The Landmark Review

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Eric Temple, DPM, Class of 2011, for compiling the list of “landmark” articles and distributing them to the future students of Des Moines University.

The purpose of this review is to provide the students of DMU-CPMS with a quick reference study guide of the major "landmark" articles of the podiatric medical profession. This list is by no means all-inclusive. The intent of this guide is to supplement, rather than replace, the reading of these articles. All articles have been summarized to the best of our knowledge and ability.

Table of Contents

Ankle Arthrodesis: Indications and Techniques

Authors: Nicholas A. Abidi, MD, Gary S. Gruen, MD, & Stephen F. Conti, MD

Date of Publication: Journal of the American Academy of Orthopedic Surgeons, May/June 2000

Level of Evidence: V

Major Points of Interest:

1. Studies have shown that factors associated with favorable patient outcome after reconstruction of ankle malunions include position of the talus in the mortise, stability of the syndesmosis, correct length of the fibula, and quality of the joint surface at time of reconstruction.
2. The main indication for ankle arthrodesis is persistent ankle joint pain and stiffness that is functionally disabling to the patient and is not alleviated by non-operative treatment, and this may be the result of previous fracture, infection, osteonecrosis, or arthritis.
3. Following a successful ankle arthrodesis, it has been shown that motion in the subtalar complex increases by an average of 11 degrees during the 1st year.
4. Surgical techniques include the use of external fixators, arthroscopy, or open arthrodesis. Regardless of the surgical technique, the optimal postoperative position of the foot and ankle joint, which provides the best alignment and accommodation of hip and knee motion, is the following: the foot should be externally rotated 20-30 degrees relative to the tibia, the ankle joint is in neutral flexion (0 deg), 5-10 degrees externally rotated, and in slight valgus (5 deg).
5. External fixation methods: recommended for those w/preexisting septic joint or osteopenia
   a. Charnley method—combined open surgical debridement of ankle joint cartilage with the use of an external fixator with one pin through the tibia and another through the neck of the talus. Compression of the fusion site relied on an intact Achilles tendon functioning as a tension band.
   b. Calandruccio method—used a triangular configuration to achieve stability and compression across the tibiotalar joint for added resistance to torsional forces at the ankle joint. The fusion site was buttressed with bimalleolar onlay bone grafts so that an intact Achilles tendon wasn't required to function as a tension band.
   c. Unilateral frame—pins placed into medial aspect of tibia, calcaneus, and neck of talus and are of larger diameter than those used in the Calandruccio method.
6. Arthroscopic arthrodesis methods: use is limited to patients w/arthritic ankles w/minimal deformity.
   a. Traditional arthroscopy—performed through 2 or, occasionally, 3 portals—one is medial to the TA tendon and the other is lateral to the EDL tendon; the third is lateral to the peroneus tertius tendon. After joint preparation, the joint is compressed w/either internal or external fixation. 2 cannulated screws can be placed across the tibia into the talus—one from the lateral tibia to the neck of talus and the other from medial malleolus into lateral talus.
   b. "Mini-open" technique—combines advantages of open and arthroscopic techniques by using enlarged portals for exposure and removal of articular cartilage and decreasing the amount of soft tissue stripping that's required with the pure open technique.
7. Open arthrodesis: used for any patient but especially useful for patients w/severe ankle joint deformity. Performed through a 2-incision transfibular exposure, and the joint position is secured using 2 cannulated screws—one from posterolateral corner of tibia to neck of talus and the other from medial malleolus to the lateral talus.
8. Tibiotalocalcaneal arthrodesis: used for patients w/symptomatic nonunions, osteonecrosis of the talus, or Charcot who usually require substantial debridement of devitalized bone from the talus. A retrograde intramedullary nail or angled blade-plate can be used, which is inserted through the posterior calcaneus and deep to the Achilles tendon.

foot ER: 20-30°
ankle: 5-10 ER slight valgus

9. The American Orthopaedic Foot and Ankle Society published a 100-point scoring system for evaluation of ankle and hindfoot pain and function and there is an Ankle Osteoarthritis Scale which evaluates OA of the ankle, but there is no one scale that has been used to evaluate functional results of ankle arthrodesis in a large series of patients.
10. Nonunion is the most common complication of ankle arthrodesis and can occur in up to 40% of patients. Risk factors include a severe fracture, an open injury, local infection, osteonecrosis of talus, coexisting major medical problems, and smoking.

Current Concepts Review: Talar Fractures
Ahmad, M.D., Jamal; Rankin, M.D., Steven
Date of Publication: Foot & Ankle International, June 2006

Nondisplaced = possible nonop

Major Points of Interest:

1. Talar fractures are often high-energy injuries that can lead to disability despite appropriate treatment.
2. CT is valuable in assessing fracture pattern and displacement.
3. Nondisplaced fractures can be treated nonoperatively, often with good results.
4. Displaced fractures should be treated with open reduction and internal fixation to restore joint congruity and stability.
5. The anteromedial and anterolateral approaches can be used for talar neck fracture reduction and fixation. The reduction can be improved by osteotomies to increase exposure if the fracture extends into the talar body.
6. Open fractures or closed fractures with skin ischemia require emergent attention.
7. Closed fractures of the talar neck without skin tenting may not require emergent treatment. The development of post-traumatic osteonecrosis appears to be more dependent upon the severity of the fracture than time to reduction and fixation.
8. Hawkins sign: a subchondral linear radiolucency on the talar dome in the AP view. Presence is indicative of bony absorption and intact blood flow within the talus; however absence of this sign does not necessarily indicate future osteonecrosis.
9. Hawkins Classification of Talar Neck Fractures
    - Type I: Nondisplaced fracture
    - Type II: Displaced fracture of the talar neck with the body remaining in the ankle mortise and the subtalar joint subluxed or dislocated — STJ
    - Type III: Displaced talar neck fracture with the body subluxed or dislocated from the subtalar and tibiotalar joints — STJ + ankle
    - Type IV: Type III talar neck fracture combined with subluxation or dislocation of the talonavicular joint. — STJ + ankle + TNJ

talar neck fx = HAWKINS classif.

10. Fortin and Balazsy Classification of Talar Body Fractures:
    - Group I: Fractures of the talar body proper or cleavage fractures (horizontal, sagittal, shear, or coronal)
    - Group II: Talar process or tubercle fractures
    - Group III: Compression or impaction fractures

11. Hawkins Classification of Lateral Process Fractures
    - Type I: Simple two-part fracture
    - Type II: Comminuted fracture
    - Type III: Chip fracture of the anteroinferior lateral process

Activity Patterns of Patients With Diabetic Foot Ulceration
Authors: Armstrong, D.P.M., David; Lavery, D.P.M., Lawrence
Date of Publication: Diabetes Care, September 2003

Major Points of Interest:

1. Patients with diabetes and complicating neuropathy commonly develop ulcers on the sole of the foot at areas of moderate to high pressure and shear that are exposed to repetitive injury related to normal walking during the course of daily activity.
2. Studies have shown that more subjects treated with total contact casting (TCC) healed within 12 weeks compared with the removable cast walker (RCW) and the half shoe. However, TCC and the RCW have similar activity profiles and reduce pressure to approximately the same extent on the sole of the foot.
3. The authors of this study believe that this might be related to poor compliance with recommendations to wear special devices to offload and protect the foot with removable modalities such as the RCW.
4. The purpose of this study was to evaluate the activity of patients with diabetic foot ulcerations and their adherence to their pressure off-loading device.
5. Twenty subjects were treated for neuropathic diabetic foot wounds corresponding to University of Texas grade 1 stage A. All were off-loaded using a removable cast walker (RCW).
6. Total activity (measured in activity steps per day) was monitored using computerized accelerometer attached to each subject's waist.
7. There was an average of 1,219 steps (activity units) taken daily by each patient. Only 28% of steps (total daily activity) were recorded while patients were wearing their RCW, indicating that patients logged significantly more daily activity units with the protective RCW off than with it on.
8. Thirty percent of patients recorded more steps (daily activity units) while wearing the RCW. Still, they only wore the device for a total of 60% of their total daily activity.
9. Subjects with diabetic foot ulcerations appear to wear their off-loading devices for only a minority of steps taken each day, perhaps explaining some poor results of agents designed to help speed the healing of these wounds.
10. The authors conclude that control of this important aspect of care with less easily removable devices may increase the prevalence of healing.

TTC > Removable b/c

Fractures and Fracture-Dislocations of the Tarsometatarsal Joint
Author: Arntz, CT *et al*.
Date of Publication: Journal of Bone & Joint Surgery, February 1988.

Major Points of Interest:

1. For dislocations and fractures of the tarsometatarsal joint, open treatment yields better results than closed treatment because it achieves and maintains an anatomical reduction which is critical for optimum results.
2. Full reduction requires reduction of fragments such as intra-articular and osteochondral fractures and the debridement of soft tissue such as joint capsule and soft tissue entrapped in the joint.
3. The tarsometatarsal joints, with their normally limited range of motion, tolerate stable internal fixation quite well.
4. Fixation of an unstable tarsometatarsal joint with AO screws proved advantageous over Kirschner wires. The precise reduction of the metatarsocuneiform joints can be facilitated by gentle compression of the joint with the use of AO screws.
5. While fractures associated with dislocation of the tarsometatarsal joint usually heal within 6 weeks, the disrupted joint capsules and ligamentous supports require protection for a longer period.
6. We recommend the screws (3.5mm cortical screw) be left in place for a minimum of 12 weeks.
7. Incomplete reduction of the fracture or dislocation, or redislocation after inadequate treatment, frequently results in permanent disability in the form of chronic pain, deformity, and difficulty with wearing shoes.
8. The degree of post-traumatic arthritis proved to be directly proportional to the degree of gross damage to the articular surface that had been identified at operation.
9. Excellent results in our series suggest that primary arthrodesis, even when the articular surfaces have been severely damaged, is not necessary in the majority of patients.

Motion of the Hindfoot after Simulated Arthrodesis

Authors: Donna J. Astion M.D., Jonathan T. Deland, M.D., James C. Otis, PH.D, Sharon Kenneally, B.S.

Date of Publication: JBJS, February 1997

Major Points of Interest:

1. Purpose: To quantify in vitro the effect of simulated arthrodesis in selected joints of the triple joint complex on the range of motion of the remaining unfused joint or joints, and on the excursion of the posterior tibial tendon.
    a. This data ultimately will help practitioners determine when a flexor digitorum longus tendon transfer is needed for replacing the function of a ruptured/non-functional posterior tibial tendon concomitantly with arthrodesis.
2. The triple joint complex (subtalar, calcaneocuboid, and talonavicular joints) allows for the most amount of pronation and supination in the foot.
    a. The posterior tibial and peroneal muscles are principle muscles acting on the triple joint complex.
3. Arthrodesis of any joint of the triple joint complex effects excursion of the posterior tibial tendon.
4. The talonavicular joint is the key joint to consider when performing a triple arthrodesis.
    a. The talonavicular joint has greatest range of motion in the triple joint complex.
    b. Arthrodesis of the talonavicular joint essentially eliminates motion of calcaneocuboid and subtalar joints.
5. Simulated arthrodesis of the talonavicular joint limits ROM of the STJ to 8-9% of its previous ROM.
6. Simulated arthrodesis of the STJ resulted in a significant decrease of ROM in the talonavicular joint (26% of previous ROM) and in the calcaneocuboid joint (56% of previous ROM).
7. Simulated arthrodesis of the calcaneocuboid joint had little effect on ROM of either the talonavicular joint (67%) or the STJ (92%).
8. Excursion of the posterior tibial tendon was significantly decreased in all simulated arthrodesis procedures that involved the talonavicular joint (talonavicular arthrodesis, double, and triple arthrodesis).
9. It is believed that transfer of a flexor digitorum longus tendon to the navicular tuberosity in order to restore function to a ruptured or otherwise non-functional posterior tibial tendon will maintain excursion if the talonavicular joint remains mobile.
    a. Therefore, a tendon transfer of the flexor digitorum longus should be performed to restore function of the posterior tibial tendon in cases of a calcaneocuboid joint arthrodesis or possibly even in arthrodesis of the subtalar joint since both preserve motion of the talonavicular joint.

Lapidus Bunionectomy: Arthrodesis of the First Metatarsocunieform Joint
Authors: Baravarian, B., Briskin, G.B., Burns, P.
Date of Publication: Clinics in Podiatric Medicine and Surgery, 2004

Major Points of Interest:

1. Indications for fusion of the first MCJ include:
    a. severe metatarsus primus adductus
    b. patients with moderate metatarsus primus adductus with hypermobility of the first ray
        i. hypermobility is excessive motion about the first MCJ during gait and is primarily a clinical diagnosis
    c. generalized ligamentous laxity
    d. adolescent hallux abducto valgus deformity
    e. degenerative changes of the first MCJ from arthridities
    f. hallux limitus with elevatus of the first ray with mild-moderate degenerative changes of the first MPJ
    g. salvage of failed hallux abducto valgus surgery
2. Gait analysis can reveal abduction of the rearfoot with elevation of the first ray and/or an early heel off. Seated examination confirms laxity of the first ray, tracking of the great toe, and any crepitus present.
3. The Lapidus procedure allows for:
    a. correction in three planes, including adduction, plantarflexion, and rotation
    b. decreased jamming of the great toe joint
    c. increased medial column stability
4. The Lapidus procedure starts with a dorsal skin and periosteal incision over the first MCJ, careful not to make it medial. It is essential to preserve the periosteum to increase the rate of arthrodesis and protect neurovascular structures.
5. It is important to remove the most plantar cartilage in the first MCJ to avoid a plantar ledge.
    a. a plantar ledge may cause subsequent dorsiflexion of the metatarsal
6. The second incision is a medial incision over the first MPJ, deepened to the joint capsule. To position the joint following the osteotomy, push medially at the first metatarsalhead and dorsiflex the great toe simultaneously.
7. If a screw is placed into the second metatarsal base, it will need to be removed after healing is achieved.
8. Following the Lapidus procedure, it is more difficult to return the plantarflexion motion of the great toe, thus plantarflexion exercises are emphasized.
9. Two common adjunctive procedures with the Lapidus are:
    a. calcaneal osteotomies (Evans)
    b. posterior musculature lengthening (Achilles or gastrocnemius lengthening)
10. Grace et al. performed a retrospective review of recurrent hallux valgus in adolescents and reported good to excellent results in 90% of patients post-operatively following the modified Lapidus procedure.
    a. these results were attributed increased stability in the first MCJ following the modified Lapidus procedure

Subtotal Calcanectomy for the Treatment of Large Heel Ulceration and Calcaneal Osteomyelitis in the Diabetic Patient
Authors: Baravarian, B. et al.
Date of Publication: JFAS, March 1999

Major Points of Interest:

1. Crandall and Wagner concluded "calcanectomy (partial or total) therefore is justified in the active diabetic patient, because the level of amputation is not changed because of the failure of the calcanectomy."
2. Saucerization of the calcaneus followed by split thickness skin grafts may be used to cover large defects directly over the calcaneus without extensive osteomyelitic changes
    a. the grafts usually cannot withstand the forces generated during weight bearing
3. When resecting an infected area:
    a. the ulcer and any sinus tracts are removed in full-thickness fashion via an elliptical incision
    b. bone is resected until it is ensured that remaining bone bleeds upon debridement and is free of gross infection
4. The Gaenslen incision is used for full-thickness removal of both the ulceration and any noted sinus tracts.
5. Postoperatively, all patients require extra support and padding through the use of AFOs and specialized extra depth shoes.
    a. generally modified AFOs by inserting a soft inner lining and an outer dense post for added protection of the heel
6. While muscle strength in the posterior compartment was decreased in one grade by all patients who underwent a subtotal calcanectomy, the muscle strength changes were unnoticed by all ambulatory patients when placed in proper AFOs.
7. When assessing for the presence of a deep-space infection or severe soft tissue infection, MRI is the diagnostic study of choice.
8. With removal of the posterior calcaneus, the Achilles tendon is in an attenuated position and has very little strength without a true attachment site remaining.
    a. in cases of osteomyelitis, the Achilles tendon is necrotic in nature and should be debrided
9. By leaving the Achilles attached:
    a. visualization is more difficult
    b. due to the tendon no longer having its original length, it is left in a lax position
10. Primary reapproximation of the skin edges avoided scar tissue that results from secondary intention, which could produce a less supple and immobile skin region.

Use of the Cobb Procedure in the Treatment of Posterior Tibial Tendon Dysfunction
Authors: Baravarian, B., Zgonis, T., Lowery, C.
Date of Publication: Clinics in Podiatric Medicine and Surgery, 2002

Major Points of Interest:

1. Clinical symptoms of PTTD:
    a. most common in females over age 40
    b. pain in the medial ankle or arch; "arch has fallen"
    c. tenderness along the tendon, especially between the medial malleolus and insertion site on the navicular
    d. localized erythema and edema to the medial aspect of the navicular
    e. with progression of PTTD, sinus tarsi pain and tenderness is common
2. Clinical tests for PTTD:
    a. "too many toes sign"
    b. single heel-rise test
    c. double heel-rise test
    d. first metatarsal rise sign
    e. forefoot to rearfoot relationship
    f. equinus deformity
3. Differential diagnosis for PTTD:
    a. arthritis of the rearfoot and/or ankle
    b. rearfoot coalition
    c. tibial spurring
    d. tarsal tunnel syndrome
    e. Baxter's neuritis
    f. plantar fasciitis
    g. tenosynovitis of the posterior tibial tendon
    h. spring ligament injury
    i. hindfoot fracture
    j. accessory navicular
4. Weinraub and Heilala classification of PTTD
    a. Stage 1: acute inflammation, tendonitis, minimal tendinosis
    b. Stage 2: tendinosis with medial attenuation and insufficiency of soft tissue static and dynamic stabilizers
    c. Stage 3: advanced attenuation or rupture of the tendon or medial supportive structures
    d. Grade A: no plantar osseous deformity
    e. Grade B: reducible plantar osseous deformity
    f. Grade C: rigid, nonreducible osseous deformity
5. Cobb procedure: the medial half od the anterior tibial tendon is transferred through a drilled hole in the medial cuneiform or navicular, and a reconstruction of the posterior tibial tendon is performed.
6. The Cobb procedure is not considered a functional transfer, because it relies on the function of the posterior tibial tendon for its action.
    a. If the posterior tibial tendon is found to be non-functional or severely scarred due to prolonged disuse, an active tendon transfer is preferred.

7. A fundamental element in dealing with PTTD is understanding the primary plane of compensation of the adult-acquired flatfoot deformity in order to select the appropriate procedures.
    a. Frontal plane deformities: addressed by calcaneal osteotomies (PCDO)
    b. Transverse plane deformities: addressed by lateral column lengthening procedures (Evans)
    c. Sagittal plane deformities: addressed by medial column stabilization procedures (talonavicular fusion, Lapidus)
8. The authors have found Stage 2 PTTD cases are well treated with isolated Cobb procedures only if the foot has minimal abnormality and the posterior tibial muscle is strong and the tendon has minimal degeneration.
    a. The authors think that the majority of Stage 2 deformity is best treated with a combination of the Cobb procedure and osseous reconstruction, such as a PCDO or Evans osteotomy.
9. The Cobb procedure is not performed on a patient until all realignment procedures have been performed.
10. Stage 3 PTTD is typically treated with osseous procedures, the authors prefer STJ arthrodesis.
    a. In this setting the midtarsal joint is still prone to abduction over time as a result of the chronic pull of the peroneal tendons.
    b. A Cobb procedure is performed by the authors in this situation to counteract the pull of the peroneal tendons.

Complications of Ankle Arthroscopy
Authors: F. Alan Barber M.D., James Click PA-C, and Bradley T. Britt M.D.
Date of Publication: Foot & Ankle International, April 1990

Major Points of Interest:

1. Purpose: The purpose of this review was to compare the number of ankle arthroscopy complications reported by the Arthroscopy Association of North America (1 complication caused by infection was reported out of 4478 ankle arthroscopy procedures) to those complications reported in the literature as well as in the authors' practice.
2. Materials and Methods: Charts from 53 ankle arthroscopies performed at Plano Orthopedic and Sports Medicine Center between 1984-1990 were reviewed. Patients were grouped according to their diagnosis as well as their treatment. These patients were then contacted via phone to answer a questionnaire about their post-surgical functional ability.
3. Results: Nine complications were reported in this follow-up, resulting in a 17% complication rate:
    a. 2 portal infections
    b. 1 deep infection
    c. 3 permanent superficial nerve injuries to the dorsum of the foot
    d. 2 synovial fistulas
    e. 1 reflex sympathetic dystrophy
4. Despite the extremely low complication rates reported by the Arthroscopy Association of North America, there are a myriad of complications that have been cited in other literature as well as by the authors from their own clinical experience:
    a. Nerve injuries
    b. Vascular complications
    c. Reflex sympathetic dystrophy
    d. Infection
    e. Synovial fistulas
    f. Persistently painful incisions
    g. Scarring near the peroneal tendon sheath
5. The authors argue that complications with ankle arthroscopy are much more frequent than is reported by the Arthroscopy Association of North America, particularly for beginning ankle arthroscopists. Surgeons should therefore realize that there is a significant complication rate with this procedure.

