should be strongly considered as treatment.
A Clinical and Radiological Correlative Study of Peroneal Tendon Pathology

Presenting Author: Eric Giza, MD
Sacramento, California

Additional Authors: Walter Mak, MD; Stephanie E. Wong, BS; Glade E. Roper, MD; Valentina Campanelli, BS; John C. Hunter, MD

Summary
Magnetic resonance imaging (MRI) is often utilized for imaging evaluation of peroneal tendon tears, but no studies have determined the correlation between MRI findings and clinical examination. The positive predictive value (PPV) of 48% found in this study demonstrates a poor correlation between MRI findings and clinical examination consistent with peroneal tendon pathology. Peroneal tendon tears are often incidental findings on MRI for patients presenting with ankle symptoms.

Introduction
The proportion of patients with clinical findings referable to peroneal pathology and magnetic resonance imaging (MRI)-diagnosed peroneal tendon pathology is unknown. Previous studies have correlated surgical findings with clinical data and preoperative magnetic resonance imaging, but there are no published studies correlating clinical examination findings with imaging findings. The purpose of this study was to determine the degree of correlation between peroneal tendon pathology as diagnosed by MRI and clinical findings of peroneal tendon pathology.

Methods
Fifty-six patients who had both MRI evidence of peroneal tendon pathology and an associated clinical examination of the ankle were evaluated over a three-year period at a tertiary care institution. The principal investigator or Orthopaedic Sports Medicine faculty prospectively recorded the clinical examination of each patient. Patients presenting with at least one of the following signs/symptoms were considered to have a positive clinical exam: peroneal tenderness, dislocation/snapping, or lateral ankle pain. A board certified, fellowship trained musculoskeletal radiologist confirmed the presence of MRI findings consistent with peroneal tendon pathology.

Results
Of the 56 patients with positive findings on MRI, 27 patients had an associated positive clinical exam and 29 patients had a negative clinical exam. The positive predictive value (PPV) of MRI for peroneal tendon tears with positive clinical findings was 48% (95% confidence interval 35-61%). Twelve of the 27 patients with a positive clinical examination and positive MRI underwent surgery. All 12 patients had operable peroneal tendon pathology (100%). While MRI demonstrated peroneal tendon tear(s) (brevis, longus, or both) in 12 patients, the tear was surgically confirmed in nine patients. Thus, MRI was 75% accurate as confirmed by surgery.

Conclusion
Patients with MRI findings of peroneal tendon pathology should undergo careful clinical examination, as the PPV of MRI for peroneal tendon pathology with actual clinical findings is low. This study demonstrates that peroneal tendon tears are often incidental findings on MRI. MRI detected operable peroneal tendon pathology 100% of the time, but was only 75% accurate.
Single-Stage Flexor Tendon Transfer for the Treatment of Severe Concomitant Peroneus Longus and Brevis Tendon Tears

Presenting Author: Jeffrey R. Jockel, MD  
Dallas, Texas  
Additional Author: James W. Brodsky, MD

Summary
Outcomes of single-stage flexor tendon transfer for the treatment of severe concomitant peroneus longus and brevis tears are presented.

Introduction
While peroneal tendon injuries are a common cause of lateral ankle pain, there is a paucity of literature specifically addressing the treatment of severe concomitant peroneus longus and brevis tears. The purpose of this study was to evaluate patient outcomes following a single-stage flexor tendon transfer for the treatment of severe concomitant tears of both peroneal tendons.

Methods
The surgical database of a single fellowship-trained orthopedic surgeon was retrospectively reviewed to identify cases addressing concomitant peroneus longus and brevis tears over a 15-year surveillance period from 1996 to present. Tendon transfer of either the flexor hallucis longus or flexor digitorum longus was indicated when both peroneal tendons were found intra-operatively to have severe non-reconstructable tears of greater than fifty percent. Tendon transfers were performed with a medial tendon harvest, lateral rotation across the posterior compartment, and attachment to the base of the 5th metatarsal utilizing a bone-tunnel technique. Side-to-side tenodeses, both proximal and distal to the torn peroneal segments, were followed by excision of the diseased tendon. Postoperatively, patients began weight-bearing in a short leg cast at 8 weeks, with initiation of physical therapy at 12 weeks. Pre-operative and post-operative AOFAS hindfoot and visual analog pain scores were prospectively collected, and patient charts were reviewed for complications. A postoperative outcome questionnaire was administered during latest follow-up to assess return to activities, satisfaction, self-rated patient outcome.

Results
Eight patients treated with a flexor tendon transfer for severe concomitant peroneus longus and brevis tears were identified. Mean age at the time of surgery was 54 years old (range 41-67), including 4 male and 4 female patients. Four of 8 patients had undergone at least one prior surgery to the lateral ankle region for lateral ligament instability, peroneal tendon subluxation, or previous partial tears. Four flexor hallucis longus tendon transfers and 4 flexor digitorum longus transfers were performed for non-reconstructable concomitant peroneal tendon tears. At the time of surgery, 5 patients were treated with additional procedures for associated pathology including cavovarus deformity, lateral ligament instability, osteochondral defects, rheumatoid arthritis/tendinopathy, and osteoarthritis of the ankle. One surgical complication occurred following FDL transfer in a patient who developed a peroneal nerve palsy which resolved by 3 months post-operatively. Mean follow-up time from surgery was 58 months (range 12-91), and 1 patient underwent a subsequent calcaneal osteotomy. Mean pre- and postoperative AOFAS hindfoot scores increased from 65 (range 54-77) to 86 (range 69-100), respectively, while mean VAS pain score decreased from 3.9 (range 0.5-6) to 1 (range 0-3). Seven of 8 patients (88%) reported a return to preoperative activity levels, noting return to activities such as
alpine skiing, volleyball, cycling, waterskiing, swimming, walking, and fishing. All patients reported satisfaction with surgical results, and seven rated their outcomes as good or excellent.