The Basics of Ring External Fixator Application and Care
Authors: Douglas Beaman, MD, Richard Gellman, MD
Date of Publication: Foot and Ankle Clinics, 2008

Major Points of Interest:

1. Advantages of external fixation:
    a. Ability to correct severe deformity
    b. Perform gradual correction
    c. Modify treatment during correction
    d. Minimizes neurovascular damage
    e. Can preserve joints and joint function
    f. Maintain or gain length
    g. Allow weight bearing during treatment
2. Uses of radiographs in pre-operative planning:
    b. AP ankle: evaluate intra-articular wear or malalignment
    c. Calcaneal axial: evaluate tibia to calcaneal deformities. Midbody of the calcaneus should be parallel and approximately 1cm lateral to the vertical midline of the tibia.
    d. CT: nonunion, tarsal coalition, DJD, rotational deformities
    e. MRI: osteomyelitis, tumors, cartilage pathology, tendon abnormalities
3. A minimum of two, and preferably three, points of fixation is needed in each segment of the foot
4. An osteotomy must have fixation on either side of it to prevent adjacent joint subluxation during gradual deformity correction
5. If you are utilizing distraction osteogenesis, it is important to minimize periosteal damage in order to preserve blood supply and minimize thermal necrosis by avoiding power saws if possible.
6. Pin care involves daily normal saline cleaning. After sutures are removed, pin care can be performed in the shower with antibacterial soap and a clean towel and hair dryer on the cool setting.
7. For a draining pin site, adjacent pins are wrapped together with bulky gauze in order to minimize movement
8. Oral antibiotics (5-7 days) are initiated when twice daily pin care has failed. Recalcitrant pin site infection is treated with IV antibiotics.
9. For soft tissue corrections, frame should stay in place for 6 weeks after plantigrade position of the foot is achieved. For osteotomies, bony healing must be confirmed on at least 3 of 4 cortices.

Clinical Tip: Extraction of a Difficult to Remove Intramedullary Antibiotic Rod in the Ankle
Authors: Belczyk, R., Wukich, D.K.
Date of Publication: The Foot and Ankle Journal, July 2008

Major Points of Interest:

1. The intramedullary antibiotic rod permits a local delivery of concentrated antibiotics while avoiding elevated systemic levels.
2. Spacers (which include rods) made of antibiotic impregnated cement were designed to prevent soft tissue contraction and maintain extremity alignment while awaiting prosthetic implantations or arthrodesis type procedures.
3. The Moreland revision instruments, originally designed to facilitate revisional hip and knee surgery, contain cement extractors which aid in the removal of previously placed prosthesis and bone cement.
4. Technique when rod cannot be easily removed from the inferior aspect of the calcaneus.
    a. insert Moreland cement extractor in a retrograde fashion
    b. if necessary, make a small window in the tibia, proximal to the rod or at the level of the ankle joint
        i. allows bone forceps to grasp the intrameduallary rod
            1. prevents proximal migration of rod during extraction
    c. extractor is inserted from the plantar aspect until the triangular hook lies proximal to the rod
    d. hook is rotated clockwise or counterclockwise to gain purchase
    e. slap hammer is used to extract the rod in an anterograde fashion
5. It is recommended at the time of rod implantation to also place a bulb tipped guidewire or a long Steinman pin that is hooked at the proximal end through the middle of the rod
6. Advantages of using hand tools versus ultrasonic instrumentation are:
    a. avoid cell death at endosteal bone surface
    b. avoid hazardous fumes from the melting PMMA bone cement
    c. avoid soft tissue damage from heat or friction burns

Technical Tip: A Simple Method for Proper Placement of an Intramedullary Nail Entry Point for Tibiotalocalcaneal or Tibiocalcaneal Arthrodesis
Authors: Belczyk, R., Sung, W., Wukich, D.K.
Date of Publication: The Foot and Ankle Journal, September 2008

Major Points of Interest:

1. Possible complications of IM nailing:
    a. nonunion
    b. delayed union
    c. malunion
    d. screw fracture
    e. painful hardware
    f. fracture of the IM nail
    g. tibial fracture
    h. wound healing complications
    i. nerve damage
2. Accurate guide wire placement is critical prior to reaming and inserting a retrograde IM nail for tibiotalocalcaneal or tibiocalcaneal fusion.
3. The guide wire is typically placed into the central medial aspect of the calcaneus and is centered in the medullary canal of the tibia
    a. medial translation of the talus and calcaneus is typically necessary to compensate for the lateral alignment of the calcaneus in relation to the tibia
    b. this guide wire placement allows insertion of a straight nail into the central portion of the tibia
4. Foot placement should be 90 degrees with respect to the lower leg, maintaining the hell in a neutral position with 10-15 degrees of external rotation.
5. Technique for determining the entry point of the IM nail
    a. place IM nail along the lateral leg just above the border of the fibula
        i. use intraoperative C-arm visualization of the long axis of the tibia on lateral view
        ii. the IM nail should visually appear to go directly through the lateral process of the talus on this lateral view
    b. use a marking pen to draw a horizontal line along the plantar aspect of the foot at the level of the IM nail
    c. place the IM nail longitudinally, directly against the plantar aspect of the heel
        i. use intraoperative C-arm visualization of the calcaneal-axial view
        ii. the IM nail should correspond to the varus or valgus rotation of the calcaneus
    d. use a marking pen to draw a longitudinal bisecting line
    e. the center point of the bisecting line is the ideal entry point for the IM nail
6. Ideal incisional placement permits accurate insertion, good screw purchase, and avoids neurovascular damage.

Tips and Techniques: Conical Shaping of Structural Allografts for Bone Block Arthrodesis in Failed First Metotarsophalangeal Joint Arthroplasty

Authors: Belczyk, R., Combs, D., Wukich, D.K.

Date of Publication: The Foot and Ankle Journal, August 2008

Major Points of Interest:

1. Structural allograft is commonly used in revision first metotarsophalangeal fusion.
2. During revisional surgery of the first metotarsophalageal joint, a defect is created from the removal of the implant and the preparation of the osseous surfaces.
3. The void can be estimated by measuring the distance from the proximal and distal bone segments.
4. Considerations for this surgery include:
    a. restoration of length
    b. maintaining proper alignment
    c. providing structural stability
5. Conical reaming of the interpostional bone graft allows for more degrees of motion for toe positioning, is reproducible, and has a higher rate of fusion over the more traditional rectangular peg-in-hole fashioning of the graft.
6. Structural allograft versus autograph
    a. corticocancellous autograft is harvested from the iliac crest and is associated with significant morbidity at the donor site
    b. allograft has an unlimited supply, has prolonged storage capacity, and is available in many sizes and shapes
    c. long term studies show no statistically significant difference in the morphology of repair between autograft and allograft
7. Proper joint debridement is obtained by:
    a. removing any fibrous tissue
    b. resecting the proximal and distal bony segments down to bleeding bone edges with the reamer
        i. called the paprika sign
8. If deep infection is suspected but no purulence is present, the absence of neutrophils under high-powered field in a frozen tissue section allows for definitive surgery to be performed safely.
9. Cup and cone reamers are used to conically shape the graft.
10. The graft is temporarily fixated during the procedure using a K-wire after it is aligned properly in all three planes. It is then permanently fixated using a 1/3 tubular plate or locking plate system, preferably placed on the dorsal surface.

Transchondral Fractures (Osteochondritis Dissecans) of the Talus
Authors: Berndt, AL & Hardy, M
Date of Publication: JBJS, September/1959

Major Points of Interest:

1. Osteochondritis dissecans is the first of many terms used to describe these lesions- originally thought to be caused by a spontaneous necrosis.
2. There are many diagnostic terms for intra-articular fragmentary fractures of the talus and there are many misunderstandings regarding these lesions. This study aims to clarify these misunderstandings.
3. Transchondral fracture- is the new name that this study proposes for these lesions since it is an etiologically and anatomically correct name. They proposed that a new name was needed since these fractures had specific characteristics that set them apart from other fractures.
4. Transchondral fracture- fracture of the articular surface of the bone. Produced by a force transmitted from the articular surface of a contiguous bone across the joint and through the articular cartilage to the subchondral trabeculae of the fractured bone. Will result in either a small area of compressed trabeculae with or without damage to the overlying cartilage, or it will cause an avulsion of an osteocartilagenous flake.
5. Transchondral fractures differ from other fractures because they are difficult to recognize clinically. They may occur as a result of a trivial trauma that goes unnoticed and they can be masked by more painful nearby soft tissue injuries. They can be painless, and proper reduction followed by immobilization often still will not result in bone union. These lesions are unusually susceptible to development of avascular necrosis.
6. Of transchondral fractures of the talar dome, 43.7% were located at the lateral border and 56.3% involved the medial border.
7. Most now believe that trauma is the etiological factor.
8. Dorsiflexion and inversion produced fractures to the lateral border of the talus (DIAL). The study showed that these lesions were often on the middle or anterior half of the lateral border.

9. Diagram shows mechanism of transchondral fractures to the lateral boarder of the talar dome.
    a. Stage 1- as the foot inverts, the lateral boarder of the dome is compressed against the face of the fibula(while collateral ligaments remain intact)
    b. Stage 2- Further inversion ruptures lateral ligament and begains avulsion of the chip
    c. Stage 3- chip is completely detached but remains in place
    d. Stage 4- Chip displaced by inversion
10. Plantarflexion, inversion, and external rotation of the tibia on the talus produced the fracture of the medial border (PIMP).
11. Diagram shoes mechanism of transchondral fractures of the medial border of the talar dome
    a. Stage 1 - Plantarflexion with inversion, followed by rotation of the tibia on the talus produces a small area of compression - lateral ligaments remain intact.
    b. Stage 2 - Osteochondral chip, partially detached
    c. Stage 3 - Completely detached
    d. Stage 4 - Displaced within the joint
12. In clinical cases, stage 2-4 have had tenderness and pain over the posterior fasciculus of the deltoid ligament.
13. Authors suggest that OCD should be accepted as a fracture because of the significance of torsional impaction forces. Painlessness of stage one is due to the lack of sensory nerves at the fracture site.
14. Osteochondral fractures can theoretically heal like other fractures, but only if reduced and immobilized until bone union has taken place. If immobilization is inadequate, motion shears ingrowing capillaries, and repair ceases. Fracture becomes covered with dense fibrous connective tissue. Fragment is dead and this condition cannot be improved but it can get worse.
15. If necrotic fragment is removed, and fibrous coating of the host surface is curetted away, new reparative process may begin.
16. No symptoms that are pathognomonic of transchondral fractures of the ankle. Authors found no record of diagnosis made on history and physical alone.
17. Acutely, symptoms may be absent (in the case of a stage 1) or in the other stages will often present as an inversion ankle sprain. Chronic phase symptoms present with symptoms similar to osteoarthritis. Chronic stage 4's may have locking as well.
18. Early x-rays are essential. AP view- shows medial margin of talus. Oblique view in 10 degrees of medial rotation- gives clearer view of the lateral margin of the talus. Lateral view- shows size of the lesion and helps plan surgical approach. Watch for small residual fragments on post operative x-rays.
19. These fractures are often underestimated and inadequately treated. Conservative treatments have a very low percentage of good results in adults and in children. Operative treatment gave good results. If more of a chronic condition, conservative treatment can no longer be expected to improve conditions.

Screw fixation of the syndesmosis: a cadaver model comparing stainless steel and titanium screws and three and four cortical fixation

Authors: Annechien Beumer, Martin M. Campo, Ruud Niesing, Judd Day, Gert-Jan Kleinrensink, Bart A. Swierstra

Date of Publication: Injury: International Journal of the Care of the Injured, 2005

Major Points of Interest:

1. Syndesmotic set screws are indicated in all injuries that result in an unstable syndesmosis. There is debate on whether one should use a set screw made of titanium or stainless steel and if patients should bear weight with the set screw in place. This study aims to answer these questions.
2. Fresh-frozen human cadaver lower legs used. Mean age at death of 85. Syndesmotic rupture without fracture was simulated by sectioning ligaments including anterior and posterior syndesmosis, anterior deltoid ligament and lower 10cm of interosseous membrane.
3. Four groups: stainless steel- three cortices, stainless steel- four cortices, titanium- three cortices, titanium- four cortices.
4. Legs subjected to axial load of 800 N for 225,000 cycles to simulate amount of steps taken by patients with syndesmotic injuries during a protected weight bearing period of nine weeks.
5. There was no statistically significant difference in recorded syndesmotic widening between the four groups.
6. When weight bearing with a syndesmotic set screw in place, screw will resist normal tibiofibular movement. This will place stresses on the screw that could cause the screw to fail.
7. In all of the successfully tested legs, there was no screw loosening, screw breakage, screw pull-out, or fracture. There was a mean increase in tibiofibular width after testing of 1.05mm. In previous studies only .25mm of widening was seen in cadaveric ankles with intact ligaments with similar loads placed on them. Also, only .02mm of widening was seen in healthy living volunteers when they would actively load their ankles.
8. Since there was such a large increase in tibiofibular width seen in this study, assumption can be made that weight bearing with a syndesmotic screw in situ impairs normal healing of syndesmotic structures and weight bearing should not be recommended until ligaments have had time to heal.
9. Stainless steel and titanium fixation had equal results. Fixation with 3 or 4 cortices also seemed to have equal results. Note- advantage of 4 cortical fixation is that if screw breaks, it can be removed medially.
10. Things to keep in mind/possible problems with study- results would probably differ using living models, limbs were mostly from older people that likely had decreased bone density, and only a severe syndesmotic injury was simulated in this study. Therefore better fixation results may be possible with patients that are younger and have less severe injures than simulated in this study.

Radiographic Measures as a Predictor of Ulcer Formation in Diabetic Charcot Midfoot
Authors: Wesley P.C. Bevan & Matthew P.W. Tomlinson
Publication: Foot & Ankle International, June 2008
Evidence Level: 4 (Retrospective Case Study)

Major Points of Interest:

1. Each foot that was determined to have pedal pulses present, had Lateral & A/P weight-bearing projections taken, and had not undergone previous reconstructive procedures, was assessed for Eichenhoz Stage (1-3), Ulcer Presence & Type (None, Pre-Ulcerative (midfoot callus), Forefoot Ulcer (toes or metatarsal heads), & Midfoot Ulcer (between TMJ & MTJ).
2. Lateral measurements included: Kite's Angle, Meary's Angle, Calcaneal Inclination Angle, Medial & Lateral Column Heights, & Cuboid Abduction Angle
3. A/P measurements included: Meary's Angle, % Talar Head Uncoverage, & Cuboid Abduction Angle
4. Location of Midfoot deformity was defined based on Schon Classification (I = Lisfranc, II=Naviculocuneiform, III = Perinavicular, IV = Transverse Tarsal) & radiographic severity was classified as alpha or beta (a = none of beta present, b = dislocation &/or, Lateral Meary's Angle $\geq$ -30 deg &/or, Lateral Cuboid Abduction Angle $\leq$ 0 deg &/or, A/P Meary's Angle $\geq$ 35 deg) where alpha is a mild-moderate deformity and beta is a moderate-severe deformity.

5. Feet with Midfoot Ulceration were compared to those with No Ulceration for significance between Ulcer Presence, Radiographic Measurements, and Schon Severity as well as Ulcer Presence and Schon Severity
6. Lateral Meary's Angle & Lateral Cuboid Abduction Angle correlated with Midfoot Ulceration with all feet with Midfoot Ulcer having Lateral Meary's Angle > (more negative) than -27 deg
7. Beta severity correlated with Midfoot Ulceration
8. Increased Lateral Meary's & Cuboid Abduction Angle correlate to Medial & Lateral Arch Height collapse, respectively, which creates a "Rocker Bottom" foot type
9. 84% of amputations in Diabetics has reportedly been attributed to the presence of a plantar ulceration, thus, identifying those at risk, through methods identified in this study, may allow preventative measures to be taken that can reduce the risk of amputation

Comprehensive Foot Examination and Risk Assessment
Authors: Boulton, A.J.M. et al.
Date of Publication: Diabetes Care, August 2008

Major Points of Interest:

1. The most common triad causing foot ulceration:
    a. neuropathy
    b. deformity
    c. trauma
2. Risk factors for foot ulcers:
    a. pervious amputation
    b. past foot ulcer history
    c. peripheral neuropathy
    d. foot deformity
    e. peripheral vascular disease
    f. visual impairment
    g. diabetic nephropathy
    h. poor glycemic control
    i. cigarette smoking
3. Essential features for a history during a diabetic foot examination:
    a. Past history of:
        i. ulceration
        ii. amputation
        iii. Charcot joint
            1. often overlooked; presents as unilateral red, hot, swollen joint; most commonly in the midfoot
        iv. vascular surgery
        v. angioplasty
        vi. cigarette smoking
    b. Neuropathic symptoms, including but not limited to:
        i. positive symptoms
            1. burning, shooting pain, electrical sensations
        ii. negative symptoms
            1. numbness, feet feel dead
    c. Vascular symptoms, including but not limited to:
        i. claudication
        ii. rest pain
        iii. non-healing ulcer
    d. Other diabetic complications:
        i. renal problems
        ii. retinal problems

4. Key components of the diabetic foot exam:
    a. Dematologic
        i. skin status
            1. color, thickness, dryness, cracking
        ii. sweating
        iii. infection
            1. always check between toes for fungal infection
        iv. ulceration
        v. calluses/blistering
    b. Musculoskeletal
        i. deformity
            1. claw toes, hammer toes, prominent metatarsal heads
        ii. muscle wasting
            1. generally seen as guttering between the metatarsals
    c. Neurologic
        i. 10-g monofilament < 7/10 plus one of the following
            1. vibration using 128-Hz tuning fork
                a. over tip of great toe bilaterally
                b. abnormal when patient loses vibratory sensation but examiner still perceives it while holding the tuning fork
            2. pinprick sensation
                a. applied just proximal to the toenail on the dorsal surface of the hallux
                b. just enough pressure to deform skin
                c. abnormal when patient is unable to perceive over either hallux
            3. ankle reflexes
                a. abnormal with total absence of reflex either at rest or upon reinforcement
            4. vibration perception threshold testing (VPT)
                a. biothesiometer tested over pulp of hallux
                b. amplitude is increased until patient can detect the vibration; that number is the VPT
                c. abnormal when VPT >25
    d. Vascular
        i. foot pulses
            1. if absent then ABI is indicated
        ii. ABI
            1. should be part of annual exam for patients with documented PAD
            2. >0.9 is normal, <0.8 is associated with claudication, <0.4 is commonly associated with ischemic rest pain and tissue necrosis
5. An ABI of >1.3 can be indicative of medial calcinosis which renders the arteries incompressible. When this occurs toe pressures or transcutaneous oxygen tension is indicated.

6. Risk classification based on comprehensive foot examination.

Risk Category	Definition	Treatment Recommendations	Suggested follow-up
0	No LOPS, no PAD, no deformity	• Patient education including advice on footwear	Annually
1	LOPS ± deformity	• Consider prescriptive/ accommodative footwear • Consider prophylactic surgery if deformity unable to be safely accommodated in shoes	Every 3-6 months
2	PAD ± LOPS	• Consider prescriptive/ accommodative footwear • Consider vascular consultation for combined follow-up	Every 2-3 months
3	History of ulcer or amputation	• Same as category 1 • Consider vascular consultation for combined follow-up if PAD present	Every 1-2 months

Operative Compared with Nonoperative Treatment of Displaced Intra-Articular Calcaneal Fractures: A Prospective, Randomized, Controlled Multicenter Trial

Authors: Richard Buckley, Suzanne Tough, Robert McCormack, Graham Pate, Ross Leighton, Dave Petrie, & Robert Galpin

Publication: JBJS, October 2002

Evidence Level: 1 (Randomized Controlled Trial)

Major Points of Interest:

1. Primary question to be answered was "Does open reduction and internal fixation of displaced intra-articular calcaneal fractures result in better outcomes, as measured by general and disease specific health-outcome measures at two years after the injury, compared with those with nonoperative management?"
2. Secondary questions to be answered included:
    a. "Is the outcome after open reduction and internal fixation of displaced intra-articular calcaneal fractures associated with the findings on the postoperative CT scan and the clinical results?"
    b. "Does open reduction and internal fixation affect the outcomes as determined by the use of patient-oriented scoring scales?"
    c. "Are radiographic classifications predictive of the functional outcomes in patients with a displaced intra-articular calcaneal fracture?"
3. All fracture patterns were classified utilizing the Sanders', Essex-Lopresti, Crosby & Fitzgibbons, & the Orthopaedic Trauma Association classifications for Intra-Articular Calcaneal Fractures
4. Patients were randomized and underwent either surgical ORIF, following identical protocols, for correction of the intra-articular fracture or underwent identical nonsurgical treatment to include a RICE protocol and completed the Short Form-36 General Health Questionnaire, a Disease Specific Visual Analog Scale, as well as surveys to assess duration from time of injury until return to work, capability to perform normal work after treatment, complications, and the need to undergo additional surgery at 1 year and 2 year follow-up appointments to assess quality of outcomes
5. Patients not receiving Workers' Compensation had significantly better results when compared to those who were receiving the monetary support when comparing the scores from either treatment group and, as such, the results of those receiving Workers' Compensation were eliminated from statistical analysis as it was found that their data significantly skewed further data analysis
6. When engaging in ORIF, a larger Bohler's Angle, Anatomic or Near Anatomic reduction, being Female, being between ages 20 & 29, and a more mild fracture as graded via the Sanders' Classification all correlated with more positive outcomes
7. No statistically significant differences were found to exist between the operative and nonoperative groups with regard to age at time of injury, Bohler's Angle, Sanders' Classification grade, gender, and normal work load.
8. Patients who have intra-articular calcaneal fractures which are unilateral, with a Bohler's Angle between 15 & 36 degrees, & are without arthrodesis, are more likely to experience positive outcomes with either treatment regimen
9. No statistical difference in outcomes was found between Operative vs Nonoperative repair

Introduction to Ultrasonography of Ankle Tendons
Authors: Burns, P., Lee, T., Vidt, L.
Date of Publication: Clinics in Podiatric Medicine and Surgery, 2002

Major Points of Interest:

1. There are both benefits and disadvantages to ultrasound
    a. benefits:
        i. non-invasive
        ii. no ionizing radiation
        iii. dynamic imaging capability
    b. disadvantages:
        i. large dependence on technician and reader
        ii. limited to structures superficial to the bony cortex
2. Ultrasound basics:
    a. lower frequencies penetrate deeper into the tissue
    b. lower frequencies produce images with less resolution
    c. impedance mismatch: a change in tissue density which causes reflection or refraction of the sound waves
    d. bright signal = large difference in the densities at the interface of the two tissues
3. Probe and waves should be 90 degrees from the tissue being imaged
    a. any obliquity can cause images to appear falsely hypogenic
4. Indications for foot and ankle ultrasonography:
    a. tendon: tenosynovitis, tendinosis, tears, subluxations, dislocations
    b. joint and bursae: effusions, intra-articular loose bodies, bursitis
    c. soft tissue: foreign bodies, plantar fasciitis, neuromas, ganglions, cellulitis, abscesses
    d. guidance for intervention: joint aspirtations, tissue biopsies, joint and tendon sheath injection
5. Normal tendons appear as a fibrillar image with a hypoechoic signal along the edges, representing the peritenon.
6. Transverse scans are the best view for visualizing tears.
7. The most common area for tendinosis or tear in the posterior PT tendon is about the medial malleolus.
8. Pathology of the extensor tendons is rare.

9. Abnormal anatomy seen with ultrasound;
    a. tendinitis:
        i. tendon with a sheath: increase in fluid, thickened tendon, hypoechoic signal within tendon
        ii. tendon without sheath: thickened with hypoechoic signal within tendon
    b. chronic tendinitis: both hypoechoic and hyperechoic areas within tendon and a loss of continuous fibrillar pattern
    c. tenosynovitis: increase of fluid within the sheath in comparision to the contralateral side
    d. peritendinitis: hypoechoic area surrounding the hyperechoic tendon; if calcifications are present, will appear as whitish areas within the tendon and cause a shadowing effect on deeper structures
    e. complete rupture: hypoechoic area where tear is present and defect filled with hematoma; frayed edges of ruptured tendon possible on either side of the defect
        i. any lack of normal sliding motion with movement eliminates any doubt of complete rupture
    f. partial rupture: hypoechoic or black area next to continuous fibrillar pattern
    g. longitudinal split: hypoechoic area within the tendon, which does not reach the surface of the tendon
    h. bursitis: bursa is enlarged and edematous with ill defined contours
        i. increased fluid is viewed as hypoechogenicity
10. Amount of fluids normally found in tendon sheaths:
    a. posterior tibial tendon: up to 4mm
    b. anterior ankle joint: up to 3mm
    c. common peroneal sheath: up to 3mm
    d. retrocalcaneal bursa: up to 2.5mm
    e. FDL, TA, Achilles, FHL: no detectable fluid

Pathologic Conditions of the Heel: Tumors and Arthritides
Authors: Burns, P., Scanlan, R.L., Zgonis, T., Lowery, C.
Date of Publication: Clinics in Podiatric Medicine and Surgery, 2005

Major Points of Interest:

1. Rheumatoid arthritis is the most common inflammatory arthritis causing heel pain.
2. Diagnostic studies for arthritides:
    a. imaging studies:
        i. radiographs: first step; show joint space narrowing, erosions, subluxations, etc
        ii. bone scans: very sensitive, but not specific
        iii. CT & MRI: rarely indicated except for tumor work-up
    b. laboratory tests:
        i. rheumatoid factor: the starting point for lab tests
        ii. ANA
        iii. HLA-B27
        iv. ESR and CRP: both non-specific; CRP elevates more rapidly
3. Criteria for diagnosis of rheumatoid arthritis:
    a. morning stiffness lasting at least 1 hour before improvement
    b. arthritis of 3 or more joints
    c. arthritis of hand joints
    d. symmetric
    e. rheumatoid nodules
    f. serum rheumatoid factor
    g. radiographic changes
        i. 4 of the 7 must be present for diagnosis, patients with 2 or more not excluded, a-d must be present for at least 6 weeks, b-e must be observed by a physician
4. Seronegative arthritides:
    a. more likely to have subcalcaneal pain as a chief complaint
    b. negative for rheumatoid factor
    c. typically involve large joints of the body (oligoarthritis)
    d. radiographs typically reveal sacroiliitis or spondylosis, along with enthesopathies
    e. include:
        i. ankylosing spondylitis
        ii. psoriatic arthritis
        iii. Reiter syndrome
        iv. associated with acute exacerbations of inflammatory bowel disease
5. Primary and metastatic lesions involve the heel more than any one area of the foot.
6. Pain with malignant bone tumors is characteristically deep and unrelenting.
7. A technetium whole-body scan should be considered with any lesion that involves bone.
8. Osteoid osteoma
    a. 2:1 male to female
    b. 20-30 years most common
    c. deep seated pain within bone, most noticeable at night, typically relieved with aspirin
    d. treatment is surgical debridement with excision of nidus
    e. removal of all reactive and sclerotic bone is not necessary

9. Enchondroma
    a. male = female
    b. 10-40 years most common
    c. typically in small bones of hand and foot, phalanges most common
    d. symptomatology based upon compression of adjacent soft tissue structures
    e. treatment is surgical excision with curettage and chemical cauterization
10. Solitary bone cyst
    a. 2:1 male to female
    b. usually before 20 years of age
    c. in younger patients most common in metaphyseal region of long bones; in older patients most common in flat and small bones
    d. "fallen fragment sign": migrated cortical bone visualized on radiograph
    e. treatment is complete surgical evacuation with curettage of the walls of the cyst
11. Aneurysmal bone cyst
    a. male = female
    b. most common bone affected is the calcaneus
    c. symptoms usually pain and swelling present for several months with or without functional impairment of the adjacent joint
    d. radiographically has a soap bubble appearance
    e. treatment is en bloc excision of the entire lesion with bone grafting to fill the osseous defect
12. Multiple myeloma
    a. 2:1 male to female
    b. peak incidence between 40-60 years
    c. most commonly widespread
    d. symptoms are typically vague complaints with an insidious onset, bone pain is generally progressive and severe, usually referring to the lower back
    e. treatment is irradiation with chemotherapy for localized bone pain
13. Intraosseous lipoma
    a. rare benign tumor
    b. radiograph reveals a calcific nidus within a radiolucent lesion in the neutral triangle of the calcaneus
    c. treatment is generally conservative

Surgical Reconstruction of the Charcot Rearfoot and Ankle
Authors: Burns, P., Wukich, D.K.
Date of Publication: Clinics in Podiatric Medicine and Surgery, August 2008

Major Points of Interest:

1. Diagnosis of Charcot includes:
    a. radiographic findings
        i. destruction of bone and joint
        ii. debris
        iii. dislocation
        iv. osteopenia
    b. clinical findings
        i. local signs of inflammation with the absence of systemic signs
        ii. typically unilateral
2. Elevating the leg for 10 minutes will show decreased edema in a patient who has Charcot deformity, whereas edema will persist in infection
3. Traditionally Eichenholtz stage 1 is treated with conservative measures, including total contact casting and off-loading, while surgery is reserved for Eichenholtz stage 3.
4. Stage 0 Charcot
    a. an "at risk" patient who has neuropathy and injury
    b. current treatment recommendations are:
        i. use of more stable constructs
        ii. prolonged non-weightbearing
        iii. increased number of office visits
5. Charcot deformities become less stable and more often require intervention with longer immobilization periods as they move more proximal.
6. Case studies and the author's experience show that the use of an intramedullary rod should be considered for Charcot reconstruction in cases of bone loss and osteopenia (neuropathic arthropathy).
7. In a patient in the acute stages of neuroarthropathy maintaing structure or limiting further collapse is of utmost importance.
    a. can be accomplished by total contact casting, Charcot restraint orthotic walkers, or non-weightbearing
8. When acute or chronic Charcot deformity has instability, surgical stabilization is often required.
    a. instability is more common with rearfoot and ankle deformity, in comparison to midfoot deformity
9. When ulceration is present in conjunction with Charcot deformity, the primary goal is the heal the ulceration.
    a. surgery can be performed in patients with non-healing or recurrent wounds, as correction of the deformity will most likely facilitate wound healing
10. Equinus increases stress on the medial arch and forefoot, thus most Charcot reconstructions are performed with concomitant lengthening of the Achilles tendon or gastrocnemius.
    a. lengthening has been shown to decrease power, decrease midfoot and forefoot pressures, and increase available dorsiflexion
    b. performed percutaneously to avoid major incisions in unfavorable skin conditions
    c. studies show no measurable change in functional limitations following lengthening

11. Arthrodesis is the treatment of choice for Charcot deformities. Important factors for successful arthrodesis include:
    a. remove all cartilage and debris
    b. debride to subchondral, bleeding bone
    c. meticulously fashion bone surfaces for contact
    d. complete debridement of all synovial and scarred capsule
    e. stable internal fixation
12. To decrease the chance of malunion during arthrodesis, external rotation should align the second toe and tibial crest.
13. Restoration of calcaneal inclination is key in Charcot resconstruction, as it is the building block for reconstructing the remaining midfoot following ankle and rearfoot reduction.

Fractures of the Neck of the Talus
Authors: Canale, ST & Kelly, FB
Date of Publication: JBJS, March 1978

Major Points of Interest:
1. Long-term evaluation of talar neck fractures. Good or excellent results achieved in 59 percent of the fractures.
2. Accurate anatomical reduction of displaced fractures recommended. Avascular necrosis of the talar body occurred in 52 percent of the fractures. Incidence varied by type of fracture.
3. Many patients with avascular necrosis that were treated conservatively had satisfactory results.
4. Complications of these fractures include: avascular necrosis, malunion, subtalar arthritis, and infection. These resulted in the need for secondary procedures.
5. Vascular supply of the talus from 3 main sources: through the neck, through the foramina in the sinus tarsi and tarsal canal, and through the foramina in the medial surface of the body.
6. Hawkins classification (correlates well with damage to blood supply of talus)

Fracture Type	Blood Supply Disrupted
I - minimum displacement	Blood supply entering in through the neck distrupted (only one)
II - Subtalar subluxation or dislocation	At least 2 of the 3 blood supplies lost, either those entering through the neck or through the tarsal canal
III - Body of talus dislocated from ankle and STJ	All 3 blood supplies may be disrupted
IV - Dislocation of talar body from ankle or STJ and complete dislocation or subluxation of head of talus from TN joint	All 3 blood supplies may be disrupted

7. Closed reduction then non- weight bearing immobilization preferred in mild to moderately displaced fractures. Reduction of less than 5mm of displacement and less than 5 degrees of malalignment is considered adequate. Of all Type- I fractures that were treated with the above treatment, 9/14 had excellent results, and 5/14 had good results. AVN developed in 2 of these fractures(13%) but both had excellent results.
8. With the exception of Type-I lesions, there was a high incidence of the following complications: AVN, arthritis of the ankle, subtalar arthritis, malunion, and infection.
9. AVN of the body of the talus occurred in half of the Type-II lesions, and nearly all of the Type-III lesions(84% in this study). AVN was uncommon in Type I lesions because only one source of blood supply was jeopardized.
10. It was not possible to predict accurately at the time of injury, which Type-II fractures would have AVN of the talar body.
11. Authors tried to treat AVN early by predicting which fractures had AVN before x-ray changes indicating collapse. Hawkins sign= subchondral radiolucency visible in the body of the talus 6 to 8 weeks after fracture. Its presence suggests that there is continuity of blood supply and evidence of vascularity to the body of the talus. Its presence makes the diagnosis of AVN unlikely. Its absence(according to this study) should not be a totally reliable indicator of development of AVN.

12. Patients treated by NWB had more excellent and good results. If NWB could not be accomplished, partial weight-bearing in a patellar tendon-bearing brace was superior to no treatment or unrestricted weight bearing.
13. When persistent pain associated with AVN did require a secondary salvage procedure, tibiocalcaneal fusion proved superior to ankle fusion or talectomy.
14. With primary treatment, most poor results were secondary to AVN. With Type-II fractures, there were many malunions which were mostly in a varus or dorsal position.
15. A normal lateral radiograph can reveal a malreduction dorsally. A varus malreduction can be more easily detected by placing the cassette directly under the foot with the ankle in a maximally plantarflexed position. Maximally flex the hip and knee as well, and pronate the foot 15 degrees. The tube is then directed cephalad at a 75 degree angle from horizontal.
16. Two-thirds of the patients with established AVN had no secondary operations indicating that not all patients with AVN of the talus have a severe disability or need surgery. Those kept NWB for an average of 8 months had the highest percentage of satisfactory results.
17. Subtalar fusion or triple arthrodesis, as a primary or secondary procedure, is a good treatment for a moderate to severe subtalar comminution, but neither operation did much to alter the course of AVN of the talus. Tibiocalcaneal fusion results were superior to talectomy if ankle and subtalar joints were involved. Some of their worst results were after talectomy alone.
18. For talar neck fracture with osteomyelitis, the preferred treatment is excision of the infected bone followed by arthrodesis.

How to Treat Ankle Fractures in Patients with Diabetes
Authors: Catanzariti, Mendicino, Sautter
Publication: Podiatry Today, April 2006

Major Points of Interest:
1. Literature emphasizes difficulty in managing ankle fractures in the diabetic and neuropathic population with high complication rates. Poor outcomes result regardless of surgical or non-surgical intervention.
2. Risk Factors:
    a. Neuropathic fractures are commonly linked with Charcot neuroarthropathy.
    b. Diabetic bone is stiffer and able to bear less load.
    c. Neuropathy, duration of diabetes greater than 10 years, insulin treatment are all associated with an increased fracture risk, and are often undiagnosed due to a lack of pain sensation.
    d. Neuropathy and peripheral vascular disease are significant risk factors in developing complications. Age, hypertension, weight, fracture type are not.
3. Complications from Surgical Management of Ankle Fractures in Diabetics:
    a. Infection, malunion, nonunion, Charcot neuroarthropathy
    b. Need high suspicion for Charcot!
4. Key Considerations
    a. Need to emphasize tight metabolic control: unregulated blood glucose levels lead to decreased bone formation and mechanical stiffness, whereas regulated blood glucose levels heal similar to non-diabetics.
    b. Medically and legally it is important to document the presence of diabetic neuropathy, sign informed consent documents, and educate about potential complications including Charcot, severe deformity, limb loss.
5. Conservative Options:
    a. Extensive period of NWB, 2x longer than a non-diabetic
    b. Use well padded casts or total contact casts with regular cast changes to eliminate iatrogenic wound formation
    c. Protect contralateral limb from wounds caused by cast
    d. Prophylactic bisphosphonate therapy may help eliminate the early bone destructive phase of Charcot
6. Pearls to Manage Open and Unstable Fractures:
    a. For unstable fractures, suggest surgical management with ORIF or closed reduction with percutaneous or external fixation.
    b. Allow for decrease in pre-op swelling before operating.
    c. Develop adequate fixation: use multiple lag screws for lateral malleolar fracture, use fully threaded cancellous screws below the ankle joint with osteopenia, use multiple transsyndesmotic screws when possible to engage all 4 cortices.
    d. Supplement with external fixator
    e. Cast changes every 7-14 days and serial radiographs
7. Surgical Treatment Outcomes:
    a. Transarticular fixation with minimally invasive technique to limit ORIF risks-- closed reduction with percutaneous fixation and protective weight bearing. 25% major complication rate.
    b. Unpublished date at West Penn Hospital reveals low complication rate for surgical treatment of diabetic ankle fractures

Double Crush Syndrome
Author: Childs, Sharon G.
Date of Publication: Orthopaedic Nursing, March/April 2003

Major Points of Interest:

1. Upton and McComas theorized that compression of a single axon at one site, caused increased sensitivity and made it more susceptible to biochemical injury at another site distal to it.
    a. This theory was termed double crush syndrome (DCS)
2. Basic premise of DCS is non-symptomatic reduction in axonal flow at one or more sites along the nerve that may combine causing a symptomatic neuropathy
3. DCS could be a result of injury to multiple areas along peripheral nerve, injury to one anatomic region by multiple structures, or a combination of both
4. Dysregulation of nerve function (sensory or motor) can be precipitated by different means including biologic/metabolic, structural, toxigenic, and vascular effects
5. Signs and symptoms include dysesthesia/paresthesia, pain, and dysreflexia. More severe cases with autonomic dysreflexia can be associated with anhidrosis and arteriovenous shunting
6. Sunderland has classification system which grades nerve injuries based on depth and extent of nerve damage. Expanded on the previously used Seddon classification.
    a. Grade 1: conduction block (neuropraxia)
    b. Grade 2: intact myelin sheath, loss of continuity of axons with intact endoneurium (axonotmesis)
    c. Grade 3: Endoneural and neural injury; loss of continuity of axons and endoneurium; perineurium intact
    d. Grade 4/5: All parts of nerve disrupted (neurotmesis)

A Simple Test for Hindfoot Flexibility in the Cavovarus Foot
Authors: Sherman S. Coleman & William J. Chestnut
Publication: Clinical Orthopaedics & Related Research, March 1977
Evidence Level: 2 (Cohort Study)

Major Points of Interest:

1. A major component of Cavovarus is a Valgus Forefoot of which is most often caused by a plantarflexed 1st Ray
2. If a Plantarflexed 1st Ray that produced Forefoot Valgus is the primary deforming force of Cavovarus, then the Rearfoot will compensate by moving into Varus in an attempt to establish a Tripod foot where the calcaneus, 5th metatarsal head, and 1st metatarsal head contact the ground
3. It is generally accepted that the primary deforming force of Cavovarus lies in the Forefoot and that, the majority of the time, Rearfoot changes are flexible compensations to establish Tripod foot
4. Coleman Block Test assesses if Hindfoot Varus is flexible or rigid by weight-bearing on a 1 inch thick wood block in such a fashion that the lateral column and calcaneus are upon the block while the medial column hangs off the edge and bears no weight
5. If Varus position reduces to Neutral or Valgus position then the Rearfoot is a flexible compensation for a Forefoot Valgus (most likely due to Plantarflexed 1st Ray), however, if Varus position remains then the Rearfoot is a rigid primary component of the Cavovarus
6. If Rearfoot is found to be flexible then all surgical correction should be directed towards the Forefoot, however, if Rearfoot is found to be rigid then it needs to be addressed surgically +/- Forefoot depending on its state of flexibility

Clinical Significance of Magnetic Resonance Imaging in Preoperative Planning for Reconstruction of Posterior Tibial Tendon Ruptures
Authors: Stephen Conti, James Michelson, Melvin Jahes
Date of Publication: Foot and Ankle, May 1992

Major Points of Interest:
1. This study aims to determine the usefulness of MRI in assessing posterior tibial tendon degeneration preoperatively for patients having tendon reconstruction surgery
2. Grading classification for MRI was compared to grading classification intraoperatively, to determine which was a better predictor of outcome of reconstructive surgery
3. Intraoperative surgical grading of posterior tibial tendon tears did not correlate with outcomes following tendon reconstruction
4. MRI grading of posterior tibial tendon tears was significantly correlated to outcome following tendon reconstruction
5. MRI grading was often more severe than surgical grading
6. MRI grading classification – useful for predicting clinical outcome
    a. Grade 1: longitudinal splits in PTT without significant tendon degeneration
    b. Grade 2: narrowed PTT, longitudinal splits, intramural degeneration
    c. Grade 3: diffuse swelling with uniform degeneration or complete rupture
7. Success following tendon reconstruction decreases steadily over time for stages 2 and 3.
    a. May consider STJ or triple arthrodeses

Calcaneocuboid Joint Pressures with Lateral Column Lengthening (Evans) Procedure
Authors: Paul S. Cooper, Michael D. Nowak, and James Shaer
Date of Publication: Foot and Ankle International, April 1997

Major Points of Interest:

1. Evans procedure is lateral column lengthening through the anterior portion of the calcaneus, proximal and parallel to the calcaneocuboid joint for reconstruction of adult acquired flatfoot
2. A different study did a long term follow-up of Evan's original adult cases and found that 15 of 23 feet had radiographic evidence of calcaneocuboid joint arthrosis
3. This study was intended to measure the calcaneocuboid joint pressures in adult cadaveric feet, both loaded and unloaded, following an Evans procedure
4. Highest calcaneocuboid joint pressures were found in both lengthening, and loading the foot
    a. Pressures increased proportionally to degree of lengthening
5. This increased pressure through the calcaneocuboid joint may create or increase arthrosis in the joint
6. Distraction bone block arthrodesis of the calcaneocuboid joint is an alternative procedure that may prevent this arthrosis

Transosseous Fixation of the Distal Tibiofibular Syndesmosis: Comparison of an Interosseous Suture and Endobutton to Traditional Screw Fixation in 50 Cases

Authors: James M. Cottom DPM, Christopher F. Hyer DPM, Terrence M. Philbin DO, Gregory C. Berlet MD.