**Conclusion**
Single-stage flexor tendon transfer is an effective surgical option for the treatment of severe concomitant peroneus longus and brevis tendon tears.
Non-operative Treatment of Acute Rupture of the Achilles Tendon

Presenting Author: Fabian Krause, MD  
*Basel, Switzerland*

Additional Authors: Timo Ecker, MD; Thorsten Mueller; Martin Weber, MD

Summary

A treatment algorithm is presented that promotes fast rehabilitation through immediate full weight-bearing and physical therapy. The re-rupture rate is lower, while the complication rate matches results after non-operative treatment reported in other studies. Concluding, non-operative treatment is a valuable option for acute rupture of the Achilles tendon.

Introduction

Treatment of acute rupture of the Achilles tendon is categorized into operative and non-operative treatment. Surgery is associated with a significantly lower number of re-ruptures but also an increased complication rate, whilst not leading to accelerated rehabilitation or improved functional outcome. We developed and evaluated a customized non-operative treatment algorithm.

Methods

Ninety-one patients were prospectively followed up for a mean of 30.6 ± 20.1 (9.38 - 88.1) months. A short ankle cast in 20° equinus position was worn in a special rehabilitation boot equipped with 2 removable heel inlays for 6 weeks. Full weight-bearing was allowed immediately. After 6 weeks, the cast was removed and patients wore the boot for another 6 weeks, removing one heel inlay every two weeks with a final 2 week period of ambulation in the boot without inlay. A special physical therapy program was absolved.

Results

The mean Thermann score was 82.2 ± 13.4 (35-100) points. Subjective satisfaction was rated „very good“ and „good“ in 92.3% of patients. There were 5 re-ruptures, three with an adequate trauma and two without, the latter undergoing surgical repair subsequently. The complication rate was 6.6%, including each one plantar fasciitis, intratendinous seroma, pressure ulcer, transient hypaesthesia, development of CRPS syndrome, and 2 deep venous thrombosis.

Conclusion

Our treatment algorithm promotes fast rehabilitation through immediate full weight-bearing and physical therapy. The re-rupture rate is lower, while the complication rate matches results after non-operative treatment reported in other studies. Concluding, non-operative treatment is a valuable option for acute rupture of the Achilles tendon.
Endoscopic Calcaneoplasty: Middle Term Results

Presenting Author:  Tahir Ögüt, MD  
Istanbul, Turkey

Additional Authors:  Gokhan Kaynak; Huseyin Botanlioglu; Selcuk Yontar

Summary
Outcomes of endoscopic treatment for retrocalcaneal bursitis and Haglund’s disease, was evaluated. 25 feet of 23 patients were operated by the same surgeon. Bilaterally operated patients had sero-negative arthropathies. After an average follow-up of 51.4 months 23 patients (25 heels) had an average AOFAS score of 52.6 preoperatively and 98.6 at the final evaluation (p<0.005). All patients satisfied. There were no complications. Retrocalcaneal endoscopy can be the procedure of choice in the treatment of Haglund’s Syndrome.

Introduction
Haglund’s disease is one of the most common causes of posterior heel pain caused by mechanical induced inflammation of the retrocalcaneal or suprascalcanal bursa and superolateral calcaneal prominence. Two different surgical techniques for Haglund’s disease have since been described: the open approach and endoscopic approach. We conducted a retrospective study to evaluate the safety and functional outcomes of this endoscopic technique for retrocalcaneal bursitis and Haglund’s disease.

Methods
Between 2003 and 2009, 25 feet of 23 patients were operated by the same surgeon because of Haglund’s disease which were resistant to conservative therapy. The average age was 37 years (range, 19 to 64). There were 15 men and 8 women. All patients had undergone endoscopic calcaneoplasty and retrocalcaneal bursectomy. Bilaterally operated patients were both men and also had sero-negative arthropathies. Under general anesthesia patient is positioned prone or supine (23 feet prone, 2 feet supine) to allow his foot and ankle hang over the edge of the table. The lateral portal is created first, just above the superior aspect of the calcaneus lateral to the Achilles tendon. With the direct visualization of the medial side, first a spinal needle is introduced to the superior aspect of the calcaneus then the medial portal is created. A resector is introduced from the medial portal to remove the inflamed bursa and superior surface of calcaneus. Then the foot is placed in plantarflexion and with the help of a burr adequate bone is removed from the calcaneus. If required, fluoroscopic evaluation can be used to evaluate the amount of bone removed. All patients are discharged at the same day and are allowed to perform range of motion exercises at the first postoperative day and allowed full weight bearing at the second postoperative week.

Results
Patients were re-examined after an average follow-up period of 51.4 months (between 24 and 75 months). 23 patients (25 heels) had an average AOFAS score of 52.6 points (between 24 and 75) preoperatively and 98.6 points (between 90 and 100) at the final evaluation (p<0.005). All patients were satisfied with the result of the operation and stated that under similar circumstances they would undergo the surgery again. All patients were also pleased with the small incisions inherent to the endoscopic surgery. There were neither intraoperative complications nor postoperative complications.
Conclusion

Haglund’s syndrome can be a challenging situation for an orthopaedic surgeon because of high chance of failure with conservative treatment and high complication rates with open operative techniques. Arthroscopic procedures become more popular because of the advantages like reduced morbidity and infection, early functional improvement and skin healing, reduced postoperative pain and outpatient procedure. Direct visualization of the Achilles tendon, removal of the symptomatic retrocalcaneal bursa, removal of calcaneal spur and more importantly improved functional rehabilitation proves that retrocalcaneal endoscopy can be the procedure of choice in the treatment of Haglund’s syndrome.
Lesser Metatarsophalangeal Joint Instability: Prospective Evaluation and Repair of Plantar Plate and Capsular Insufficiency

Presenting Author: Michael J. Coughlin, MD  
Boise, Idaho

Additional Authors: Caio Nery, MD; Daniel Baumfeld, MD

Summary
From January 2010 to July 2011, we prospectively treated 28 patients (55 MTP joints) with lesser MTP joint instability, but only 22 patients (40 MTP joints) were treated by the direct repair of the plantar plate. The AOFAS score improved substantially with this surgical treatment (average of 52 points preoperatively to 92 point postoperatively). The anatomic repair of the plantar plate can correct the deviation of the affected toe, which lead to diminished pain with improved functional scores.