Date of Publication: JFAS, November/December 2009

Major Points of Interest:

1. Purpose: This retrospective cohort study compares traditional AO screw fixation to an endobutton and transosseous suture (Arthrex Ankle Tightrope™) for the treatment of an unstable distal tibiofibular syndesmosis.
2. Materials and Methods: 50 non-diabetic patients with distal tibiofibular syndesmotic injuries were divided evenly into one group undergoing traditional AO fixation and the other group undergoing endobutton and transosseous suture placement. Post-operatively, patients in both groups were immobilized for 10 days in a non-weightbearing splint, followed by a weight-bearing cast for 3 additional weeks. They were then placed into a removable full-weightbearing boot walker.
3. Materials and Methods: Pre- and post-surgical results were compared using radiographs, a modified AOFAS hindfoot and ankle scoring system, as well as a Short Form (SF)-12 Health Survey, which addressed both a physical component summary (PCS) as well as a mental component summary (MCS).
4. Results: (**=statistically significant, $P \leq .05$)
    a. Interosseous suture endobutton group:
        i. Mean follow-up: 10.78 months
        ii. Mean time to full-weightbearing: 5.52 weeks
        iii. Radiographic measurements:
            1. Mean Medial Clear Space:
                a. Pre-operatively: 5.48mm
                b. Post-operatively: 3.00mm
            2. Average post-operative tibiofibular overlap: 6.88mm
            3. Mean post-operative tibiofibular clear space: 3.80mm**
            4. Modified AOFAS hindfoot scoring system (maximum score= 63 points)**
                a. Mean pre-operative: 29.84
                b. Mean post-operative: 50.64
            5. SF-12 Survey
                a. Mean pre-operative: 29.84
                b. Mean post-operative: 50.64
    b. AO Screw fixation group:
        i. Mean follow-up: 8.2 months
        ii. Mean time to full-weightbearing: 10.52 weeks
        iii. Radiographic measurements:
            1. Mean medial clear space:
                a. Pre-operative: 6.40mm
                b. Post-operative: 3.08mm
            2. Average post-operative tibiofibular overlap: 7.96mm
            3. Mean post-operative tibiofibular clear space: 4.76mm**
            4. Modified AOFAS hindfoot scoring system (maximum score= 63 points)**
                a. Mean pre-operative: 33.42
                b. Mean post-operative: 53.45
            5. SF-12 Survey:
                a. Mean pre-operative: 33.42
                b. Mean post-operative: 53.45

5. The only statistically significant difference between the 2 treatment groups was the post-operative tibiofibular clear space. The AOFAS evaluation was statistically significant for both groups when comparing their pre-operative and post-operative scores, indicating marked improvement after treatment. The SF-12 survey also showed improvement in both groups, but was not statistically significant. All other results had no statistically significant differences between the two surgical groups.
6. It should be noted that while there were no hardware failures in the interosseous suture and endobutton group, there were 5 patients who had loosened screws and 7 patients who had hardware failure in the AO screw fixation group, resulting in a 48% complication rate in that group.
7. Although the treatment outcomes were similar between the two groups, the authors believe that there are clear benefits in using the interosseous suture and endobutton over the traditionally used AO screw fixation for treatment of a disrupted distal syndesmosis:
    a. The endobuttons provide semi-rigid dynamic stabilization as opposed to rigid internal fixation.
    b. Patients are able to begin physical therapy and to return to normal daily activities faster than patients who undergo screw fixation.
    c. Interosseous suture and endobutton technique requires minimal incisions for placement.
    d. Late diastasis of the syndesmosis is prevented, as the ligaments are able to heal while the implant is still in place.
    e. Should removal be needed, the implant can easily be removed with minimal incisions.
8. Conclusion: The interosseous suture and endobutton method is a viable option for treatment of distal syndesmotic injuries, and offers surgeons a choice other than the widely-used traditional AO screw fixation.

Treatment of Syndesmotic Disruptions with the Arthrex Tightrope™ : A Report of 25 Cases
Authors: James M. Cottom DPM, Christopher F. Hyer DPM, Terrence M. Philbin DO, Gregory C. Berlet MD.
Date of Publication: Foot & Ankle International, August 2008

Major Points of Interest:

1. Purpose: To study the efficacy of the Arthrex Tightrope™ for treatment of distal syndesmotic disruptions in 25 non-diabetic patients. As treatment options for syndesmotic injuries is a highly debated topic, this serves as a potential avenue for treatment.
2. Arthrex Tightrope™ is designed based on the suture endobutton. This device helps to avoid many of the complications faced with traditional AO fixation which include hardware failure, stiffness, and pain associated with the hardware.
3. Materials and Methods: 25 Patients with distal syndesmotic disruptions underwent surgery using arthrex tightrope. Syndesmotic disruption was determined using standard radiographs. Despite different fracture patterns, all tightrope placement procedures were done the same. Post-operatively, patients were in a non-weight-bearing splint for 10 days. They were then placed in a non-weight-bearing cast for 3 weeks, followed by a removable, full-weight-bearing boot walker.
4. Post-operative results were assessed after 6 months at the earliest (range 6-12 months), using radiographs, a modified AOFAS scoring system, and a Short Form (SF)-12 Health Survey which addressed both a physical component summary (PCS) as well as a mental component summary (MCS).
5. Mean Follow-up was 10.8 months. Mean time to full-weightbearing was 5.5 ± 1.9 weeks, with an average healing time of 4.9 ± 1.9 weeks when removing patients with Maisennouve fractures from the mean.
6. Mean pre-operative score for the modified AOFAS Hindfoot scoring system was 29.8 out of 63. Post-operatively, mean score was 50.6 out of 63. The immediate post-operative SF-12 PCS/MCS score was 32.5/52.0, respectively. 6 month post-operative average score was 47.0/55.3.
7. For obese patients or patients with Maisonneuve fractures and/or Weber type B fractures, it is recommended that 2 tightropes be placed to enhance stability. The second tightrope should be placed 1cm proximally to the first and at a different angle to enhance stability.
8. Conclusion: The arthrex tightrope is a minimally invasive procedure that is quick to perform and avoids the need for hardware removal. Patients are able to get back to their daily activities in a short period of time, thus making it a possible treatment option for distal syndesmotic disruption.

Hallux Rigidus: Grading and Long Term Results of Operative Treatment
Authors: Coughlin, MJ & Shurnas, PS
Publication: Journal of Bone & Joint Surgery, 2003

Major Points of Interest:

1. Clinical- Radiographic System for Grading Hallux Rigidus

Grade	Dorsiflexion	Radiographic Findings	Clinical Findings
0	40° to 60° and/or 10% to 20% loss compared with normal side	Normal	No pain; only stiffness and loss of motion on examination
1	30° to 40° and/or 20% to 50% loss compared with normal side	Dorsal osteophyte is main finding, minimal joint-space narrowing, minimal periarticular sclerosis, minimal flattening of metatarsal head	Mild or occasional pain and stiffness, pain at extremes of dorsiflexion and/or plantar flexion on examination
2	10° to 30° and/or 50% to 75% loss compared with normal side	Dorsal, lateral, and possibly medial osteophytes giving flattened appearance to metatarsal head, no more than 1/4 of dorsal joint space involved on lateral radiograph, mild-to moderate joint-space narrowing and sclerosis, sesamoids not usually involved	Moderate-to-severe pain and stiffness that may be constant; pain occurs just before maximum dorsiflexion and maximum plantar flexion on examination
3	≤10° and/or 75% to 100% loss compared with normal side. There is notable loss of metatarsophalangeal plantar flexion as well (often ≤10° of plantar flexion)	Same as in Grade 2 but with substantial narrowing, possibly periarticular cystic changes, more than 1/4 of dorsal joint space involved on lateral radiograph, sesamoids enlarged and/or cystic and/or irregular	Nearly constant pain and substantial stiffness at extremes of range of motion but not at mid-range
4	Same as in Grade 3	Same as in Grade 3	Same criteria as Grade 3 BUT there is definite pain at mid-range of passive motion

2. For patients who desire preservation of motion and are willing to accept less than total pain relief, cheilectomy provides a high proportion of good and excellent long term results.
3. Cheilectomy does not appear to alter the natural progression of the disease process, but it enables a patient to be more comfortable during the course of the metatarsophalangeal joint degeneration.
4. Cheilectomy can be used with success for Grades 1, 2, and 3 hallux rigidus, but patients with Grade 4 or with <50% of the cartilage surface of the metatarsal head remaining at the time of surgery should be treated with arthrodesis.
5. With the more aggressive resection technique, the indications can be extended to include more advanced disease without compromising the result or creating an unstable joint.
6. Pain at the mid-range of motion (Grade 4) is a harbinger of a poor result following cheilectomy and that it is critical to recognize this finding especially in the presence of advanced radiographic changes.
7. Arthrodesis should be considered in patients who clearly have pain in the mid-range of motion on examination.
8. We noted no progression of degenerative changese in the interphalangeal joint following cheilectomy or arthrodesis.
9. A simple procedure such as cheilectomy tends to reduce elevation of the 1st ray as the joint functions more normally.
10. When a joint has deteriorated clinically to the point where elevation of the 1st ray is pronounced, it is an indication for metatarsophangeal arthrodesis because 1st ray elevation significantly diminished after arthrodesis.

Osteomyelitis of the Foot and Ankle in the Diabetic Population: Diagnosis and Treatment
Authors: Crim, B.E., Wukich, D.K.
Publication: The Journal of Diabetic Foot Complications, Vol 1 (2)

Major Points of Interest:

1. Diabetic patients are at an 80% increased risk of cellulitis, a 4-fold increased risk of osteomyelitis, and a 2-fold risk of both sepsis and death caused by infection.
2. In Charcot patients, increased midfoot breakdown was associated with a talo-1st metatarsal (Meary's) angle of greater than 27 degrees.
3. Immnopathy due to impairment of leukocyte phagocytosis and chemotaxis may be present in diabetic patients, thus the signs of inflammation may be absent in up to 2/3 of ulcers with histopathologic evidence of osteomyelitis.
    a. always consider osteomyelitis in ulcerations which fail to heal properly
4. Direct inoculation of bone through ulcers in the most common cause of osteomyelitis, thus the prevalence of osteomyelitis in the forefoot > midfoot > rearfoot.
5. Gold standard for diagnosis of osteomyelitis is bone biopsy.
    a. antibiotics must be held for at least 48 hours prior to culturing
    b. both deep soft tissue and bone should be cultured for analysis
6. Micropathological analysis can identify both acute and chronic processes.
    a. acute: infiltration of neutrophils
    b. chronic: plasma cells and lymphocytes
7. Two most important factors found in osteomyelitis and not cellulitis are:
    a. ulcer depth > 3mm
    b. CRP > 3.2mg/dL
8. Imaging Studies
    a. plain film radiography
        i. first imaging modality of choice
        ii. osteomyelitis appears as permeative radiolucencies, destructive changes, cortical defects and/or periosteal new bon formation
        iii. may be lacking in evidence initially because 30-50% bone loss is needed to show signs
    b. Tech-99 bone scan with labeled WBC
        i. shows changes in more timely fashion than plain film radiographs
        ii. difficult to differentiate from Charcot because Charcot has increased WBC uptake due to marrow reactivation
    c. MRI
        i. TI shows decreased signal intensity in bone with osteomyelitis
        ii. T2 shows increased signal intensity in bone with osteomyelitis
        iii. found to be superior to plain film, Tech-99 scans, and Tech-99 labeled WBC scans in diagnosing osteomyelitis
9. Antibiotic therapy of osteomyelitis
    a. only variable associated with remission of > 12 months with culture-based therapy
    b. imperative to cover staphylococcus, with MRSA coverage if indicated by cultures
    c. no route, parenteral or oral, has been shown to be superior
    d. classically 4-6 weeks of parenteral antibiotics in conjunction with debridement is used to treat osteomyelitis
        i. currently no hard data to guide treatment

10. Surgical debridement should result in debridement to bleeding, viable bone, with all necrotic and infected bone being resected.
    a. wide excision of bone with margins > 5mm have been shown to decrease recurrence rate in chronic osteomyelitis as opposed to resection < 5 mm
    b. debridement should be considered for:
        i. all infected ulcerations with obvious purulence
        ii. patients who have failed antibiotic treatment
        iii. abscess formation
        iv. necrotizing faciitis
        v. gangrene

Intermetatarsal Angle After First Metatarsophalangeal Joint Arthrodesis for Hallux Valgus
Author: Cronin, JJ
Publication: Foot & Ankle International February 2006

Major Points of Interest:

1. Patients with severe hallux valgus and 1st MPJ degeneration arthrodesis can significantly correct the IM angle without the addition of a basal osteotomy.
2. The actions of the adductor hallucis, through the lateral sesamophalangeal ligament, contribute largely to the deforming forces of hallux valgus.
3. Once the proximal phalanx is fused to the 1st metatarsal, these deforming forces will act on the 1st metatarsal to correct its varus malalignment.
4. The action of the adductor hallucis will have a greater effect after 1st MPJ fusion due to the fact that it is acting on a longer lever arm after surgery (proximal phalanx alone pre op vs proximal phalanx fused to 1st metatarsal post op).
5. The correction of the IM angle increased as the metatarsus primus varus component of hallux valgus (IM angle) progressed from moderate to severe.
6. Although the correction is obtained in the first 6 weeks after surgery, an additional few degrees of correction may occur after that time.

Varus Malalignment of the Talar Neck, It's Effect on the position of the Foot and on Subtalar Motion
Author: Daniels, TR
Date of Publication: JBJS, October 1996

Major Points of Interest:

1. Authors sought to determine whether a varus malalignment of the talar neck alters the position of the foot and subtalar motion.
2. Removal of a medially based wedge of bone in the neck of the talus caused a varus malalignment of the talus which resulted in a decrease in subtalar motion. This was characterized by an inability to evert the foot.
3. Removal of the medial wedge produced a decrease in the average arc of subtalar motion in all planes. The average decrease in subtalar arc was 30%.
4. Removal of a medially based wedge causes the hindfoot and forefoot to be inverted and there is a shortening of the medial column bringing the calcaneus beneath the talus. The forefoot is adducted and tilted into a varus malalignment. Resultant foot is “C” shaped in the anterior-posterior plane.
5. There was a strong positive linear correlation between the decrease in subtalar motion and the degree of varus deformity created at the talar neck.
6. Arc of subtalar motion was decreased because the foot was locked in an inverted position. The arc of eversion was restricted; however, the arc of inversion was unchanged.
7. Rotational capacity of the TN joint is greater than that of any other tarsal articulation.
8. The more anatomical the reduction of the talar neck, the less the subtalar motion and position of the foot are adversely affected.
9. Authors suggest using caution when compressive fixation is used in the medial column of the talus, especially when there is medial comminution, since excessive compression could create a varus deformity.
10. This study shows that varus malalignment of the talar neck shortens the medial column and locks the hind foot in varus and internal rotation. A direct linear correlation was found between the degree of varus malalignment of the talar neck and the change in the position of the foot and the subtalar motion; thus, the authors emphasize the importance of anatomical reduction of fractures of the talar neck.

Nutritional Status: Importance in Predicting Wound-Healing After Amputation
Authors: Dickhaut, M.D., Steven; Delee, M.D., Jesse
Date of Publication: Journal of Bone & Joint Surgery, January 1984

Major Points of Interest:

1. Protein and calorie malnutrition affects the morbidity and mortality of patients undergoing operations.
2. Laboratory assessments of nutritional status that include evaluations of serum albumin levels and total lymphocyte counts are valid tests to assess a patient's nutritional status.
3. This study examined the influence of preoperative nutritional status on morbidity in 23 diabetic patients who underwent a Syme amputation.
4. All of the patients at least met Wagner's criteria for a Syme-level amputation.
5. Only 43% or 10 of the 23 patients healed at this amputation level when selected based on Wagner's criteria alone.
6. Six of the seven or 86% of patients that met Wagner's criteria and additionally had a serum albumin level of at least 3.5 grams per deciliter and a total lymphocyte count of at least 1500 cubic millimeters healed at the Syme level amputation.
7. Only two of the eleven or 18% of patients that met Wagner's criteria but had a serum albumin level of less than 3.5 grams per deciliter and a total lymphocyte count of less than 1500 cubic millimeters healed at the Syme level amputation
8. The authors conclude that combining nutritional evaluation with accepted clinical criteria for Syme-level amputation may identify a population that is at risk for non-healing.
9. Correction of existing nutritional deficiencies prior to definitive amputation may favorably affect healing.

Risk of Sural Nerve Injury with Intramedullary Screw Fixation of Fifth Metatarsal Fractures: A Cadaver Study

Authors: Brian G. Donley, MD, Michael J. McCollum, MD, G. Andrew Murphy, MD, E. Greer Richardson, MD

Date of Publication: Foot & Ankle International, March 1999

Major Points of Interest:

1. The authors had patients who experienced postoperative pain due to prominent screw heads that was not relieved after hardware removal. They suspected the pain may be related to sural nerve injury
2. 4.5mm partially threaded cancellous screws with 8mm heads were placed into 10 fresh-frozen cadaver feet.
3. Nerve injury occurred in 1 of 10 specimens. The dorsolateral branch of the sural nerve was found to lie within 2mm of the screw head in 5 of 10 specimens, and within 3mm in an additional 3 specimens.
4. "Sural neuroma should be considered in patients who complain of pain at the base of the 5th metatarsal after intramedullary screw fixation of fractures, especially if the pain is not relieved by screw removal."

Osteotomy of the Calcaneum for Pes Cavus
Author: F.C. Dwyer
Publication: JBJS, February 1959
Evidence Level: 4 (Prospective Case Series)

Major Points of Interest:

1. Pes Cavus only develops after the age of 3, and direct timing depends upon if etiology is neuromuscular or Idiopathic in origin
2. As Pes Cavus progresses, 4 main deformities occur: 1) Forefoot Equinus 2) Plantar Fascial Contracture 3) Digital Clawing & Callosity Formation & 4) Rearfoot followed by Forefoot Varus
3. Contracture of the Tendo-Achilles IS NOT typically a cause of Pes Cavus; although can be at times
4. As Rearfoot Varus develops it leads to 3 major forces leading to deformity: 1) Achilles becomes an Invertor & activates Windlass Mechanism producing Forefoot Varus 2) Weight-bearing shifted to Lateral Column reinforcing Rearfoot & Forefoot Varus 3) Weight-bearing fails to stretch the Plantar Fascia & rigid contracture occurs
5. Steps of Dwyer Osteotomy: 1) Sub-Q release of Medial Band Plantar Fascia (currently avoided) 2) Curvi-Linear Incision over PosteroSuperior aspect lateral Calcaneus 3) PL Tendon located & Superior & Inferior aspect Calcaneus exposed 4) Wedge of bone w/ base 8-12mm thick cut in lateral wall just posteroinferior to & following path of PL tendon & narrowing to Apex at medial wall which must be penetrated 5) Forefoot Dorsiflexed to accomplish approximation of anterior & posterior borders of cut 6) Ensure Calcaneus is, at least, in Neutral or very slight Valgus position 6) Fixation w/ Staples or Herbert Whippel Screws
6. Failure to properly manipulate calcaneus out of Varus will, without variability, lead to reoccurrence of the Cavus deformity
7. Forefoot Varus, so long as a flexible compensation for the Rearfoot Varus, will correct on its own after Rearfoot Varus is corrected
8. If Anterior Pes Cavus is rigid, a dorsal wedge of bone may be removed at Lis Franc's joint to dorsiflex the Forfoot on the Rearfoot
9. Muscle imbalances, other than failing to manipulate calcaneus out of Varus, are the most common cause of reoccurrence of Cavus after performing Dwyer and, if present, tendon balancing techniques must be performed
10. In the rare case that Rearfoot Equinus is present, must correct the contracted Tendo-Achilles prior to performing any other osteotomies

The Virulence of Staphylococcus Pyogenes for Man. A Study of the Problems of Wound Infection
Authors: S. D. Elek and P. E. Conen
Date of Publication: The British Journal of Experimental Pathology, April 1957

Major Points of Interest:

1. 26 volunteers were injected intradermally or subcutaneously into superficial scratches or full-thickness incisions, with varying strains and dosages of Staphylococcus Pyogenes
    a. Aim was to determine the minimum pus-forming dose in humans
    b. Also looking to determine if there were differences in virulence of strains, size of infective dose, or in local factors present
2. Minimum pus-forming dose of S. Pyogenes on intradermal injection was 10^6 cocci per 0.1 mL
    a. Minimum dose wasn't any less for subcutaneous injection (infection of full thickness wounds)
3. Minimum pus forming dose was comparable between strains taken from lesions, those taken from healthy nasal carriers, and those taken from epidemic strains
4. Minimum dose was not reduced by presence of local factors such as excess staphylococcal toxin, mucin, human plasma, or starch
5. Minimum pus forming dose was greatly reduced by presence of foreign body reaction, in the form of sutures
6. Authors suggest that factors that delay the normal defense mechanism, such as foreign bodies, reduce the minimum dose needed to form pus, leading to a clinical infection

The Mechanism, Reduction Technique, and Results in Fractures of the Os Calcis
Author: Peter Essex-Lopresti
Publication: The British Journal of Surgery, March 1952
Evidence Level: 4 (Case Series)

Major Points of Interest:

1. Superolateral aspect of the Calcaneus contains a "cortical strut" of bone that runs from the anterior aspect of the bone to the posterior margin of the posterior facet and is angled, this angle of which forms the Critical Angle of Gissane, to accommodate the lower tip of the lateral process of the Talus
2. Sustentaculum Tali lies along the medial aspect of the calcaneus and supports the Neck & Proximal Head of the Talus via the middle facet
3. The initial fracture pattern of Subtalar Joint fractures of the Calcaneus occur in an unvariable pattern where the body weight is first transferred down the lateral aspect of the Tibia, through the Talus, and leads to the lateral tip of the lateral process "axing" through the Critical Angle of Gissane and lateral wall of the Calcaneus. Next, the body weight continues down the medial aspect of the Tibia, through the Talus and seperates the Sustentaculum Tali & Medial 1/2 to 1/3 of the Posterior Process from the body of the Calcaneus. From this point, either a Tongue or Depression style fracture will occur
4. In the Tongue Fracture the secondary fracture line runs posteriorly, in a horizontal fashion, from the Critical Angle of Gissane to the posterior tubercle of the Calcaneus in such a fashion that, as the Talus continues to be driven down into the Calcaneus, a large fragment of bone, the "tongue", with the most anterior aspect containing the lateral 2/3 to 1/2 of the posterior facet, is depressed into the body of the calcaneus. As force continues through the talus, the anterior portion of the tongue pivots, like a see-saw, down into the body further which forces the Calcaneal Tuberosity posterosuperiorly causing severe comminution.
5. In the Joint Depression Fracture the secondary fracture line runs lateral to medial, from the Critical Angle of Gissane, just posterior to the posterior facet. The lateral 2/3 to 1/2 of the posterior facet remains intact. As the force continues downward through the Talus, this fragment is forced downward into the body of the Calcaneus where if hinges on the secondary fracture line in a posteroinferior direction. If force continues to be applied through the Talus, the Tuberosity moves posterosuperiorly, as in the "tongue" type fracture, and sever comminution occurs
6. In all non-displace fractures and displaced fractures in those over 50, physical therapy to prevent contraction and limitations in ROM is the most successful treatment option
7. All displaced fractures in those under the age of 50 are most successfully treated by reduction
8. Failure to obtain complete reduction of displaced fracture fragments is considered to be an unsuccessful operation because, in this case, results will be far more unsuccessful than if physical therapy was initiated as primary treatment method
9. Up to 12% of displaced Calcaneal fractures are associated with Lumbar Spine fractures of which should always be assessed in the case of traumatic Calcaneal injuries

Calcaneo-Valgus Deformity

Authors: Dillwyn Evans, Cardiff, Wales

Date of Publication: The Journal of Bone and Joint Surgery, August 1975

Major Points of Interest:

1. Equino-varus and calcaneo-valgus are opposite deformities. The difference between the two in terms of tarsal structure lies in the relative difference in length of the two columns of the foot
    a. Long lateral column is associated with varus deformity
    b. Short lateral column is associated with valgus deformity
2. Lateral column is foundation of skeletal structure of the foot.
    a. Its length relative to medial column is big influence on shape of the foot
3. Can correct calcaneo-valgus deformities by lengthening lateral column through insertion of bone graft from ipsilateral tibia.
    a. Should be done in anterior calcaneus proximal to calcaneo-cuboid joint so as to preserve the joint
4. After graft is added, forefoot becomes adducted and heel moves into varus. Extension of ankle becomes decreased. Foot is placed in position of slight equino-varus and casted for 4 months to allow for healing of calcaneus. Weightbearing allowed at 4 weeks. No additional treatment needed after cast is removed
5. Lengthening of lateral column found to be an alternative to triple arthrodesis procedure in persons with valgus deformity in these cases: over-correction of talipes equino-varus, calcaneo-valgus following poliomyelitis, rigid flat foot, and gross idiopathic calcaneo-valgus
    a. All show medial directed talar head and laterally displaced navicular in relation to head of talus
6. Procedure has been successfully performed on 55 feet. Resulted in decreased extension of ankle and eliminates excessive eversion
    a. Calcaneo-valgus from poliomyelitis – best age to correct 8-12. Not possible to over-correct this deformity, instead adequate correction can be difficult
    b. Rigid flat foot – over-correction not possible. Shape of foot slightly improved but offers relief of pain
    c. Severe idiopathic valgus – must only lengthen as far as needed to create normal shape as over-correction is possible and can lead to an equino-varus deformity.
7. Lengthening of lateral column is contraindicated in neurological conditions including spasticity in children and spina bifida
    a. Spastic conditions – overcorrection is too common
    b. Spina bifida – calcaneus is too soft to hold graft and allow correction

Complications in Foot and Ankle Arthroscopy
Author: Richard D. Ferkel, Henry N. Small, & Jeffrey E. Gittins
Publication: Clinical Orthopaedics & Related Research, October 2001

Major Points of Interest:

1. Overall complication rate is ~ 9% of which 49% is neurologic in nature and is typically with resolution within 6 months of the procedure
2. 3 main categories of complications include Systemic, Preoperative, & Procedure
    a. Systemic = anesthesia rxn, inadequate stress response, & cardiopulmonary complications
    b. Preoperative = incorrect diagnosis or use of diagnostic modalities & poor surgical plannig
    c. Procedural = structural damage, fluid complications, infection, pain, & instrument failure
3. Structural Damage
    a. Neurovascular injuries most often occur due to poor portal or pin placement, rapid distraction with forces > 50 lbs that is maintained for greater than 1-1.5 hrs, or application of a tourniquet in an inappropriate location, without adequate padding, &/or for greater than 60 minutes at excessive pressures
    b. Tendon injury is most often caused by poor portal placement or repeated passing of instruments through portals or attempts to establish a portal
    c. Ligament injury is often caused by performing distraction rapidly with forces > 50 lbs, for greater than 1-1.5 hrs, & with too large of pins with failure forces greater than that of the ligament, as well, improper portal placement, excessive debridement, and repeated passing of instruments through portals or attempts to establish a portal
    d. Wound complications include Skin Sloughing & Necrosis (most often due to inappropriate skin handling, portals placed in close proximity, repeated passage of instruments, and postoperative swelling), Seromas & Hematomas (extremely rare), & Sinus Tracts (most often form due to slow healing or infected portals)
    e. Articular Cartilage damage is most often due to inappropriate portal placement, failure to adequately distract the joint space, infection, instrument or osseous debri, excessive debridement, & joint effusions
    f. Stress Fracture most often occurs due to invasive distraction techniques with pin placement spanning both cortices
4. Fluid Related Complications
    a. Excessive Extravasation of fluid into surrounding soft-tissue compartments, while rare, can lead to a compartment syndrome and is most common when an arthroscopic fluid pump is utilized
    b. Joint Effusion, although rare, can lead to excessive intraarticular pressures that can cause cartilage degeneration and structural damage as well as serve as a nitus for infection
    c. Hemarthrosis is most often the result of procedures, such as synovectomies and chondroplasties, failure to adequately maintain hemostasis, or failure to discontinue NSAID's prior to treatment, and should always be aspirated to prevent infection and increased intraarticular pressure
5. Infection is most often attributed to failure to utilize prophylactic antibiotics, use of absorbable subcutaneous sutures, and failure to adequately perform an iodine scrub of the region prior to performing the procedure
6. Instrument failure typically occurs as a result of failure of adequate inspection for loose parts or fatigue damage prior to use, use of multi-section instruments, and failure to handle instruments gently
7. Pain typically manifests secondary to neuroma formation within superficial cutaneous nerves &/or residual joint debris and, if not addressed, can manifest Reflex Sympathetic Dystrophy

Total Contact Casting for Neuropathic Ulcers: A Lost Art?
Authors: Robert M. Greenhagen, DPM, Dane K. Wukich, MD
Date of Publication: The Journal of Diabetic Foot Complications, December 2009
Level of Evidence: V

Major Points of Interest:

1. Treatment for diabetic foot ulcers can be based on the pneumonic, "VIPs" (Vascular—adequate limb perfusion, Infection—controlling infection, and Pressure—mitigating plantar pressures through proper offloading), and the gold standard for offloading therapy is total contact casting (TCC).
2. The authors present a basic 8 step technique for applying a TCC:
    a. Step 1: Appropriately dress the wound—minimal dressing to prevent bunching or cast shifting (ex: secure dressing w/single layer of cast padding)
    b. Step 2: Interdigital moisture control and padding—apply gauze, cotton, lamb's wool, or silver alginate in the interdigital web spaces
    c. Step 3: Cast stocking—use a seamless stocking to cover the lower extremity from toes to tibial tuberosity
    d. Step 4: Padding—apply self-adhering felt padding to the following bone prominences: medial and lateral malleoli, anterior shin, 1st and 5th metatarsal heads, and medial aspect of navicular as well as any deformities or to offload the ulceration
    e. Step 5: Web roll—apply minimal padding (1 layer thick) with web roll to prevent excessive motion that would occur when excessive padding compresses
    f. Step 6: Offload and protect the forefoot—apply adhesive foam pad to the toes in "sandwich" like manner to prevent ulceration in digits
    g. Step 7: Casting—apply fiberglass cast (3-5 rolls) from toes to just below tibial tuberosity (protects common peroneal n.). The toes are completely covered, and the plantar foot is reinforced with the fiberglass cast, especially on the heel
    h. Step 8: Cast boot—applied once the cast has dried with immediate FWB
3. Healing rates of plantar ulceration have been reported to range from 73%-100%, and other studies have also reported reductions in peak plantar pressure at the ulcer site.
4. 2 proposed mechanisms for how the TCC offloads the foot:
    a. Theory of load distribution (Paul Brand): the decrease in pressure is due to an increase in the weight bearing surface (ex: some of the forefoot load is transferred to the rearfoot); however, most studies found that the forefoot continues to bear the majority of plantar foot pressure despite a decrease in the overall plantar load.
    b. Theory of load sharing (Shaw et al., 1997): the decrease in plantar pressure is due to the proximal portion (tibia) of the TCC bearing much of the load. Two studies showed that the proximal cast wall/shank bore about 30% of the weightbearing load, supporting the idea that the transfer of force to the tibia is more important for offloading than load distribution.
5. TCCs are also effective for controlling edema, decreasing risk of infection, increasing compliance (vs. removable cast walkers), decreasing the amount of ambulation and activity which reduces the number of cycles of repetitive stress on the ulceration, and offloading both forefoot and non-forefoot plantar uclerations.
6. Major concern with TCCs is the risk of iatrogenic complications, especially pressure ulcers, which can be decreased by frequent cast changing, and the highest risk for complication is Charcot neuroarthropathy.
7. When comparing graft skin, negative pressure wound therapy, Regranex, Dermagraft, TCC, and TCC with TAL treatments, the TCC with TAL showed the highest healing rate and the TCC alone showed the second highest healing rate. Mueller et al. found that TAL decreases the risk of ulcer recurrence by 75% at seven months and 52% at 2 years.

Arthrodesis of the Ankle and Subtalar Joints

Authors: Gary S. Gruen M.D., Dana C. Mears M.D

Date of Publication: Clinical Orthopeadics and Related Research, July 1991

Major Points of Interest:

1. Purpose: To characterize the original injury, illustrate the posterior surgical approach for reconstruction, and to assess the functional outcome of treatment in 5 patients who underwent late reconstruction of a complex non-union (of the distal tibial metaphysis, ankle, or subtalar joint) using a blade plate administered through a posterior approach.
2. Historically, late reconstruction of a non-union to distal tibia or ankle is complicated by presence of an osseous defect, substantial loss of adjacent soft tissues, post-traumatic infection or the presence of multiple surgical scars.
3. Methods: 5 patients with the aforementioned complex non-unions were referred for treatment and assessed using a modified version of the Boston Children's Hospital ankle-scoring system both pre-operatively and post-operatively.
    1. Posterior Surgical Approach:
        a. Patient positioned in a prone position on the operating table
        b. Limb exsanguinated using tourniquet
        c. Midline, posterior longitudinal incision measuring 15-20cm in length
        d. Achilles tendon is osteotomized at its insertion into the calcaneus and is reflected
        e. Posterior capsule of STJ and tibiotalar joints is incised
        f. Adjacent periosteum is reflected from distal tibia
        g. Articular cartilage is removed from both joints
        h. Non-union site is curetted until viable bone is visualized
        i. Autologous cancellous bone graft is harvested from proximal tibial metaphysis or iliac crest and is packed into the defect of the non-union
        j. Foot is aligned in neutral position and a 5-hole, 95̊ 50-mm blade plate is seated in the posterior calcaneal surface
        k. Bone block with attached Achilles tendon is then reattached to calcaneus using a 6.5mm cancellous screw and ligamentous washer
    2. Results:
        a. Average pre-operative assessment score was 13 points (ranged 8-16)
        b. Post-arthrodesis, mean assessment score was 44 points (ranged 40-48).
    3. Post-operatively, 2/5 patients were able to ambulate without assistance of external support, while remaining 3 required intermittent use of cane or crutch, compared to pre-operatively, where all 5 patients were dependent on using a crutch or brace for support.
    4. There was solid osseous union in all ankles with a follow-up period of greater than 24 months (average time to radiographic union was 4 months).
    5. A distinct advantage of the posterior approach is that the posterior cutaneous surface of the distal tibia and hindfoot is intact and suitable for a surgical approach. Likewise, the posterior approach allows for access to the posterior tibial vessels since many times the anterior tibial vessels are compromised at the time of acute injury.
    6. A complication of patients with this type of injury is the degree of talar collapse as well as damage to the subtalar joint.

Injuries to the Tarsometatarsal Joint: Incidence, Classification and Treatment
Author: Hardcastle, PH
Publication: Journal of bone & Joint Surgery, 1982

Major Points of Interest:

1. Classification:
    a. Type A: Total incongruity. Displacement is in one plane which may be sagittal, coronal or combined.
    b. Type B: Partial Incongruity. Displaced segment is in one plane similar to type A.
        i. Medial dislocation: Affects the 1st metatarsal either in isolation or combined with displacement of 1 or more of the 2nd, 3rd, or 4th metatarsals.
        ii. Lateral dislocation: Affects one or more of the lateral 4 metatarsal but the 1st metatarsal is not affected.
    c. Type C: Divergent. There may be partial or total incongruity. On AP radiograph, 1st metatarsal displaced medially, while any combination of the lateral 4 metatarsals may be displaced laterally. Sagittal displacement occurs in conjunction with the coronal displacement.
2. Treatment and prognosis depend not so much on the direction of the causal force as upon whether there is incongruity (partial or total) of the tarsometatarsal joint.
3. Whenever there is displacement, closed reduction should be attempted. If adequate reduction is achieved, it should be stabilized with percutaneous wires.
4. If closed reduction is inadequate due to soft tissue interposition, marked comminution, or a large articular fragment, open reduction should be performed ASAP and certainly within 6 weeks of injury.
5. The absolute indication for open reduction is vascular insufficiency that does not improve after closed reduction. Exploration of both the DP and PT arteries are suggested.
6. Redisplacement sometimes occurred when only a single Kirschner wire was used, and we therefore recommend using 2 wires.
7. Weight bearing as soon as the swelling subsided (approximately 2 weeks) did not seem to affect the final outcome, provided the foot was protected in a plaster cast and reduction stabilized by internal fixation.

Effects of Isolated Weber B Fibular Fractures on the Tibiotalar Contact Area
Authors: Harris, J. and Fallat, L.
Publication: JFAS, Jan/Feb 2004

Major Points of Interest:

1. Danis Weber Classification of Fibular Fractures (Ortho Clinics of North America 1980):
    a. Type A: transverse avulsion fracture of the fibula beginning below the syndesmosis (SAD-I)
    b. Type B: spiral, oblique fracture of the fibula beginning at the level of the syndesmosis (SER-II, PAB-III)
    c. Type C: fracture of the fibula beginning above the level of the syndesmosis (PER-III)
2. Controversy over the surgical repair of SER-II ankle fractures
    a. PRO-repair: need to anatomically reduce the fibula, and need to prevent lateral displacement of the talus, which can alter tibiotalar joint mechanics.
    b. ANTI-repair: if the medial structures are intact, displacement is insignificant in its effect on causing arthritis of the ankle joint.
3. The purpose of this study was to measure changes in contact area between the tibial plafond and the talar dome with lateral and superolateral displacement of the distal fibula and an intact medial collateral ligament, simulating a SER-II and Weber B fracture.
    a. By measuring contact area, we can measure the effects on ankle joint dynamics. As contact area decreases, force per unit area increases.
4. Tibiotalar contact area decreases with lateral and posterosuperior displacement. For the same distance of displacement, tibiotalar contact area decreases at a greater rate with lateral versus posterosuperior displacement.
5. Physiologic axial loading of the ankle joint with a fibular fracture will also decrease tibiotalar contact area.
6. Decrease in the tibiotalar contact area equals increase in the force per unit area. Thus, greater stresses are generated on the articular cartilage and bony tibia/talus, which could lead to osteoarthritis.
7. Results support the notion that ORIF should be used in fibular fractures with lateral or posterosuperior displacement of 2mm or greater.
    a. This surgical intervention will anatomically align the fibula and provide stability along the lateral column to prevent displacement and resulting changes in tibiotalar contact area.

Fractures of the Neck of the Talus
Author: Hawkins, LG
Date of Publication: JBJS, July/1970

Major Points of Interest:

1. The most common mechanism of injury was forced dorsiflexion often resulting from some type of trauma such as, motor vehicle accidents, falls from a height, or small-plane crashes.
2. Hawkins classification for vertical fractures of the neck of the talus, is based on x-ray appearance at time of injury.

Group	Fracture Description	Blood Supply Disrupted	AVN Risk
I	undisplaced	only 1	
II	displaced, STJ subluxed or dislocated	2-3	42%
III	displaced and body of talus dislocated from ankle and STJ	all 3	91%

3. Overall incidence of AVN was 58%.
4. Between the 6th and 8th week following the fracture dislocation is the time to recognize the presence of avascular necrosis. An AP x-ray of the ankle reveals the presence or absence of subchondral atrophy in the dome of the talus. Subchondral atrophy excludes the diagnosis of avascular necrosis.
5. If reduction is obtained in a Group II fracture, and AVN does not follow, a good to excellent result is the expected outcome. In this group, primary bone grafting and fusion are contraindicated.
6. In this series, no treatment for AVN was superior to all others. It was clear that the fracture should be allowed to heal in an anatomical position in a NWB plaster dressing.
7. There may a delay in x-ray evidence of union and NWB should be maintained until the fracture line is completely obliterated. Once union is present, start progressive weight bearing.
8. In this series, no operative procedure that was performed assured rapid replacement of dead bone or assured protection from late collapse and degenerative changes in the ankle and subtalar joints.
9. Collapse of talar dome was well tolerated in most patients and occurred in spite of enforced NWB for several years in some patients.
10. If there was no AVN, mostly good and excellent results followed. In patients without AVN, mild losses in range of motion were reported, all of these patients returned to work, and no late fusions were required.
11. If there was AVN, a high percentage of fair and poor results followed. There was routinely a marked decrease in range of motion, which was not usually a concern to most patients. Calf atrophy was noted in each patient. All but one patient was able to return to their former occupation, though many had aching pain with fatigue.
12. Of those with AVN that had fusions, the fusion rate was only 50% since it is difficult to fuse a joint when one of the articulating bones is necrotic.

Open Reduction Internal Fixation Versus Primary Arthrodesis for LisFranc Injuries: A Prospective Randomized Study
Author: Henning, JA
Publication: Foot & Ankle International, October 2009

Major Points of Interest:

1. Primary arthrodesis (PA) resulted in a statistically significant decrease in the number of followup surgeries performed compared to primary open reduction internal fixation (PORIF) if hardware removal is routinely performed.
2. Patients treated with PA for primarily ligamentous tarsometatarsal joint injuries function as well as those patients treated with PORIF.
3. Similar clinical results, as measured by functional outcomes, clinical assessment, and patient satisfaction, were obtained with PORIF or PA for Lisfranc joint injuries.
4. In patients who fail to resolve symptoms following initial treatment and rehabilitation, arthrodesis is recommended.
5. Only the medial 3 tarsometatarsal joints, or nonessential joints (relatively immobile), should be fused.
6. The lateral 2 tarsometatarsal joints, or essential joints (more mobile), should be only temporarily stabilized.

Tricortical Versus Quadricortical Syndesmosis Fixation in Ankle Fractures: A Prospective, Randomized Study Comparing Two Methods of Syndesmosis Fixation

Authors: Hoiness, P, and Stromsoe, K

Date of Publication: Journal of Orthopedic Trauma, July 2004

Major Points of Interest:

1. This study compared functional results of fixation of a ruptured syndesmosis using: more rigid traditional quadricortical syndesmotic screw fixation with a single 4.5mm cortical screw through both tibial cortices(screw removed after 8 to 12 weeks), vs. newer more dynamic tricortical approach with two 3.5mm cortical screws each engaging only one cortex of the tibia(screws left in place).
2. With traditional approach, quadricortical screws have to be removed after 8-12 weeks. This means that patient has to have an additional surgery and must be partial weight bearing for an additional 2 to 6 weeks.
3. Tricortical approach is beneficial since early motion of injured joints is generally recommended. Screws can be left in place and are only removed if they are causing complications.
4. The tricortical group, at 3 months post-op, had a functional score was significantly higher and pain was significantly lower than the traditional quadracortical group. At 1 year there were no significant differences in pain or function between groups.
5. This study supports the hypothesis that fixation of ruptured syndesmois with newer dynamic approach, using 2 tricortical screws is safe and improves early function.