Introduction
Anatomical dissection of the second metatarsophalangeal (MTP) joint suggests that the plantar plate is the major stabilizing structure of the joint due to its central location and multiple important attachments. Many surgical procedures have been recommended when conservative treatment has failed, but some have had limited clinical success. The aim of our prospective study was to show the results obtained in the treatment of a group of patients with plantar plate tears by direct repair through a dorsal approach combined with a Weil metatarsal osteotomy with a minimum follow up of 12 months.

Methods
From January 2010 to July 2011, we prospectively treated 28 patients (55 MTP joints) with lesser MTP joint instability, but only 22 patients (40 MTP joints) were treated by the direct repair of the plantar plate and were included in the study. All of them had initial complaints of acute forefoot pain with the subsequent development of deformity and instability of the MTP joints. All patients were evaluated clinically, radiographically, (plain radiographs and MRI exam), and by MTP joint arthroscopy. With this data, a direct correlation between the clinical staging and the anatomical grading for plantar plate dysfunction of each patient was determined (P<0.001).
Results
The plantar plate of the 2nd MTP joint was the most commonly affected joint (63%), and the Grade III type tear (transverse and/or longitudinal extension tear) was the most frequent type of tear. With the surgical treatment we performed, we were able to markedly improve the parameters studied (pain, medial or dorsomedial deviation of the toe, joint stability, muscle balance, and joint congruence) to acceptable levels. The AOFAS score improved substantially with this surgical treatment (from an average of 52 points preoperatively to 92 point postoperatively).

Conclusion
The direct plantar plate repair combined with a Weil osteotomy and lateral soft tissue reefing can restore the normal alignment of the MTP joint. We have demonstrated that the anatomic repair of the plantar plate can correct the deviation of the affected toe (medial, dorsal, dorsomedial or dorsolateral), which lead to diminished pain with improved functional scores.
Arthroscopic Radiofrequency of the Plantar Plates combined with a Weil Osteotomy to Repair Grades 0 and I Lesser MTP Joints Instability

Presenting Author: Fernando C. Raduan, MD
Sao Paulo, Brazil

Additional Authors: Caio Nery, MD; Daniel Baumfeld, MD; Michael J. Coughlin, MD; Carla Chertman, MD

Summary
Plantar Plate plays an important role in the stabilization of the lesser MTP joints. The observation of these lesions led us to propose a Grading System focused on clinical and radiological findings. Seventeen MTP joints were treated with arthroscopic radiofrequency shrinkage and sealing of the plantar plate lesions with a Weil osteotomy. We showed a restoration of the normal alignment of the MTP joint in Grade 0 and Grade I lesions with this treatment.

Introduction
At the present time, it is becoming a common sense that the fibro-cartilaginous Plantar Plate (PP) plays an important role in the stabilization of the lesser metatarsophalangeal (MTP) joints. The accurate observation of the natural story of these lesions led us to propose a Grading System focused on clinical and radiological findings. The second natural step is trying to find correlations between each type of lesion with the best therapeutic option and prognosis. The aim of this prospective study is to show the results obtained in the treatment of a group of patients with Grade 0 and Grade 1 plantar plate lesions by arthroscopic radio-frequency shrinkage and sealing of the PP lesions combined with a Weil metatarsal osteotomy with an average follow-up of 16 months.

Methods
From January 2010 to July 2011, we prospectively treated 28 patients (55 MTP joints) with lesser MTP joint instability, but only 8 patients (17 MTP joints) were treated by the arthroscopic radio-frequency shrinkage and sealing of the plantar plate lesions combined with a Weil metatarsal osteotomy and were included in this study. All of them had initial complaints of acute forefoot pain with the subsequent development of light deformity and instability of the MTP joints. All patients were evaluated clinically, radiographically, (plain radiographs and MRI exams), and by MTP joint arthroscopy. With this data, a direct correlation between the clinical staging and the anatomical grading for plantar plate dysfunction of each patient was determined (P<0.001).

Results
In our sample, there are 8 patients - 7 (88%) females and 1 male (12%) – with 12 feet and 17 MTP’s affected. The second MTP was involved 8 times (47%); the third, 7 times (41%) and the fourth MTP only 2 times (12%). Nine MTP were classified as Grade 0 (Attenuation) lesions (53%) and eight as Grade I (partial, short transverse) lesion (47%). After the arthroscopic inventory of the joint, the plantar plates were submitted to shrinkage or the sealing of the tear with the help of a radiofrequency mini-wand. The surgical procedure was completed with a metatarsal Weil osteotomy to reduce the mechanical tension over the articular soft tissues. With the surgical treatment we performed, we were able to markedly improve the parameters studied (pain, dorsal deviation of the toe, joint stability, muscle balance, and joint congruence) to acceptable levels. The AOFAS score improved substantially with the surgical treatment (from an average of 58 points preoperatively to 93 point postoperatively).
Conclusion
The arthroscopic radiofrequency shrinkage or sealing of the plantar plate attenuation/lesion combined with a Weil osteotomy can restore the normal alignment of the MTP joint in Grade 0 and Grade I lesions. This method can correct the deviation of the affected toes, which leads to pain reduction with improved functional scores.
MRI Evaluation of the MTP Plantar Plates Compared with Arthroscopic Findings: A Prospective Study

Presenting Author: Daniel Baumfeld, MD

Boise, Idaho

Additional Authors: Caio Nery, MD; Michael J. Coughlin, MD

Summary
MRI is considered in the literature as the gold-standard tool for lesser MTP joint instability. The sensitivity and accuracy of this method compared to direct vision is not established yet. In this study we aim to identify the accuracy of the MRI when compared to arthrosopy visualization using the Anatomic Grading for plantar plate. Our result shows that the knowledge of the classification by a radiologist helps to find and describe the type plantar plate tear.

Introduction
Instability of the metatarsophalangeal joint has been widely reported and plantar plate may be the central of this pathology. The diagnosis is made clinically and can be enhanced by imaging studies. To enhance the diagnosis of this condition MRI is considered in the literature as the gold-standard tool but the sensitivity and accuracy of this method compared to direct vision of the lesions is not established yet. In this study we aim to identify the accuracy of the MRI on describing plantar plate ruptures when compared to a direct arthrosopy visualization using the Anatomic Grading System.

Methods
Between January 2009 and June 2010, 35 patients were prospectively studied with MRI, arthrosopic view and surgical treatment of 62 lesser metatarsophalangeal joints. All patients had positive drawer sign in some degree and had preoperative MRI. Twenty-eight patients with instability of 55 lesser metatarsophalangeal joints met this criterion and were included in this study. We asked four radiologists to analyze the images. Two senior radiologists, fully trained and experienced in MRI analysis for more than 10 years, and two junior radiologists, senior residents. None of them was informed of the surgical findings or each other’s impressions. They were divided in two groups matching a senior and a junior radiologist on each group. Each professional received a set of CDs with the MRI images of all patients with no remarks of others. For the first group we presented a report sheet with a description of the types of plantar plate lesion (morphology, length, width) among the MRI plains. For the second group we presented a drawing with the Anatomical Grading System. Both groups were asked to report the morphology of the lesion on the plantar plate. All questions that they presented at that time were solved and no other information regarding the patient’s complaints, treatment’s choice or surgical findings was given. The reports of the first group were analyzed by one of the surgeon who considered the descriptions of the radiologists and classified each lesion according to the Anatomical Grading System. The second group of observers reported the classification of each lesion according the Anatomical Grading System presented.

Results
The anatomic grading shows improvement in the radiological evaluation, the knowledge of the classification by a radiologist helps to find and describe the type of tears of the plate. The time of training and the experience of the radiologist were also important findings in our study. The senior radiologists have had better levels of accuracy – group 1, 77.0%; group 2, 88.5%.
Conclusion
The prior knowledge of the pathophysiology and morphological types of lesions of the plantar plates is essential for correct identification and description of the tears by the radiologist.
Clinical and Radiographic Results of the Pro-Toe® Implant for Hammertoe Correction Surgery

Presenting Author: Justin M. Weatherall, MD
Charlotte, North Carolina

Additional Authors: Kathryn L. Garrels, MD; Carroll P. Jones, III, MD; Bruce E. Cohen, MD; W. Hodges Davis, MD; Robert B. Anderson, MD

Summary
A retrospective review of 63 patients consisting of a total of 93 toes that underwent hammertoe correction surgery with the Pro-Toe Implant® (Wright Medical Technology, Arlington, TN). Four implants failed (4.3%) and eight patients (8.6%) required revision surgery. The average AOFAS score was 84.7, and 74% of patients rated their toe alignment as good or excellent. Eighty-seven percent of patients were satisfied with the surgery. The Pro-Toe® is a safe and reliable implant for hammer-toe correction.

Introduction
The results of proximal interphalangeal arthrodesis historically have been unpredictable due to limited fixation devices available. The most common type of fixation is a Kirschner wire (K-wire), which does not provide rotational stability but can be sufficient to achieve fusion or a stable arthrodesis. This type of device has to traverse the distal interphalangeal joint to achieve fixation, which can lead to joint stiffness. Another disadvantage is that there is a potential for the wire to be bent, break or inadvertently pulled out. The Pro-Toe implant is a one-piece implant made of stainless steel that provides multi-axial fixation. The purpose of this study is to evaluate radiographic and clinical results with the Pro-Toe Implant® (Wright Medical Technology, Arlington, TN) used for hammertoe deformity correction surgery.

Methods
A retrospective chart review of demographic, radiologic, and clinical data was performed. Patients were followed for a minimum of 6 months post-operatively. Toes were evaluated for alignment in the transverse and sagittal planes, radiographic bony union, implant failure, and the need for revision surgery. Implant failures were defined as implant breakage or cut-out. Patients completed the AOFAS lesser MTP-IP Scale (Max 95) at their 6 month post-op visit. Patients were also asked if they were satisfied with the alignment of their toe and with their surgery.

Results
Sixty-three patients (52 Females and 11 males) and a total of 93 lesser toes were included in the study. The average patient age was 62 (range 25-82) years with an average follow-up of 8.4 (range 6 – 14.7 months) months. Eighty-one (87.1%) toes compared to ten (10.75%) fair and two (2.2%) poor had good medial/lateral angulation and 74 (79.6%) toes had good alignment compared to 14 (15.1%) with fair and 5 (5.4%) with poor alignment in regards to dorsal/plantar angulation. Fifty-eight (62.4%) toes had achieved bony union at the proximal interphalangeal joint (PIP). Four (4.3%) implants failed with three failures due to implant cut-out and one implant broke requiring removal. All of the implant cut-outs occurred at the middle phalanx. Eight patients (8.6%) required revision surgery, three (3.2%) of the eight revisions were performed at the PIP joint and the remaining five were procedures were at the metatarsal-phalangeal joint. The average AOFAS score was 84.7. Seventy-four percent of patients rated their toe alignment as good to excellent compared to 17.2% and 8.6% who rated their toe alignment as fair or poor, respectively. Eighty-seven percent of patients said they were satisfied with the surgery.
Conclusion