Radiologic History Exhibit, Musculoskeletal Eponyms: Who Are Those Guys?
Author: Hunter
Publication: Radiographics, 2000

Major Points of Interest:

1. Eponyms, when precisely used and accurately defined, convey a large amount of specific information in a very abbreviated way.
2. Without a thorough understanding of the meaning of eponyms, their use can be confusing and even dangerous. Avoid using an eponym unless you are certain of its precise definition.
3. Authors designated fracture eponyms that are no longer in use or that are poorly understood as archaic, and they recommend that they not be used.
4. This is a large article that gives descriptions of eponyms all over the body. It lists them in alphabetical order. The Eponyms listed below, I felt would be important for us to understand thoroughly in the field of Podiatry.
    a. **Bosworth Fracture**- archaic term for a fracture of fibula and a posterior dislocation of the talus.
    b. **Chopart Fracture**- Involves mid tarsal joints (talonavicular and calcaneocuboid). Francis Chopart performed amputations at this area.
    c. **Cotton Fracture**- archaic term for a trimalleolar fracture
    d. **Danis-Weber Classification(Weber classification)**- see "Weber Classification" below.
    e. **Dupuytren Fracture**- archaic term used to describe many types of bimalleolar ankle fractures. Commonly used to refer to a fracture of the distal fibula(above the lateral malleolus) with an associated tear of the deltoid and tibfib ligaments. Talus will be displaced laterally and medial malleolus may be fractured as well. Dupuytren was a French Surgeon whose name was associated with 12 different conditions or operations. Known as "the greatest of surgeons and the meanest of men."
    f. **Essex- Lopresti Fracture(calcaneal fracture classification)**- Type of arm injury described in this paper. More known in podiatry for his Calcaneal fracture classification, which was not described in this paper. World War II surgeon, was an expert in parachuting injuries.
    g. **Freiberg infarction**- deformity of the head of the 2^{nd} or 3^{rd} metatarsal from avascular necrosis, adolescent girls.
    h. **Gosselin Fracture**- V-shaped fracture of distal tibia, extends into tibial plafond and divides it into anterior and posterior fragments.
    i. **Jones Fracture(Robert Jones Fracture)**- base of 5^{th} metatarsal, distal to the tuberosity. Happened to Robert Jones in 1902 while dancing. Sir Robert Jones, British orthopedic surgeon.
    j. **Lauge- Hansen Classification**- Ankle fracture classification which uses mechanism of injury to classify the fractures. Niel Lauge-Hansen, a Danish physician.
    k. **Le Fort Fracture of the Ankle**- vertical fracture of the anterior medial portion of the distal fibula and an associated avulsion of the anterior tibiofibular ligament.
    l. **Lisfranc Fracture**- fracture-dislocation or fracture-subluxation of the tarsometatarsal joints, typically 2^{nd} -5^{th} joints with lateral displacement of the metatarsals. Jacques Lisfranc De Saint Martin, surgeon in Napoleon's army, performed amputations at this area.
    m. **Maisonneuve Fracture**- Spiral fracture of the upper 3^{rd} of the fibula associated with a tear of the distal tibfib syndesmosis and the interosseous membrane. Also associated with rupture of the deep deltoid ligament or fracture of the medial malleolus.
    n. **Osgood- Schlatter Disease**- chronic fatigue injury, effects the growth and development of the tibial apophysis at the site of the attachment of the patellar tendon to the tibial tuberosity.
    o. **Pott Fracture**- archaic term loosely applied to a variety of bimalleolar ankle fractures. Originally described a partial dislocation of the ankle with a fracture of the distal fibular shaft and rupture of the medial ligaments of the ankle.

p. **Salter-Harris Classifiation(Harris fracture)**- Most commonly used system for categorizing growth plate injuries.(diagram page 832)
    i. I-fracture through growth plate with possible dislocation of the epiphysis
    ii. II- most common type, fracture through the growth plate and through a portion of the metaphysis
    iii. III- through growth plate and the epiphysis
    iv. IV- through epiphysis, growth plate, and the metaphysis
    v. V-crush injury to the growth plate
q. **Shepherd Fracture**- involves lateral tubercle of the posterior process of the talus, may simulate os trigonum.
r. **Tillaux Fracture**- Avulsion of the anterior tibial tubercle at the attachment of the distal anterior tibiofibular ligament.
s. **Weber Classification(Danis-Weber Classification)** Ankle fracture classification, first introduced by Danis, later modified by Weber. Widely used because it is easily learned and gives good prediction of how well the fracture will heal. Classification based on the location of the fibular fracture. The higher fractures have greater likelihood for ankle mortise insufficiency.
    i. A- Lateral malleolar fractures below the level of the ankle joint space. Syndesmosis and deltoid intact, there may also be an associated oblique fracture of the medial malleolus.
    ii. B-Oblique Lateral malleolar fractures that start at the level of the joint space and extend proximally. May be associated deltoid ligament tear or transverse medial malleolar fracture.
    iii. C- fracture of the distal shaft of the fibula proximal to the ankle joint. May be associated deltoid ligament tear or transverse medial malleolar fracture.
    iv. Both B and C may have an associated posterior malleolar fractures as well.

Abnormalities of Vasomotor Regulation in the Pathogenesis of the Acute Charcot Foot of Diabetes Mellitus

Author: William J. Jeffcoate
Publication: Lower Extremity Wounds, 2005
Evidence Level: 5 (Literature Review / Hypothesis)

Major Points of Interest:

1. A very small portion of Diabetics with Peripheral Neuropathy succumb to Charcot even though the former is rather common
2. While Neuropathy is highly associated with a loss of Autonomic NS control over vascular resistance and vascular calcifications, it appears as though those effected by Charcot have severe Neuropathy, however, they have, through unknown mechanisms, retained ability to vasodilate in response to inflammatory cytokines even in the presence of substantial vascular calcification
3. While Osteopenia is often found in the individual presenting with Charcot, it, in and of itself, is not likely a predisposing factor to the development of Charcot as there appears to be a different presentation of Osteopenia between Type I and Type II Diabetes but no difference in the Charcot presentation between the two
4. It appears as though the RANK-L/OPG signaling pathway is a common denominator that links Diabetes, Peripheral Neuropathy, Vascular Calcification, Osteolysis, Inflammation and Charcot
5. Peripheral Neuropathy is caused by damaging end-products of poor glycemic control in the presence of Diabetes and these same end-products are shown to increase the expression of RANK-L. RANK-L is shown to be associated with vascular calcification, the activation of Osteoclasts, and the acute inflammatory cascade, as well, it is elevated in the case of Diabetes & Charcot
6. It is thought that the neuropathic patient is unable to detect microtrauma to the bones and joints of the foot which prevents them in engaging in protective behaviors. This failure leads to repetitive microtrauma, stimulation of the acute inflammatory cascade, continuously elevated RANK-L, over-activation of Osteoclast activity, continous bone resorption, and eventual architectural collapse of the pedal architecture
7. If RANK-L/OPG is the underlying pathway in the development of Charcot, it leaves open the possibility for drug therapy that directly targets the pathway of which may be able to arrest the acute inflammatory phase more rapidly and prevent destruction of the pedal architecture

Charcot Neuro-Osteoarthropathy
Author: William J. Jeffcoate
Publication: Diabetes/Metabolism Research and Reviews, April 2008
Evidence Level: 5 (Literature Review)

Major Points of Interest:

1. While now known to be the number one cause of Charcot, Diabetes was not implicated in the development of the pathology until 1936
2. Typical clinical presentation includes:
   a. **DIABETIC**with **PERIPHERAL NEUROPATHY** & in mid-50's
   b. Unilateral, Red, Hot, Swollen foot or ankle excessive for level of trauma manifesting signs
   c. Lack of Peripheral Vascular Disease or other forms of vascular occlusion
   d. Easily palpable pedal pulses due to widened Pulse Pressure
   e. Calcification of pedal vasculature & Osteopenia are very often seen on X-Ray
   f. X-Ray may or may not reveal fragmentation & architectural changes
   g. Focal pain in a location(s) that is generally insensate
3. Osteopenia on X-Ray IS NOT a result of Diabetes and, therefore, is NOT a predisposing risk factor for developing Charcot but, rather, a pathological manifestation secondary to developing Charcot
4. 2 general etiological theories have long been accepted in the manifestation of Charcot
   a. Neurotraumatic: states that peripheral neuropathy leaves the bones and joints insensate and with lack of ability to transfer pain signals to the CNS which prevents the individual from engaging in protective mechanics or seeking medical attention leading to repetitive microtrauma and eventual breakdown
   b. Neurovascular: states that there is damage to the Autonomic NS which leaves the individual with inability to regulate vascular resistance and, as a result, A-V shunting occurs as there is increased blood flow through the bones and joints which leads to a "washing out" effect until the structural integrity is compromised to the point of collapse
5. Neither of the etiological theories, on their own, adequately addresses all pathological changes and the role inflammation plays in Charcot, nor are they able to explain 3 very significant differences between Diabetic Peripheral Neuropathy and Charcot Arthropathy:

	CHARCOT	vs	DIABETIC NEUROPATHY
a)	Unilateral		Bilateral & Symmetric
b)	Self-Limiting		Chronic/Irreversible
c)	Rare		Common

6. A new theory, which is all encompassing, accounts for the 3 differences above, and accounts for the role of inflammation, appears to be gaining scientific integrity based upon new research: "Inflammatory Cytokine Theory"

The role of proinflammatory cytokines in the cause of neuropathic osteoarthropathy in diabetes
Author: William J. Jeffcoate, Fran Game, & Peter R. Cavanagh
Publication: The Lancet, December 2005
Evidence Level: 5 (Expert Opinion/Hypothesis)

Major Points of Interest:

1. The rarity, unilateral, & self-limiting nature of Charcot, as well as its potential link to Reflex Sympathetic Dystrophy, have sparked recent debate about the potential for a more complex pathophysiological mechanism underlying the disease in Diabetic Peripheral Neuropathy than has long been accepted
2. The authors hypothesize that the Acute Charcot Event occurs as the result of an over exaggerated inflammatory response after a minor injury, of which, is often unnoticed by the patient
3. Bone injury causes release of TNF-a and IL-1B which increases transcription of RANK-L which leads to activation of NF-kB which then causes induction of Osteoprogenitor Cell differentiation into mature Osteoclasts ultimately leading to bone breakdown
4. Authors suspect the RANK-L/NF-kB pathway due its role in manifesting Monckeberg's Sclerosis of pedal vessels of which is present, at high frequency, in Diabetic Peripheral Neuropathy & Charcot
5. Due to the insensate state of Peripheral Neuropathy, the patient does not have adequate pain response and fails to offload the injured region which leads to further injury and continuation of the aforementioned sequence of events of the inflammatory response
6. Local inflammation, which leads to Redness, Warmth, & Edema of the involved region, will, without variance, be present during the Acute Phase of Charcot and will be the main sign that raises suspicion on the part of the clinician
7. While making one more susceptible to microfracture, preexisting Osteopenia does not appear to be a "triggering event" for the development of Charcot due to the fact that it is much more prevalent in Type 1 than Type 2 DM, however, the presentation of Charcot is identical in Type 1 & Type 2 DM
8. It is not clear how or if the metabolic changes that accompanies Peripheral Neuropathy and Diabetes play a role in the initiation of the Charcot event, however, it is known that all Charcot events, no matter who the individual or what the underlying condition, have 2 things in common:
    a. Acute Inflammatory Cascade
    b. Denervation
9. Comparison of Diabetics with Peripheral Neuropathy has shown that, while all individuals have increased basal peripheral arterial blood flow, those who manifest Charcot retain some ability to manipulate vascular resistance in response to inflammatory cytokines such that blood flow can be increased further, whereas, those who don't manifest Charcot do not have such ability
10. If the hypothesis is correct, then measurements of the aforementioned inflammatory cytokines, as collected from circulation & bone specimens, could be utilized as laboratory markers of Charcot and the efficacy of therapy with agents that directly inhibit such inflammatory factors could be tested with serial measurements in hopes of developing an early detection and treatment regimen

Vascular calcification and osteolysis in diabetic neuropathy-is RANK-L the missing link?
Author: William J. Jeffcoate
Publication: Diabetologia, August 2004
Evidence Level: 5 (Expert Opinion/Hypothesis)

Major Points of Interest:

1. Diabetic Neuropathy is associated with vascular calcification & osteolysis and no more apparent than in the case of the Diabetic with Peripheral Neuropathy in whom Charcot develops
2. Vascular calcification leads to diminished ability to perform sympathetic mediated vascular constriction which leads to increased basal arterial blood flow through bones, and this increased blood flow has been statistically correlated to the presence of Osteopenia in Type 1 Diabetics in whom Neuropathy is present
3. RANK-L is a trans-membrane protein of the TNF super-family which interacts with the RANK receptor on pro-osteoclasts to induce their maturity to active osteoclasts and which is shown to be elevated in a variety of conditions in which osteolysis occurs; it is also shown to cause vascular calcification
4. OPG (osteoprotegerin) is a glycoprotein that acts as a "dummy receptor" for RANK-L so that, upon binding OPG, the effective concentration of RANK-L is reduced such that OPG provides a protective mechanism against the osteolytic & calcification effects of RANK-L
5. Increase in RANK-L will promote a delayed increase in OPG such that an increase in either is adequate to assume a state of increased RANK-L in which osteolysis & vascular calcification can occur due to an increase, even if transiently, in the RANK-L/OPG balance
6. Increased OPG is observed in Coronary Artery Disease, Osteoporosis, Diabetes & Bone Fractures
7. For some time, it has been noted that Osteopenia, Vascular Calcification, & Neuropathy have been common complications in Diabetes, a disease known to have elevated levels of circulating OPG, and Osteolysis and Neuropathy are constitutional and there is Vascular Calcification present in up to 90% of individuals in whom Charcot develops which calls into question the potential link of the RANK-L/OPG pathway as a common variable between Diabetic Neuropathy and Charcot
8. Because expression of RANK-L in bones is force/flow dependent and RANK-L can lead to Vascular Calcification, it is possible that it is this increased flow that leads to Charcot, however, the majority of Neuropathic Diabetics do not manifest Charcot and, when combined with the fact that Charcot is unilateral while Neuropathy & Calcification bilateral, increased flow, alone, is not the likely culprit
9. Because Bone Fracture increases RANK-L & flow to bones, it is more likely this "second hit" to the involved limb, Diabetic Neuropathy & Calcification being the first, is enough to manifest Charcot
10. The RANK-L/OPG ratio is likely further manipulated by 3 effects that occur as a result of Diabetic Peripheral Neuropathy and can lead to a state of Osteolysis & Calcificatio
    a. Calcitonin Depletion: direct inhibition & blocking RANK-L stimulation of osteoclast prevention
    b. CGRP Depletion: ability to increase osteoblast & decrease osteoclast activity is prevented
    c. IAPP Depletion: released from Pancreatic b-Cells & so ability to inhibit osteoclast activity is lost in Type 1 DM

Tibialis Posterior Tendon Dysfunction

Authors: Kenneth A. Johnson, M.D., and David E. Strom, M.D.

Publication: Clinical Orthopaedics and Related Research, February 1989

Major Points of Interest:

1. Tibialis posterior tendon (TPT) dysfunction progresses through a series of stages, each of which has characteristic pain symptoms, clinical signs, and radiographic changes
    a. Staging system allows for better diagnosing and treatment the condition
2. Stage 1: Tendon length normal
    a. Pain is mild to moderate along course of TPT from medial malleolus to navicular – exacerbated by physical activity
    b. Swelling inferior to medial malleolus
    c. Able to perform the single-heel-rise test but it is painful and weaker
    d. Alignment of hindfoot to forefoot is normal
    e. No radiographic changes at this stage
    f. MRI may demonstrate tendon degeneration
    g. Treatment
        i. Conservative – anti-inflammatory agents, rest, arch supports, medial shoe wedges or orthotics for 3-6 months
            1. Avoid injecting steroids as they can weaken the tendon
        ii. Surgical
            1. Synovectomy and tendon debridement.
                a. If tendon is enlarged 1.5 times normal size – wedge is removed and tendon is sutured closed
                b. Short leg walking cast is worn for 3 weeks
3. Stage 2: Tendon elongated, hindfoot mobile
    a. Evolved from stage 1 over months to years
    b. Pain is increased in severity and distribution along course of TPT – present even while NWB
    c. Swelling still present
    d. While viewing from behind, there is presence of the “too many toes” sign
    e. Patient in normal base and gait – count the number of toes that are visible laterally. Greater number seen on affected side
    f. Single-heel-rise test is more difficult due to progressive weakening of TPT
    g. Radiographic changes
        i. AP view – forefoot abducted in relation to hindfoot. Navicular subluxed off head of talus. Long axes of talus and calcaneus increased
        ii. Lateral view – sagging at talonavicular joint. Divergence of long axes of talus and calcaneus
        iii. MRI may show tendon discontinuity, as well as balling-up of the tendon proximally
    h. Treatment
        i. Surgical – FDL transfer
            1. 6 weeks cast immobilization
4. Stage 3: Tendon elongated, hindfoot deformed and rigid
    a. Pain may now be transfer laterally to sinus tarsi
    b. TPT is now completely disrupted allowing hindfoot to go into eversion, causing inferior surface of talus to impinge on superior surface of calcaneus at sinus tarsi
    c. Palpation over sinus tarsi can recreate pain
    d. When viewed from behind, significant eversion of hindfoot and abduction of forefoot
        i. “Too many toes” sign
    e. Unable to perform single-heel-rise test

f. Radiographs
    i. AP and lateral views – hindfoot valgus and forefoot abduction more severe than Stage 2
    ii. Secondary degenerative changes with joint narrowing and osteophyte formation may be seen in subtalar, talonavicular, and calcaneocuboid joints
    iii. If impingement of inferior talus on superior calcaneus is present, sclerosis will be seen on calcaneus known as “sinus tarsi impingement sign”
g. Treatment
    i. Surgical - realignment, followed by arthrodesis (STJ, TN with CC, or triple)
        1. Deformity is rigid so tendon transfer will not work
        2. 10 weeks cast immobilization

5. Possible Stage 4
    a. Hindfoot is fixed in eversion,
    b. Produces valgus tilt of talus in ankle mortise and lateral tibiotalar degeneration
    c. Treatment
        i. Arthrodesis from tibia to calcaneus

Ankle Fractures in Patients with Diabetes Mellitus
Authors: Jones, Maiers-Yelden, Marsh, Zimmerman, Estin, Saltzman
Publication: JBJS, April 2005

Major Points of Interest:

1. This study is a retrospective review of 42 patients with both diabetes mellitus and acute, closed, rotational ankle fractures. Patients were matched individually to non-diabetic controls. The aim was to determine whether or not poor prognosis healing acute ankle fractures could be linked to identifiable subpopulations among diabetic patients.
2. Following ankle fractures, more diabetic patients required long-term bracing; especially those with Charcot neuroarthropathy, neuropathy, insulin dependence, longstanding diabetes, or retinopathy.
3. Diabetic patients and their controls did not differ significantly in total complication rates
    a. Diabetic patients without comorbidities had complication rates equal to their controls.
    b. Diabetic patients with comorbidities had complication rates higher than their controls. Such comorbidities included nephropathy, retinopathy, vascular disease, history of major amputation, and history of Charcot neuroarthropathy.
4. Diabetic patients did not have a significant increased risk of infection.
    a. Diabetic patients with a history of Charcot neuroarthropathy did have a significant ncreased risk of infection.
5. Risk for malunion, nonunion, and Charcot neuroarthropathy are greater in those patients with a history of Charcot, longstanding diabetes, insulin use, nephropathy, or neuropathy presence.
6. Patients with a comorbid history of Charcot neuroarthropathy were associated with every complication measured.
7. Patient age, gender, type of fracture, and method of fracture treatment (operative vs. non-operative) did not correlate with any complications.
8. Surgical treatment did not increase the risk of infection, nor did non-surgical treatment increase the risk of malunion, nonunion, or Charcot neuroarthropathy.
9. Diabetes mellitus may worsen the prognosis for a patient with a closed rotational ankle fracture, but ONLY IF the patient has known related major comorbidities.

The Diagnosis of Osteomyelitis in Diabetes Using Erythrocyte Sedimentation Rate
Authors: Kaleta, D.P.M., Jennifer; Fleischli, D.P.M., Jeffrey
Date of Publication: Journal of American Podiatric Medical Association, October 2001

Major Points of Interest:

1. Osteomyelitis secondary to diabetic foot infections can lead to proximal amputation if not diagnosed in a timely and accurate manner.
2. Laboratory tests such as white blood cell count, erythrocyte sedimentation rate and C-reactive protein have been proposed to aid in the diagnosis of osteomyelitis, but their response in the presence of infection is questionable.
3. The erythrocyte sedimentation rate is a simple and inexpensive laboratory test used to assess inflammatory or acute-phase responses to disease after the first 24 hours.
4. The reference range in healthy adults under 50 years old is 0 to 15 mm/h for men and 0 to 20 mm/h for women and is slightly elevated in the elderly population. Factors influencing ESR are provided below.

Increase ESR	Decrease ESR	No Significant Effect
Old age Female Pregnancy Anemia Technical factors Elevated fibrinogen level	Corticosteroids Protein abnormalities Sickle cell disease Technical factors	Obesity Body temperature Aspirin NSAIDs

5. This study retrospectively reviewed charts of 29 diabetic patients admitted to the hospital with diagnoses of osteomyelitis or cellulitis of the foot during a 1-year period.
6. Erythrocyte sedimentation rate was the only measure that was significantly different between the osteomyelitis and cellulitis groups among all lab values and demographic factors considered in this study.
7. A receiver operating characteristic curve was used to obtain the optimal cutoff value of 70 mm/h.
8. Values exceeding 70 mm/h indicated that osteomyelitis was present with the highest sensitivity (89.5%) and highest specificity (100%), along with a positive predictive value of 100% and a negative predictive value of 83%.
9. This authors conclude that in the erythrocyte sedimentation rate is highly predictive of osteomyelitis when in combination with clinical suspicion in diabetic foot infections.
10. The value of 70 mm/h is the optimal cutoff to accurately predict the presence or absence of bone infection.

Early Complications Following the Operative Treatment of Pilon Fractures With and Without Diabetes
Authors: Kline, Alex J., MD et. al.
Publication: Foot & Ankle International/Vol. 20, No.11/November 2009
Level of Evidence: IV, Retrospective Case Series

Major Points of Interest:

1. They performed a retrospective review to determine the rates of complications in diabetic patients undergoing operative fixation of tibial pilon fractures compared with a control group of patients without diabetes. They specifically, they looked at the rate of infection (superficial and deep), the rate of nonunion or delayed union, and the rate of surgical wound complications.
2. Fractures involving the tibial plafond are notoriously difficult to treat, with high rates of infection, wound healing complications, and post-traumatic arthritis. Treatment requires a delicate balance between obtaining a stable, congruent articular reduction while respecting the delicate surround soft tissue envelope. Even with meticulous attention to the surrounding soft-tissues, high complication rates are still seen.
3. Diabetic patients have impaired fracture healing ability, impaired wound healing and increased rate of infection. These unique characteristics make the management of pilon fractures exceptionally difficult in the setting of diabetes.
4. A total of 14 fractures in 13 diabetic patients, and 69 fractures in 68 non-diabetic patients met inclusion criteria.
5. The infection rate was 71% for diabetic patients (43% deep infection), and 19% for non-diabetic patients (9% deep).
6. Overall, the rate of non-union/delayed union was 43% in the diabetic group versus 16% in the non-diabetic group.
7. The rate of surgical wound complications was 7% in both the non-diabetic and diabetic patient groups. The overall complication rate seen in their series for both groups was 41%, which was comparable to other series in the literature.
8. Conclusion: The management of tibial pilon fractures in diabetic patients is difficult, with a high rate of complications compared to non-diabetic patients. These results mirror those previously reported for ankle fractures in diabetic patients.

Suture-Button Versus Screw Fixation of the Syndesmosis: A Biomechanical Analysis
Authors: Robert Klitzman M.D., Heng Zhao PhD, Li-Qun Zhang PhD, Greg Strohmeyer B.S., Anand Vora M.D.
Date of Publication: Foot & Ankle International, January 2010

Major Points of Interest:

1. Purpose: To compare both the biomechanical and physiologic properties of suture-button fixation to the intact syndesmosis and to screw fixation.
2. Methods: 8 fresh frozen human cadaveric ankles were studied, dividing them into 3 groups which all underwent submaximal loads in a hope to measure the syndesmotic gap, laxity, and fibular movement in the sagittal plane, post-submaximal load cycling.
    a. 3 groups included:
        i. Intact syndesmosis and deltoid ligaments
        ii. Suture-button fixation of a disrupted syndesmosis +disrupted deltoid ligament
        iii. 3.5mm Tricortical syndesmotic screw fixation of disrupted syndesmosis + disrupted deltoid ligament
3. Results after submaximal load cycling:
    a. Syndesmotic gap was NOT significantly different between the intact group and the suture-button group but the screw fixation DID have a significantly smaller syndesmotic gap.
    b. Deltoid laxity before and after load cycling:
        i. Intact group showed no significant difference before and after load cycling
        ii. Suture-button group DID show significant laxity
    c. Sagittal plane fibular movement:
        i. Movement was significantly greater in the suture-button group compared to the intact group, and even moreso than in the screw fixation group.
4. Suture-button fixation maintains reduction after undergoing submaximal loads, similarly to that of an intact syndesmosis.
5. Suture-button fixation allows for more physiologic movement of the fibula in the sagittal plane, compared to using tricortical screw fixation.
6. Clinically, this has relevance since screws are traditionally used to provide rigid fixation for healing of the syndesmosis. The authors feel that a less rigid fixation method such as the suture-button fixation will provide a more physiologic type of healing of the syndesmosis.

Ankle Arthrodiastasis

Authors: Andrew J. Kluesner, DPM & Dane K. Wukich, MD

Date of Publication: Podiatrics: The Clinics, April 2009
Level of Evidence: V

Major Points of Interest:

1. Ankle joint distraction, or arthrodiastasis, has been shown to benefit patients in short-term and long-term treatment of ankle arthritis. It is based on the theory that osteoarthritic cartilage in the ankle has healing capacity. Scientific studies have shown beneficial intraarticular changes with joint distraction. It can potentially decrease pain and improve joint function; therefore, it has become a potential alternative to arthrodesis for treating degenerative joint disease in the ankle.
2. The development of osteoarthritis can be divided into 2 fundamental mechanisms:
    a. Adverse effects of "abnormal" loading on normal cartilage—this is the most common posttraumatic cause of ankle joint arthritis; it induces mechanical strain on the chondrocyte causing increased oxidative stress which is partially responsible for decline in cartilage health.
    b. "Normal" loading on abnormal cartilage—with progressive loss of articular cartilage, there is an increase in Subchondral bone plate thickness, formation of new periarticular bone, Subchondral sclerosis, and development of subchondral cysts.
3. It has recently been suggested that growth factors and cytokines derived directly from the subchondral bone may be responsible for the progression or initiation of osteoarthritis. Therefore, the unloading of the periarticular subchondral bone via joint distraction is another proposed mechanism leading to cartilage growth and repair.
4. Historically, hinged external fixation devices were used to mobilize joint contractures, reduce old dislocations, and compress nonunited periarticular fractures of the elbow and knee. A technique of articulated distraction was later used in combination with arthroplasty for treating the elbow, knee, and ankle and had "good" results. It was eventually determined that articulated joint distraction was a viable treatment alternative in younger patients (<45 yrs) with arthritis in the hip. These results led to the use of joint distraction for ankle arthritis.
5. It has been suggested that the intermittent hydrostatic pressure induced by distraction with weightbearing, in combination with the absence of mechanical stress, may stimulate actual repair of osteoarthritic cartilage. Because the ankle joint cartilage is exposed to higher loads per unit surface area than the hip and knee with walking, it has different thickness and biomechanical properties that may afford the ankle joint a greater capacity for repair.
6. Indications: those with posttraumatic arthritis, are <45 years old, have a congruent joint, and have pain that is severe enough to consider ankle arthrodesis
7. Circular ring external fixation should be used for distraction while allowing the patient to be WB. Sequential distraction of the joint after application to a total of 5 mm should be maintained. Ankle joint ROM during distraction has been shown to be beneficial and can be achieved with use of hinges in the fixator. Current studies recommend treatment for at least 3 months with necessary adjustments to maintain distraction at 5 mm. (Refer to article for details on surgical technique and frame application)
8. When nonoperative treatment fails in patients who have ankle arthritis that's secondary to trauma, ankle arthrodiastasis provides a joint-sparing treatment alternative that avoids the potential complications associated with ankle arthrodesis or joint replacement.

Treatment of Mobile Flat Foot by Displacement Osteotomy of the Calcaneus
Authors: E. Koutsogiannis, Larissa, Greece
Date of Publication: The Journal of Bone and Joint Surgery, February 1971

Major Points of Interest:

1. Anatomy of mobile flat foot
    a. Calcaneus is in valgus with its dorsal articular surface lying more medial than normal causing flattening of the longitudinal arch
    b. Talus is rotated medially and plantarly, causing subluxation of talonavicular joint
    c. Weightbearing load is medial to calcaneus
        i. Forefoot is pronated and abducted at midtarsal joint
2. The goal of the calcaneal osteotomy is to restore normal weightbearing by moving the posterior calcaneus medially
3. Technique
    a. Patient is positioned prone
    b. Lateral incision is made parallel, posterior, and inferior to peroneal tendons from Achilles tendon to inferior aspect of calcaneus
    c. Use of self retaining retractor to keep skin edges apart. Bone spikes are placed above and below calcaneus to expose its surfaces
    d. Periosteum is incised and elevated along incision line. Broad osteotome used to cut bone. Periosteum is also divided on medial side to allow for the medial sliding of the bone
    e. Posterior fragment of calcaneus is moved medially until its medial edge is in line with the sustentaculum tali
    f. When adequate displacement is achieved, fragment is stabilized using one or two K- wires inserted obliquely from posterior-inferiorly
    g. Skin is closed and a padded below knee cast is applied with ankle in neutral position
4. Post-Op Care
    a. Sutures and K-wires are removed 3 weeks after operation
    b. New below knee weightbearing cast is applied
    c. Radiographs taken at 6 weeks
        i. If union of bone has occurred, patient is free to mobilize
5. Clinical results are positive. Majority of patients had:
    a. Improved fatigue and function
    b. No problems with shoe gear
    c. Corrected valgus deformity
        i. Less successful in improving longitudinal arch

Outcome After Open Reduction and Internal Fixation of Lisfranc Joint Injuries
Author: Kuo, RS
Publication: JBJS, November 2000

Major Points of Interest:

1. Stable anatomical reduction leads to optimal results with a significantly lower prevalence of secondary osteoarthritis and a significantly better average AOFAS outcome score than did patients without anatomical reduction.
2. The advantage of open reduction is that it allows direct visualization of fracture-dislocation for the debridement of comminuted fracture fragments, soft tissue, and osteochondral debris.
3. We found a high rate of failure when Kirschner wires were used. Since then, we have employed rigid screw fixation in the medial column.
4. In our study, screws were placed without compression (set screws). Compression across a reduced joint was unnecessary and it increased the risk of developing degenerative changes.
5. The purely ligamentous injuries did not always heal, and there was a trend toward an increase in degenerative changes compared with patients with combined ligamentous and osseous injuries.
6. Primary arthrodesis for the treatment of purely ligamentous injury may be a better option compared to open reduction and internal fixation.

Diagnosis and Treatment of Achilles Tendon Rupture
Author: Kuwada, G
Publication: Trauma, October 1995

This intent of this article is to provide a systematic approach to diagnosing and treating Achilles tendon ruptures. The author creates a classification system with treatments based on extent of injury.

Major Points of Interest:

1. Contributing factors to Achilles tendon rupture:
    a. Most Achilles ruptures occur with athletic activity, but can occur spontaneously in the elderly with previous pathology or systemic illness. Ruptures have been linked to chronic Achilles tendinitis, muscinous degeneration, RA, gout, SLE, hyperparathyroidism.
    b. Ruptures are most likely the end result of prior Achilles pathology.
    c. Ruptures have been linked to a watershed area in the Achilles, approximately 2-6cm proximal to the insertion of the Achilles.
    d. Muscle damage occurs due to overexertion and may take 5-10 days to recover. This vulnerable period is susceptible to Achilles tendon rupture.
    e. Corticosteriods have a deleterious effect on tendons.
    f. Prevent ruptures with stretching and strengthening exercises with combination concentric and eccentric exercises.
2. Conservative Therapy:
    a. Above knee cast with knee flexed approximately 15 degrees and the foot plantarflexed for 8 weeks. Then cast with foot at 90 degrees for 8 weeks with WB on crutches.
    b. Posterior splint for 1 week with the foot plantarflexed. Below knee cast for 8 weeks with the foot plantarflexed, and 8 more weeks with the foot at 90 degrees.
3. Five goals of Achilles tendon surgical repair:
    a. regain pre-injury strength compared with uninjured Achilles tendon
    b. regain function near pre-injury
    c. return athlete to competition in the shortest period of time near optimal
    d. retain adequate dorsiflexion/plantarflexion
    e. perform strength and conditioning to increase strength and function
4. Intraoperative Considerations:
    a. Severity of Achilles rupture must be determined intraoperatively after successful debridement of necrotic, friable ends. Debride until you see healthy tendon and then measure the defect.
    b. After completing the repair, you need a maximum 15 degrees dorsiflexion at the ankle.
    c. The strength of the repair needs to be tested intraoperatively, to the full range of dorsiflexion and with considerable load applied.
5. Kuwada Classification of Achilles Tendon Ruptures
    a. Type I: partial tear < 25%
    b. Type II: partial tear > 25% to a complete tear with defect after debridement < 3cm
    c. Type III: complete tear with defect after debridement 3-6cm
    d. Type IV: complete tear with defect after debridement > 6cm
6. Treatments based on classification:
    a. Type I: Cast immobilization
    b. Type II: End-to-end anastamosis
    c. Type III: Gastrocnemius recession or autogenous central rotation graft
    d. Type IV: Gastrocnemius recession and/or autogenous rotation graft

7. Surgical Repair Techniques:
    a. End-to-end anastamosis: suture techniques include Bunnell, modified Bunnell
    b. Autogenoous flap or synthetic mesh (carbon fiber, Dacron, Marlex, prolene mesh)
    c. Fascial turn down procedures, TFL grafts, peroneus brevis, percutaneous repair
    d. Gastrocnemius recession: modified Baker, modified Vulpius, Strayer.
8. Surgical Repair Pearls:
    a. When indicated, gastrocnemius recession should be performed first and used maximally.
    b. Synthetic mesh grafting is often used to reinforce the repair. The mesh should be placed on the inferior side of the repaired tendon to avoid excessive adhesions.
    c. Want no more than 15 degrees of dorsiflexion upon repair. Typically after casting, you will lose 5 degrees due to adhesions.
    d. Tendon sheath should be meticulously repaired, and if no sheath is present then the tendon should be covered in adipose tissue.
9. Post-operative management:
    a. Posterior splint at 90 degrees with NWB status is kept until swelling subsides
    b. Below-knee cast at 90 degrees with NWB status for 3-4 weeks
    c. Weight bearing cast with crutches for 4 weeks
    d. Patient is returned to shoe with slight heel rise
    e. Physical therapy is begun in 1-2 weeks.
10. Complications are more prevalent with the cast immobilized group, than with the surgically repaired group. It is important to look at the patient's activity level and patient's expectations to determine if surgical repair is indicated.
11. Last studies have found mixed results with post-injury muscle strength.
    a. The author reports: patients subjectively admitted greater or equal strength if surgically repaired Achilles and less strength if conservatively treated versus pre-injury strength.
12. Author recommends surgical intervention for all athletes and active individuals looking for optimal return to pre-injury activity.

Heel Pain Triad (HPT): The Combination of Plantar Fasciitis, Posterior Tibial Tendon Dysfunction and Tarsal Tunnel Syndrome

Author: Labib, SA

Publication: Foot & Ankle International, March 2002

Major Points of Interest:

1. In evaluating chronic recalcitrant heel pain, when the symptoms and signs extend beyond the classic first step pain and medial calcaneal tuberosity tenderness to include pain at rest, a slow relief of pain when the foot is unweighted and posterior tibial tendon dysfunction signs, the treating physician should consider the triad of plantar fasciitis, PTTD, and tarsal tunnel syndrome or the heel pain triad.
2. The heel pain triad may represent 5% of chronic heel pain patients seen in foot and ankle clinics.
3. In the heel pain triad patients, complete surgical release of the plantar fascia and tarsal tunnel followed by reconstruction of the PTTD were proved 85.7% successful in relieving pain and improving function.
4. Hindfoot osteotomy or fusion appear to give better results in a subgroup of patients who are older, heavier and have a long history of advanced PTTD.
5. Heel pain triad may be a stage of the spectrum of disease in the breakdown of the longitudinal arch.
6. Stage 3 PTTD patients do not all have neurologic symptoms, although most have attenuated or ruptured plantar fascia which is usually not symptomatic at late presentation.
7. Treatment of PTTD alone with disregard for tarsal tunnel and plantar fascia symptoms at surgery may be insufficient. The untreated plantar fascia and tarsal tunnel will continue to flare in a significant number of patients.

Operative Correction of the Metatarsus Varus Primus
Author: Lapidus, PW
Publication: Surgery, Gynecology, and Obstetrics, pp 183-191

Major Points of Interest:

1. In a great majority of cases of hallux valgus, there is metatarsus varus primus, which is the primary underlying cause of the deformity hallux valgus occurring secondarily because of shoe pressure.
2. Hallux valgus is not so much a lateral deviation of the big toe, as the medial protrusion of the 1st metatarsal head forming body proliferation because of constant trauma.
3. There is a type of square foot, with a widely spread metatarsal head and metatarsal varus primus. This foot closely resembles that of primates and is considered atavistic.
4. This atavistic foot has a congenital potential tendency toward hallux valgus formation, and therefore hallux valgus is often hereditary, appearing in youth, mostly in women, because of their type of shoe.
5. No operative procedure is satisfactory, unless correction of the metatarsus varus primus is accomplished.
6. Operation for correction of metatarsus varus primus by resection of a small wedge, at the lateral part of the 1st cuneiformometatarsal joint is described.
7. Any operation creating shortening of the 1st metatarsal, or the big toe, is emphatically condemned as unphysiological, and causing static and dynamic disturbance of the foot.
8. Conservatism and individualization in indication for operative correction of “bunion” is advocated.

Fractures of the Ankle
Author: Lauge-Hansen, N
Publication: Archives of Surgery, March 1948

Major Points of Interest:

1. Plantarflexion and Dorsiflexion:
    a. PF and DF take place through the talocrural joint
    b. The talus can also move proximally and distally in the malleolar fork. As it moves proximally, there is concurrent movement in the tibiofibular syndesmosis—which thus plays an important role in talocrural movement.
2. Supination and Pronation:
    a. result of a combination of mobility of the articulations between the talus-calcaneus, talus-navicular, calcaneus-cuboid, tarsal-metatarsals
    b. supination = inward rotation + adduction (hindfoot) + inversion (forefoot)
    c. pronation = outward rotation + abduction (hindfoot) + eversion (forefoot)
3. Lauge-Hansen classification for ankle fractures describes:
    a. the position of the foot at the moment of force
    b. the forced movement of the foot producing the fracture
4. Lauge-Hansen Classification for Ankle Fractures:
    a. SAD- I, II
    b. SER- I, II, III, IV
    c. PAB- I, II, III
    d. PER- I, II, III, IV
5. Supination-Adduction
    a. SAD-I: straight transverse fracture of the lateral malleolus at or below the level of the ankle joint or rupture of the LCL
    b. SAD-II: Oblique fracture of the medial malleolus (directed inferolateral-superiomedial)
6. Supination-External Rotation
    a. SER-I: Rupture of the AITFL or a Tillaux-Chaput avulsion fracture or a Wadstaffe avulsion fracture
    b. SER-II: Spiral oblique fracture of the lateral malleolus at the level of the ankle joint (posterior spike on lateral view)
    c. SER-III: Rupture of the PITFL or a Volkman's fracture
    d. SER-IV: Straight transverse fracture of the medial malleolus or rupture of the deltoid ligament
7. Pronation-Abduction
    a. PAB-I: Straight transverse fracture of the medial malleolus or rupture of the deltoid ligament
    b. PAB-II: Rupture of both the AITFL and PITFL (without diastasis)
    c. PAB-III: Straight oblique fracture of the lateral malleolus at the level of the ankle joint (lateral spike on AP x-ray)
8. Pronation-External Rotation
    a. PER-I: Straight transverse fracture of the medial malleolus or rupture of the deltoid ligament
    b. PER-II: AITFL rupture with tear of tibiofibular interosseous membrane (diastasis) or a Tillaux-Chaput avulsion fracture or a Wagstaffe avulsion fracture
    c. PER-III: Spiral oblique fracture of the fibula above the level of the ankle joint
    d. PER-IV: Rupture of the PITFL or a Volkman's fracture

Classification of Diabetic Foot Wounds
Authors: Lavery, D.P.M., Lawrence; Armstrong, D.P.M., David; Harkless, D.P.M., Lawrence
Date of Publication: Journal of Foot & Ankle Surgery, 1996

Major Points of Interest:

1. Foot ulcers in persons with diabetes are one of the most common precursors to lower extremity amputation.
2. Appropriate care of the diabetic foot ulceration requires a clear, descriptive classification system that may be used to direct appropriate therapy and possibly predict outcome.
3. A classification popularized by Wagner includes a system mainly based on wound depth, which includes: grade 0 (intact skin), grade 1 (superficial ulcer), grade 2 (deep ulcer to tendon, bone or joint), grade 3 (deep ulcer with abscess or osteomyelitis), grade 4 (forefoot gangrene) and grade 5 (whole-foot gangrene).
4. Limitations of the Wagner classification system include that it does not allow classification of superficial wounds that are infected or associated with peripheral vascular disease. Additionally, only the most severe signs of vascular disease (forefoot gangrene and whole foot gangrene) are considered.
5. The authors of this study describe a clinical classification system for diabetic foot wounds that evaluates wound depth, the presence of infection and peripheral arterial occlusive disease in every category of the wound assessment.