Based on our results the Pro-Toe® is a safe and reliable implant for hammer-toe correction without the disadvantages of k-wire fixation such as rotational instability, pin-tract infection, inadvertent wire pull-out, or the wire breaking or bending in-situ. Only 3.2% of patients required revision surgery of the PIP joint, and 62% of patients achieved a radiographic bony fusion with the remaining patients developing a clinically stable fibrous union.
Computed Tomography Analysis of Third Webspace Injections for Interdigital Neuroma

Presenting Author: Walter Hembree, MD  
Baltimore, Maryland  
Additional Author: Adam T. Groth, MD; Lew C. Schon, MD; Gregory P. Guyton, MD

Summary
Fluid extravasation after injection for interdigital neuroma is large and occurs beyond what is predicted by the volume of injected solution. The extravasation contributes to high injection accuracy but limits ability to distinguish pain between adjacent webspaces. Smaller injected volumes might minimize complications while still maintaining accuracy.

Introduction
Interdigital neuroma is one of the most common causes of forefoot pain. Local steroid injection can improve symptoms but can also be complicated by fat atrophy, altered cutaneous pigmentation, telangiectasia, and nerve injury. Inaccurate technique and fluid extravasation can increase the complication rate. The primary objective of this study was to determine the accuracy of injection for interdigital neuromas. Secondarily, we aimed to quantify and localize how much extravasation occurs in surrounding soft tissue. We hypothesized that extravasation occurs beyond what is predicted by the volume injected.

Methods
Two fellowship trained foot and ankle surgeons performed injections into the third webspace of 49 cadaveric specimens. Specimens were free of forefoot deformity or trauma and thawed at room temperature prior to injection. Palpable anatomic landmarks were used to guide injection. Group one included 29 specimens injected with a 2 ml solution (1 ml Omnipaque and 1 ml methylene blue). Group two included 20 specimens injected with a 1 ml solution (0.5 ml Omnipaque and 0.5 ml of methylene blue). The specimens were then frozen and computed tomography scans were obtained. A third fellowship trained foot and ankle surgeon analyzed the scans to determine accuracy of injection. Note was made if contrast had extravasated into the second or fourth webspaces or the third metatarsophalangeal joint. Maximal dimensions of contrast extravasation were determined.

Results
All injections in group one and group two were graded as accurate and none had contrast located within the third metatarsophalangeal joint. In group one, 72.4% and 48.3% of specimens had contrast present in the second and fourth webspaces, respectively. In group two, 75% and 30% of specimens had contrast present in the second and fourth webspaces, respectively. Average maximal dimensions of contrast extravasation in group one were 27.9 mm, 52.1 mm, and 25.2 mm for the medial to lateral, distal to proximal, and dorsal to plantar planes, respectively. Average maximal dimensions in group two were 23.7 mm, 40.4 mm, and 17.1 mm. Group one dimensions were larger than those of group two (p < 0.05). No differences were observed between surgeons.

Conclusion
This study proves our hypothesis that extravasation occurs beyond what is predicted by the volume of injected solution. The large amount of extravasation likely contributes to the high degree of injection accuracy. Given the presence of contrast in adjacent webspaces, steroid injections might not be useful for distinguishing pain in different webspaces. Contrarily, given the lack of contrast in the third metatarsophalangeal joint, steroid injections might be useful for distinguishing nerve and joint pain.
Smaller volumes could potentially be used in the clinical setting to minimize complication rate while still maintaining accuracy.
Role of Plantar Plate and Surgical Reconstruction Techniques on Static Stability of Lesser Metatarsophalangeal Joints: A Biomechanical Study

Presenting Author: Carla Chertman, MD
Sao Paulo, Brazil

Additional Authors: Ornusa Chalayon, MD; Andrew Guss; Florian Nickisch, MD; Charles L. Saltzman, MD; Kent Bachus, PhD

Summary
Instability of the lesser metatarsophalangeal joints (MTPJ) is a common clinical problem caused by partial or complete rupture of the static restraints of the MTPJ. All surgical treatments described show mixed clinical results. This biomechanical study shows that disruption of the plantar plate and the collateral ligaments causes loss of stability of the lesser MTPJ in dorsiflexion, plantarflexion and subluxation tests. Flexor to extensor tendon transfer, whether by itself or following a Weil Osteotomy restores the majority of joint stability, whereas the Weil osteotomy alone did not restore it to intact values.

Introduction
Instability of the lesser metatarsophalangeal joints (MTPJ) is a common clinical problem that is thought to be caused by partial or complete rupture of the static restraints of the MTPJ; the plantar plate and/or the collateral ligaments. All of the surgical treatments described have shown mixed clinical results. In an effort to better understand the role of the static restraints and current surgical reconstruction techniques on lesser MTPJ instability we conducted this biomechanical study.

Methods
Fresh-frozen and thawed human cadaveric foot specimens were mounted to a rigid plate supporting the forefoot; the 2nd, 3rd, and 4th toes were individually displaced in subluxation, dorsiflexion, and plantar flexion using an Instron test frame using position control. Each specimen was pre-cycled 10 times at 80% of full physiological range of motion and then load data were recorded at 100% of full physiological motion for each motion axis in intact, disrupted, and repaired (Tendon Transfer alone, Weil Osteotomy alone, and Tendon Transfer following Weil Osteotomy) test conditions. Specimens were displaced with a 25 mm moment arm measured distally from the center of rotation of the lesser MTPJ for dorsiflexion, and plantar flexion. For subluxation displacements, the clinical “drawer test” was simulated by displacing the toes as proximally as possible while controlling rotation. Stability was determined by the change in load over the range of displacement. Data for the disrupted and all repaired conditions were normalized to the intact condition of each toe. Significance was determined at a p-value less than 0.05 using a Paired t-Test between Intact and Disrupted toes then between Intact and Repaired toes, and finally between the Repaired conditions and the Disrupted conditions.

Results
Results to date indicate that both the Tendon Transfer alone and the Tendon Transfer after Weil Osteotomy restore the average stability of the toe, while the Weil Osteotomy alone did not restore the average stability of the toe back to the intact values. Dorsiflexion, subluxation and plantar flexion results indicated that disruption of the plantar plate significantly decreases stability by 33%, 18% and 18% of intact, respectively. Dorsiflexion results indicated that a tendon transfer alone restores stability to 118% of the intact joint and a tendon transfer after Weil osteotomy restores stability to 104% of the intact. In contrast, the Weil osteotomy failed to restore stability by reaching only 63% of the intact values. Subluxation results indicated that a tendon transfer alone restores stability to 103%
of intact and a tendon transfer after the Weil osteotomy restores stability to 97% of the intact. Again, the Weil osteotomy failed to significantly restore the stability and only reached 69% of intact. In contrast to the previous two motions, plantar flexion results indicated that a tendon transfer alone only restored 75% of the intact joint stability, and a tendon transfer after the Weil osteotomy failed to significantly restore stability and reached only 69% of the intact. As with the loading in the other two planes, the Weil osteotomy alone failed to restore the stability and only reached 65% of the intact.

**Conclusion**
Disruption of the plantar plate and the collateral ligaments of the lesser MTP joints led to significant instability. Distal metatarsal osteotomy causes significant instability of the joint while a tendon transfer of the long flexor to the extensor hood tendon after the Weil osteotomy restores almost normal static restraints against subluxation, dorsiflexion and plantar flexion.
11:55 – 12:30 pm

Paper Session #10:
Flat Foot #2

Moderators:

John G. Anderson, MD
Grand Rapids, Michigan

Geoffrey S. Landis, DO
Tucson, Arizona

11:55 am

Biomechanical Assessment of Flexible Flatfoot Correction: Comparison of Techniques in a Cadaver Model

Presenting Author: Diego H. Zanolli, MD
Durham, North Carolina

Additional Authors: Richard Glisson, BS; James A. Nunley, II, MD; Mark E. Easley, MD

Summary
Using a cadaver flatfoot model, we evaluated the ability of a range of current surgical methods to correct the deformity and resist flattening during ensuing mechanical challenges. Emphasis was placed on determining whether spring ligament repair contributes appreciably to the integrity of the surgical correction.

Introduction
Introduction: Using a cadaver flatfoot model, we evaluated the ability of a range of current surgical methods to correct the deformity and resist flattening during ensuing mechanical challenges. Emphasis was placed on determining whether spring ligament repair contributes appreciably to the integrity of the surgical correction.

Methods
Methods: Flatfoot deformity was created in ten fresh frozen lower legs through ligament attenuation and repetitive axial loading coupled with extrinsic tendon loading. In the intact, flat, and corrected conditions the angular positions of key bones were documented during post-surgical load cycles 100, 500, 1000 using electronic clinometers attached to the talus, navicular, and first metatarsal. The talus-first metatarsal angle was measured in the sagittal plane, and the talus-navicular angle was measured in the coronal plane. Six corrective procedures were sequentially evaluated, and repeated measures ANOVA with Bonferroni post-hoc tests were used to determine differences among the treatments: 1. Lateral column lengthening using an 8 mm wedge. 2. Medial displacement calcaneal osteotomy and flexor digitorum longus (FDL) transfer. 3. Medial displacement calcaneal osteotomy and FDL transfer plus lateral column lengthening. 4. Treatment 3 plus "pants-over-vest" spring ligament repair. 5. Treatment 3 plus "distal posterior tibialis stump to spring" ligament repair. 6. Treatment 3 plus "sutures and anchors" spring ligament repair.
Results

The mean sagittal plane flattening, reflected by the talus - 1st MT angle, was 8.3 degrees. As indicated by the graph, all treatments achieved some degree of correction, which gradually decreased during post-operative cyclic loading. Correction afforded by Treatments 1, 3, 4, 5 and 6 exceeded that of Treatment 2 (medial displacement calcaneal osteotomy and FDL transfer) at all evaluated time points (p < 0.05). Treatment 2 corrected significantly less than all other treatments (p < 0.05). No initial sagittal correction differences were distinguishable among treatments 1, 3, 4, 5 and 6. In the coronal plane, flattening produced mean navicular eversion of 6.0 degrees relative to the talus. Treatment 2 talus-navicular angle correction was inferior to all other treatments at all time points (p<0.001). Treatments 1, 3, 4, 5 and 6 maintained near-normal talus-navicular angles throughout cyclic loading, with no differences evident among treatments.

Conclusion

Discussion and Conclusion: FDL tendon transfer with a medial displacement calcaneal osteotomy was markedly inferior to all other evaluated treatments. Lateral column lengthening is a powerful technique that allows correction in both sagittal and coronal planes, and consistently achieved the most talus-1st MT angle correction. Addition of spring ligament repair to combined medial displacement calcaneal osteotomy/FLD transfer/lateral column lengthening resulted in only minor improvements to the correction in each plane, too small to be statistically significant. Thus, including spring ligament repair in association with the “All American” procedure may have limited value.
Load Response of Forefoot and Medial Longitudinal Arch Bones in Patients with Flatfoot Deformity: In vivo 3D Study

Presenting Author:   Masamitsu Kido, MD
Kyoto, Japan

Additional Authors:   Kazuya Ikoma, MD, PhD; Yusuke Hara, MD; Kan Imai, MD, PhD;
Masahiro Maki, MD, PhD; Ryota Takatori; Daisaku Tokunaga;
Nozomu Inoue; Toshikazu Kubo, MD, PhD

Summary
The bone rotations during weightbearing were evaluated for each joint in the medial longitudinal arch, and the comparison of the load response in healthy feet with that in flat feet was done by analyzing the reconstructive 3D CT image data. In the flat feet, forefoot bones dorsiflexed more significantly than those in the healthy feet. Some procedures including forefoot might be needed to deal with the reconstruction of the flatfoot deformity.

Introduction
Measuring the load response of foot bones is important for the evaluation of clinical conditions or staging of foot diseases. However, there have been no three dimensional (3D) studies reported so far to evaluate the load response of forefoot and medial longitudinal arch bones with flatfoot deformity using CT images. Last summer, we reported 3D load response of the hindfoot bones in patients with flatfoot deformity at the 2011 AOFAS meeting. The purpose of this study is to evaluate the bone rotation of each joint in the medial longitudinal arch during weightbearing and compare the load response in healthy feet with that in flat feet by using the reconstructive 3D CT imaging techniques.

Methods
All patients provided written informed consent to participate in the IRB approved research. CT scans of 21 healthy feet (11 volunteers) and 21 feet with flatfoot deformity (11 patients) were taken in non-load followed by full-body-weight bearing load. The images of the six bones (tibia, talus, navicular, cuneiforms and first metatarsal bone) of the medial longitudinal arch were reconstructed into 3D models using CAD software. The volume merge method in three planes was used for calculating each bone-to-bone relative rotation of the medial longitudinal arch bones. The global x-y-z coordinate system was used to describe the orientation and position of bones. The data were analyzed using unpaired t-test. A significant difference was defined as p less than 0.05.

Results
The total relative rotations between non-load and full-body-weight bearing load were significantly larger in the flatfoot in comparison with the healthy foot in all joints and the largest rotation was recognized in the talonavicular joint (healthy foot: 4.9±2.8°; flatfoot: 7.0±3.4° average ± SD, p< 0.05), followed in order by talocalcaneal joint (healthy foot: 3.2±1.9°; flatfoot: 4.9±2.4°, p< 0.05), tibiotalar joint (healthy foot: 2.6±1.6°; flatfoot: 4.3±2.9°, p< 0.05), cuneo-1st metatarsal joint (healthy foot: 1.4±0.8°; flatfoot: 2.6±1.1°, p< 0.05) and naviculocuneiform joint (healthy foot: 1.4±0.9°; flatfoot: 2.0±1.1°, p< 0.05) (figure, the upper part). The cuneiform position difference to the load response relative to the navicular in the naviculocuneiform joint in the flatfoot was 0.9 degree more dorsiflexed than that in the healthy foot and the difference was significant (healthy foot: 0.3±0.9°; flatfoot: 1.2±1.1°, p< 0.05). Significant difference was neither observed in the coronal plane (healthy foot: -0.6±0.7°; flatfoot: -0.8±1.0°, p=0.45) nor in the transverse plane (healthy foot: 0.3±0.9°; flatfoot: 0.2±1.0°, p=0.79). The 1st metatarsal position difference to the load response relative to the cuneiform in the cuneo-1st metatarsal joint was 1.0 degree more dorsiflexed (healthy foot: 0.8±0.9°; flatfoot:
1.8±1.0°, p< 0.05). Significant difference was neither observed in the coronal plane (healthy foot: -0.4±0.9°; flatfoot: -0.7±1.4°, p=0.39) nor in the transverse plane (healthy foot: 0.0±0.6°; flatfoot: 0.4±1.1°, p=0.19) (figure, the lower part).

**Conclusion**
In the peritalar joints, the total rotations were larger than the other joints of medial longitudinal arch. In the flat feet, forefoot bones dorsiflexed more significantly than those in the healthy feet. Some procedures including forefoot might be needed to deal with the reconstruction of the flatfoot deformity.

![Figure showing total rotation](image)

![Figure showing rotation of joints](image)

df: dorsiflexion/ plantarflexion  
ev: extension/ i: inversion  
abd: abduction/ add: adduction
The Effect of the Dorsal Opening Wedge (Cotton) Osteotomy as a Combined Procedure for the Treatment of Acquired Flat Foot Deformity

Presenting Author: Lew C. Schon, MD
Baltimore, Maryland

Additional Authors: Lawrence Wei, BS; Casey Humbyrd, MD

Background:
A dorsal opening wedge (Cotton) osteotomy is utilized as an ancillary procedure to correct medial column deformities while preserving midfoot articular surfaces. This study is a retrospective review of the radiographic findings after Cotton procedure as a combined surgery for acquired flat foot.

Methods:
Radiographic Results were analyzed in 91 feet (88 patients). The average age of the patients was 50.85 years (standard deviation 14.49) and there was a predominance of women (61/88) in the population studied. All of the radiographic parameters were measured on the weightbearing AP and lateral x-ray films. Data was analyzed with paired t-tests using statistical software.

At the beginning of the study, 24 feet demonstrated evidence of arthritis at the naviculo-cuneiform joint and/or the first metatarso-cuneiform joint. At final follow-up, 16 additional feet developed arthritis. Eight feet developed arthritis at the naviculo-cuneiform joint, 6 at the first metatarso-cuneiform joint, and 2 at both the naviculo-cuneiform and first metatarso-cuneiform joint. Thirteen feet were treated with metal grafts while the remaining seventy-eight patients were treated with standard bone grafts. Ten of the grafts failed to unite with the healed bone (3/13 metal and 7/78 standard bone graft). The majority of bone grafts demonstrated some degree of displacement (11/13 metal graft and 43/78 standard bone graft). 4 feet required revision surgery, with 1 needing a second revision. Standing lateral films showed the mean lateral talus-first metatarsal angle improved from 20.0 degrees to 11.3 degrees (p < 0.0001), the calcaneal pitch improved from 14.0 degrees to 16.3 degrees (p < 0.0001), the medial column height improved from 11.4mm to 15.9mm (p < 0.0001) and the medial column length improved from 24.7mm to 29.1mm (p < 0.0001).

Summary:
Dorsal opening wedge osteotomy of the medial cuneiform (Cotton procedure) is an effective procedure for the treatment of forefoot supination and medial arch collapse in flat foot surgery. The metal grafts demonstrated a lower rate of incorporation compared to standard bone graft (76.9% versus 91.0%). Anticipation of a delayed collapse of the wedge may help with intra operative planning.
The Corrective Power of the Cotton Osteotomy

Presenting Author: Ryan T. Scott, DPM
Westerville, Ohio

Additional Authors: Bradly W. Bussewitz, DPM; Christopher F. Hyer, DPM, MS;
Gregory C. Berlet, MD; Terrence M. Philbin, DO

Statement of purpose:
To determine the amount of angular correction from the Cotton osteotomy of the medial cuneiform using measured wedge grafts.

Methodology/Procedure:
Twenty cadaver specimens were used to determine the amount of angular correction using various sized Cotton wedge grafts. Fluoroscopic exam was performed using a template jig, to simulate weight bearing, and Meary’s angle was measured. A Cotton osteotomy was performed in the medial cuneiform and the Cotton wedge grafts were inserted. The sizes of the Cotton wedges used were 4.5 mm, 5.5 mm, and 6.5 mm. Fluoroscopic exam was once again performed and Meary’s angle was measured with the various sized wedges.

There was a mean change in Meary’s angle by 7.75 ± 1.64 degrees with the creation of the Cotton osteotomy and insertion of the 4.5 wedge as compared to the pre-operative radiograph. This angular change increased by a mean change of 2.86 ± 1.04 degrees with 5.5 mm wedge and 2.96 ± 1.18 degree change with the 6.5 mm graft. The total degree change was 7.75 ± 1.64 degrees, 10.6 ± 2.41 degrees, 13.55 ± 2.08 degrees respective to 4.5, 5.5, and 6.5 mm Cotton wedge grafts. The mean correction seen was 1.91 ± 0.15 degrees for each millimeter of wedge graft.

Based on our findings we feel this will give foot and ankle surgeons a set of guidelines to use when planning for the Cotton osteotomy. With this data, the surgeon can pre-operatively reliably estimate the size of the wedge graft needed to achieve the desired correction.
Late Effects of Clubfoot Deformity in Adolescent and Young-adult Patients Treated with Surgical Intervention

Presenting Author: David A. Joos, MD  
*St. Louis, Missouri*  
Additional Authors: Perry Schoenecker, MD; Sandra E. Klein, MD; Jeremy J. McCormick, MD; Jeffrey E. Johnson, MD

**Background:**  
Children with clubfoot deformity often have residual foot deformity, pain and limited function in adolescence and young adulthood, especially following extensive soft tissue release procedures. These patients represent a heterogeneous group that often requires an individualized management strategy. There is a paucity of literature to help guide the treatment of these patients. Our objective was to review the surgical treatments and outcomes of patients presenting with late effects of clubfoot deformity at our institution, and to identify common patterns in pathology and management within this group.

**Materials and methods:**  
We identified all patients that underwent surgery between January 2001 and January 2011 for problems related to a prior clubfoot deformity. All patients included in the study were between ten and twenty years of age at the time of surgery. We retrospectively reviewed the charts of these patients and collected data regarding their history, presenting complaints, physical examination, type of surgery, complications, postoperative examinations, and subjective outcomes. Subjective outcomes were assigned on a four-point scale from Excellent to Poor, based on the final follow-up notes.

**Results:**  
Forty-five patients were identified that fit our inclusion criteria, with an average age of 13 years. All patients had been treated at a young age with serial casting, and most had at least one prior surgery on the affected foot. Pain with or without deformity was the most common presenting complaint. Average post-surgical follow-up was 13 months. Most patients had improvement of their deformity on physical examination, as well as an improvement in their symptoms. Good or Excellent outcomes were assigned to 80% of the patients based on the final follow-up note. Although each case was unique, we found several common patterns with regard to presenting complaints, deformity, and types of surgeries performed. These included clubfoot undercorrection (43%), clubfoot overcorrection (25%), anterior impingement (15%), dorsal bunion (12%), and lateral impingement (5%). Surgeries in the undercorrection group were primarily cavus foot reconstructions or fusion. Surgeries in the overcorrection group were primarily flatfoot reconstructions. Anterior impingement patients typically underwent exostectomy with or without tibial osteotomy, while lateral impingement patients typically had exostectomy with or without calcaneal osteotomy. Surgery for dorsal bunion deformities were corrected using a new double bone block midfoot fusion technique with other forefoot bone and soft tissue procedures and tendon transfers as needed.

**Conclusion:**  
Late effects of clubfoot can be successfully managed with surgical intervention in patients during their second decade of life. Certain patterns of pathology are present in these patients, and identification of these patterns has helped us adopt an algorithm to assist in management of these problems.
Summary:
Late effects of clubfoot deformity in adolescent and young-adult patients can be challenging to manage, with current literature offering minimal guidance. Although this is a heterogeneous group, certain patterns of pathology are present in these patients which can help guide successful surgical intervention.
12:30 – 1:00 pm

Symposium #3
What’s Hot in Cartilage, Bone and Ligament: Best of Pre-Meeting Course Lectures

Moderator:
Eric M. Bluman, MD, PhD
Boston, Massachusetts

12:30 pm
Bone
Sheldon S. Lin, MD
Newark, New Jersey

12:40 pm
Cartilage
Eric Giza, MD
Sacramento, California