6. The University of Texas Health Science Center, San Antonio, diabetic wound classification system is provided below.

	0 (Pre/Post ulcerative lesion)	I (Superficial wound)	II (Wound penetrating to tendon)	III (Wound penetrating to bone/joint)
A	completely epithelialized	not involving capsule, tendon, bone	with no infection or ischemia	with no infection or ischemia
B	completely epithelialized with infection	not involving capsule, tendon, bone with infeciton	with infection	with infection
C	completely epithelialized with ischemia	not involving capsule, tendon, bone with ischemia	with ischemia	with ischemia
D	completely epithelialized with infection and ischemia	not involving capsule, tendon, bone with infeciton and ischemia	with infection and ischemia	with infection and ischemia

7. The goal of this system is to improve communication, leading to a less complex, more predictable treatment course and, ultimately, an improved result.

Lavery Armstrong 07?

Probe-to-Bone Test for Diagnosing Diabetic Foot Osteomyelitis
Authors: Lavery, D.P.M., Lawrence; Armstrong, D.P.M., David
Date of Publication: Diabetes Care, February 2007

Major Points of Interest:

1. Osteomyelitis can be challenging to diagnose and can be done using a variety of modalities which include clinical signs and symptoms, laboratory findings, radiographs, radionucleotide scans and magnetic resonance imaging.
2. Grayson et al. described a clinical technique used in diabetic patients with a foot infection that involves exploring the wound for palpable bone with a sterile blunt metal probe, finding that his probe-to-bone test had a positive predictive value of 89%.
3. The study performed by Grayson et al. was flawed: (1) the prevalence of osteomyelitis in their population with "severe limb-threatening infections" was 66% and (2) the investigators did not obtain a bone culture for microbiological confirmation to diagnose osteomyelitis.
4. The purpose of this study was to assess the accuracy of the probe-to-bone test in diagnosing foot osteomyelitis in a cohort of diabetic patients with a confirmed infection through bone culture.
5. This two year longitudinal cohort study involved 1,666 diabetic individuals who underwent an initial standardized detailed foot assessment and examinations at regular intervals.
6. This study compared the results of the probe to bone test and bone culture for all patients with a lower-extremity wound. A positive probe to bone and presence of osteomyelitis were indicated by palpable bone or joint and positive bone culture, respectively.
7. Osteomyelitis was found in 30 patients over an average of 27.2 months of follow-up with 12% of those found in patients with a foot wound and 20% of those found in patients with a foot infection.
8. The probe to bone test was found to be highly sensitive (0.87) and specific (0.91); the positive predictive value was only 0.57, but the negative predictive value was significant at 0.98.
9. The authors conclude that a negative test probe to bone test may exclude the diagnosis of osteomyeltis when used in a population of diabetic patients with a foot wound among whom the prevalence of osteomyelitis was 12%.
10. In a population with "limb-threatening" infections and a high prevalence of osteomyelitis, a positive PTB is probably quite helpful in diagnosing bone infection. In more typical clinical settings, however, the probe to bone test is a better tool to exclude osteomyelitis.

Physical Examination of the Ankle for Ankle Pathology

Authors: Tara K. Lee, DPM, AACFAS & Richard Maleski, DPM , FACFAS

Date of Publication: Clinics in Podiatric Medicine and Surgery, April 2002

Major Points of Interest:

1. The lateral ankle ligaments are more commonly injured, through the inversion of the ankle, than the medial ones, which are injured in an eversion type ankle sprain. The anterior inferior and posterior inferior tibiofibular ligaments and interosseous membrane can also be injured, causing pain at the ankle joint even though they don't actually cross the ankle joint.
2. When examining an injured ankle, not only should the ankle joint and its surrounding soft tissue structures be palpated, but also the joints more proximal and distal to it, beginning with the leas painful joints and ending on the suspected injured joint. With ankle fracture, it is not uncommon for areas away from the initial ankle, such as base of 5^{th} metatarsal, to be fractured.
3. The only 2 reliable tests for evaluating syndesmotic type injuries after other injuries have been ruled out are the squeeze test and the external rotation test.
    a. Squeeze test: assesses AITFL, PITFL, and IO/syndesmosis; the fibula and tibia are squeezed together in the midshaft of the lower leg, and a positive test is signified by pain in the anterolateral region of the ankle or distal fibula.
    b. External rotation test: most reliable test for syndesmotic injuries; pain is elicited by externally rotating the foot and ankle with the knee at 90 deg and the ankle in neutral
4. A suction sign or dimple may be seen along the lateral ankle if the ATFL is severely disrupted but may not be present if there's swelling. The Gungor test is similar to the anterior drawer test because it evaluates anterior displacement of the talus from the ankle mortise, except it is more reliable if the ankle is swollen and the patient is guarding.
    a. Gungor test: prone position w/feet hanging past exam table; each heel is pressed downward to force the talus anteriorly within the ankle mortise—positive sign is when the skin becomes taut and Achilles tendon becomes increasingly defined.
5. Peroneus brevis tendinitis: pain elicited at the posterior and distal aspect of lateral malleolus on palpation. Flexion and abduction of the foot against resistance will cause pain over the tendon.
6. Peroneus longus tendinitis: pain along the lateral calcaneal wall to the cuboid. Flexion and pronation of the foot will cause pain over the tendon.
7. The medial ligaments are less commonly injured than the lateral ones because the deltoid ligaments are 20-50% stronger and because the lateral malleolus extends further distally than the medial malleolus, providing more of a bony obstruction to an eversion type ankle injury.
8. Although the Thompson test is good for detecting acute Achilles tendon ruptures, it does not accurately detect chronic ruptures. The Matles test can be used to diagnose a chronic rupture.
    a. Matles test: prone position, flex knees to 90 degrees, and observe the position of the foot and ankle. Normally, the foot is slightly PF as the knee is flexed to 90 degrees, but if there's a rupture, the foot will be in neutral or a DF position.
9. Posterior ankle impingement of soft tissues or bony structures, such as os trigonum, can be mistaken for disorders of the FHL tendon complex. Pain caused by posterior ankle impingement is located posterolateral to the ankle joint, while FHL tendinitis is painful along the posteromedial aspect of the ankle

10. If a lateral radiograph shows that the posterior tibial fracture involves 25% or more of the plafond or is displaced > 2 mm proximally after reduction of the fibular fracture, the fracture needs to be reduced and fixated.
11. To determine if the foot structure is the etiology of tarsal tunnel symptoms, a temporary varus heel wedge can be placed under the heel to correct for either heel varus or heel valgus in order to reduce the stretch on the posterior tibial nerve in the tarsal tunnel area.

Tibiotalocalcaneal Arthrodesis with the Use of a Humeral Locking Plate

Authors: Nicholas J. Lowery, DPM, Alison M. Joseph, DPM, & Patrick R. Burns, DPM

Date of Publication: Clinics in Podiatric Medicine and Surgery, July 2009

Major Points of Interest:

1. Purpose: to highlight the technique of insertion of the humeral locking plate for the stabilization of tibiotalocalcaneal (TTC) arthrodesis. The authors site a study by Ahmad et al. which showed that fusion using the proximal humeral locking plate was achieved in 17 of 18 arthrodeses.
2. TTC arthrodesis indications: those with severe degenerative joint disease of the ankle and subtalar joints, deformity, revisional surgery, Charcot neuroarthropathy, and instability or progressive neuromuscular disorders that have failed conservative methods, and the prognosis with this is better in the older population and/or sedentary individuals as compared to young, active individuals.
    a. Locking plate fixation indications: those who have questionable bone quality or have a history Charcot neuroarthropathy.
3. Operative procedure: supine position with a lateral incision over the fibula for a transfibular approach. The distal fibula is resected so the STJ and ankle joint are visualized. If necessary, a 6.5 mm cannulated screw is placed across the ankle joint or STJ to achieve compression. The humeral locking plate is inverted and placed along the lateral aspect of the TTC complex. Typically, 3 or 4 screws in the tibia, 3 in the talus, and 4-6 in the calcaneus.
4. Tips: Access to the lateral wall and tuberosity of the calcaneus is required for placement of the plate and screws, and the initial screw should be placed in the central combination-hole across the dorsal talar dome. Traditional cortical screws may used in the talar portion of the plate if the locking screw angles aren't optimal.
5. The plate allows stable fixation across both joints without screws crossing the joints, which can be useful with implantable bone stimulators because the screws don't interfere with the stimulator leads.
6. Postoperative management: compression splint immediately after procedure. Patient is transitioned into a NWB cast until about 8 weeks or longer if bony union isn't complete, and serial radiographs are taken until bony consolidation is seen; after that, can switch to a walking boot for 1 month.
7. The types of fixation that can be used for TTC arthrodesis include blade plates, screws, external fixation, and intramedullary rods; but there is no consensus on the most effective fixation method.
8. The advantages of any locking plate fixation include the creation of a fixed angle construct, which increases overall construct stability, and limited contact b/w the plate and bone, reducing stress on periosteal blood flow.
9. The humeral locking plate fits well when inverted and applied to the lateral TTC complex, provides biomechanical advantages due to the locking plate technology, the screws are angled in a convergent and divergent fashion which may add to the stability, and the plate placed laterally is not prominent when used with a transfibular approach.
10. Use of this plate for TTC arthrodesis can be combined with interfragmentary compression screws across the ankle or subtalar joints.

Treatment of Primarily Ligamentous LisFranc Joint Injuries: Primary Arthrodesis Compared with Open Reduction and Internal Fixation
Authors: Ly, TV & Coetzee, JC
Publication: JBJS, March 2006

Major Points of Interest:

1. Stable arthrodesis is a better primary treatment for ligamentous Lisfranc injuries, with superior short and medium-term outcomes than those following open reduction and internal fixation.
2. Healing of the ligaments and capsules provided insufficient strength to maintain the initial reduction in primarily ligamentous Lisfranc injuries.
3. Because of the poor healing potential of the ligament-osseous interface and the trend toward a higher rate of correction loss, increasing deformity, and degenerative arthritic changes, we believe that primarily ligamentous injuries are a subset of Lisfranc joint injuries that are not as amenable to internal fixation.
4. We recommend that only the medial 2 or 3 rays be fused during primary arthrodesis.
5. It is beneficial for a patient to have motion in the lateral 2 rays and that it is not necessary to perform a complete fusion to obtain optimum results.

The Hazards of Biopsy in Patients with Malignant Primary Bone and Soft-Tissue Tumors
Authors: Mankin, HJ; Lange, Thomas; Spanier, Suzanne
Date of Publication: The Journal of Bone and Joint Surgery, October 1982

Major Points of Interest:

1. Study involving 329 patients performed to determine the frequency of problems associated with biopsy, and how these problems affected patient outcomes
    a. Patients were unselected with malignant primary bone and soft tissue tumors
2. High incidence of errors in diagnosis, poor biopsy technique, and problems with wound healing after biopsy, often leading to changes in patient treatment and prognosis
    a. As a result of these problems:
        i. 18.2% of patients were treated by less than optimum plan
        ii. 8.5% had more unfavorable prognosis
        iii. 4.5% required amputation, in situations where the limb may have been able to be saved
3. The risk for all of the above was greatly increased when the initial biopsy was carried out in a referring institution, rather than a treating center
4. To minimize these problems associated with biopsies and provide better care for our patients, it is recommended by the authors that we:
    a. Plan the biopsy as carefully as the definitive surgery. It is not a simple procedure
    b. Pay as close attention to asepsis, skin prep, hemostasis, wound closure, and so on as with any other operation
    c. Place the skin incision in such a manner so as to not compromise a subsequent surgical procedure. Avoid transverse incisions!
    d. Be certain that an adequate amount of representative tissue is obtained, and that the pathologist prepares the slides in a manner that will allow a definitive diagnosis
    e. If the pathologist cannot make a diagnosis because of unfamiliarity with bone and soft tissue tumors, urge him/her to seek consultation promptly
    f. If the institution is not equipped to perform accurate diagnostic studies or definitive surgery and adjunctive treatment, the patient should be referred to a treating center PRIOR to performance of the biopsy

Fasciotomy of the Foot: An Anatomical Study with Reference to Release of the Calcaneal Compartment
Authors: Arthur Manoli, II, MD, Timothy Weber, MD
Date of Publication: Foot & Ankle, April 1990

Major Points of Interest

1. Author's patients who had suffered from calcaneal fractures were developing claw toe deformities as a late sequela. There hypothesis is that this complication was a result of soft tissue contractures from a compartment syndrome.
2. Injected dye into 17 cadaveric specimens. They identified a separate compartment (from the widely accepted "9") which lies deep to the superficial compartment in the hindfoot.
3. This "calcaneal" compartment contained the Quadratus Plantae muscle only.
4. The compartment is bound by:
    a. Superficial fascial plane that arises from the medial intermuscular septum and extends to the lateral intermuscular septum
    b. Deep aspect is limited by the calcaneus and tarsal bones
    c. Distally the compartment is limited by the Flexor Digitorum Longus tendon
    d. Proximally the compartment communicates with the deep posterior compartment of the leg
5. In the patients who experienced clawing of the toes, plantarflexion of the ankle did no reduce the deformity, indicating an intrinsic foot contracture.
6. The authors recommend a medial incision that begins 4cm anterior to the posterior portion of the heel and 3cm from the plantar surface. The incision is 6cm long.

Comparison of Lateral Locking Plate and Antiglide Plate for Fixation of Distal Fibular Fractures in Osteoporotic Bone: A Biomechanical Study
Authors: Minihane, Lee, Ahn, Zhang, Merk
Publicaton: J Orthop Trauma, September 2006

Major Points of Interest:

1. Short, oblique fractures of the fibula at the level of the syndesmosis (Weber B) have traditionally been treated with lateral neutralization plating and an independent lag screw. This offers direct exposure.
2. Brunner and Weber advocated an antiglide plate to counter some of the disadvantages to lateral plating (wound complications/pain, peroneal nerve injury, risk of intraarticular screw placement, poor distal fixation).
    a. This construct was stronger than the lateral plate and was suggested for use in osteoporotic bone. Due to its orientation, the plate acts as a buttress to superior and posterior displacement of the distal fragment which resists the forces on these oblique fractures.
    b. Weber and Kraus however reported high complication rates with peroneal tendon lesions and hardware removal.
3. The advent of the lateral locking plate has shown improved mechanical stability versus the conventional plate as well and is also indicated in osteoporotic bone. Locking plates prevent motion between the screws and plate, thus creating a single-beam construct to increase strength of fixation.
4. This study aimed at seeing how these two plates (lateral locking versus antiglide) compare mechanically.
5. Torque to failure and construct stiffness were greater on the side with the posterolateral antiglide plate than on the side with the lateral locking plate.
6. There was no difference in angular rotation at failure.
7. Failure Sites:
    a. Lateral Locking Plate: failed at distal fragment and distal fragment screws pulling out
    b. Antiglide Plate: failed by bending of plate at distal site, or screws pulling out at diaphyseal site
8. Bone mineral density did not differ between the two groups (specimens were matched), and it was positively correlated to the construct stiffness for both plates.
9. In situations where fixation may need to be optimized, an antiglide plate may be favored over a lateral locking plate due to its superior biomechanical fixation.

Early Screw Fixation Versus Casting in the Treatment of Acute Jones Fractures
Authors: Timothy S. Mologne, MD, Jeffrey M. Lundeen, MD, Mark F. Clapper, MD
Date of Publication: The American Journal of Sports Medicine, 2005

Major Points of Interest:

1. In 1984, Torg et al published a study in which they achieved a 93% healing rate with treatment of acute Jones fracture in a nonweightbearing cast for 8 weeks.
2. A prospective, randomized study utilized 37 active duty military personnel who were suffering from an acute Jones fracture (as defined by Torg et al):
    a. Fracture line with sharp margins without widening, absence of intramedullary sclerosis, and minimal or no cortical hypertrophy or evidence of periosteal changes due to chronic stress.
3. 19 patients were treated surgically with an intramedullary 4.5mm malleolar screw. 18 Patients were placed into a nonweightbearing short leg cast for 8 weeks.
4. Cast group: 8 patients (44%) had treatment failures. Of successful treatments, mean time returning to running and jumping was 15.6 weeks.
5. Surgical group: 1 patient (5.3%) had treatment failure. Successful treatments had a mean time of 7.9 weeks.
6. Screw head discomfort was the most common complication and occurred in 6 surgical patients (32%)
7. “Early surgical treatment results in a shorter time to clinical union and allows patients to return to sports and activities of daily living faster than with cast treatment.”

Calcaneocuboid Joint Pressure after Lateral Column Lengthening in a Cadaveric Planovalgus Deformity Model

Authors: Nathan Momberger, James M. Morgan, Kent N. Bachus, John R. West
Date of Publication: Foot & Ankle International, September 2000

Major Points of Interest:

1. Previous concern was that lateral column lengthening (Evan's) procedure may lead to calcaneocuboid joint arthroses
    a. Cooper et al wrote that lateral column lengthening increased pressure too much across the joint
2. This study set out to evaluate how the procedure affected the calcaneocuboid joint
3. Measured change in pressure across calcaneocuboid joint in normal versus flatfoot, and then change across the joint in flatfoot after lateral column lengthening
    a. Medial tissue was sectioned in cadaver feet to create flatfoot resembling adult acquired flatfoot
4. Peak pressure across calcaneocuboid joint was greatly increased in flatfoot as compared to normal foot
5. Peak pressure across calcaneocuboid joint after lateral column lengthening of flatfoot was not different
6. Pressure across the calcaneocuboid joint after lateral column lengthening of a normal foot is increased, but is not statistically different from the pressure across the joint in an uncorrected flatfoot
7. Calcaneocuboid joint arthoses is not typically found in untreated flatfoot, so the authors conclude that the increased pressure across the joint, whether from the procedure or the flatfoot itself, is within physiologic limits
8. This study's results do not support the previous concern that lateral column lengthening leads to calcaneocuboid joint arthoses

Anterior Tibial Tendon Injuries

Authors: Jolene Moyer, DPM & Rodney Kosanovich, DPM

Date of Publication: Clinics in Podiatric Medicine and Surgery, July 2002

Major Points of Interest:

1. A study by Anzel et al. found that only 10 of 1014 tendon injuries were ruptures of the anterior tibial tendon, and reports of chronic injury are even less frequent. Anterior tibial tendon injury can be the result of acute trauma, such as forced plantarflexion of the foot and ankle, open injury or laceration, repetitive microtrauma, a pathological condition or systemic disease, such as lupus and RA, or as some believe, due to a hypovascular zone 45-67 mm long in the anterior half of the tendon.
2. The anterior tibial muscle is the strongest dorsiflexory of the ankle, providing up to 80% of the dorsiflexory power of the anterior leg muscles.
3. Patients with anterior tibial tendon injuries often present months or years after the injury because they don't have a lot of pain immediately following the rupture or strain. Most are men over 45 y/o that present with tripping or slapping of the foot during gait. Only 10% of reported cases have been in women.
4. Common symptoms include snapping in the arch of the foot or stabbing pain through the midfoot, an abnormal gait with a variable degree of foot slap, a history of tripping or tendency to stub the toes, generalized foot pain or weakness, and difficulty walking on the heels.
5. Ruptures have frequently been reported as occurring approximately 1-3 cm from the tendon insertion on the medial cuneiform or 1st metatarsal base, and there may be a palpable mass at the level of rupture which is usually painful with palpation. There also may be edema or ecchymosis in the anterior aspect of the ankle or along the medial arch and with gait analysis, there may be visible EHL muscle recruitment for active dorsiflexion and/or contracted lesser digits if the injury has gone untreated.
6. Several articles have reported that there are few long-term problems when anterior tibial tendons aren't surgically repaired, unless the patient is active. Conservative treatment includes custom orthosis, bracing, or shoegear modification.
7. Surgical repair is indicated in physically active or younger patients to prevent the long-term sequelae of ruptures that go untreated and lead to deformities such as foot drop, inability to walk on uneven surfaces, and/or various ankle strains.
8. Surgical methods of repair include primary end-to-end anastomosis, proximal tendon lengthening and reattachment, interpositional tendon grafting or tendon transfers, and distal tendon transosseous fixation. Surgery can usually be performed w/in 3 months of the initial injury, but better results have been reported within an acute time frame.
9. Before performing surgery, the anterior tibial tendon should be evaluated using ultrasound or MRI. An anteromedial incision along the course of the tendon should be used to examine the extent of the injury intraoperatively.
10. One type of surgical method described by Trout et al. involves creating a window-type flap in the center 1/3 of the tendon to bridge the deficit. Another method described by Miller et al. involves splitting the tendon longitudinally, turning it down, and advancing it distally to the medial cuneiform.

Hallux IPJ Fusion

Authors: J. Moyer, DPM, C. Lowery, DPM, J. Knox, DPM, & A. Mudrey, DPM

Date of Publication: Clinics in Podiatric Medicine and Surgery, January 2004

Major Points of Interest:

1. The primary goal of an IPJ arthrodesis is to provide a stable lever arm to compensate for the muscular imbalance between the long and short flexor tendons, thereby restoring the function of the hallux. Although the surgical technique may be fairly universal, the modes of fixation are variable.
2. Indications: to overcome painful or otherwise deleterious deformity of the hallux IPJ that is often caused by neuromuscular pathology. Indications for hallux IPJ fusion can be classified according to the plane of deformity. The clawed hallux would be a sagittal plane deformity. Transverse and frontal plane deformities can be present with hallux abducto valgus or hallux varus. Arthroses can cause deformities in all planes and might cause so much pain that IPJ fusion is necessary to alleviate symptoms.
3. Indications that may produce necessity of hallucal IPJ arthrodesis
    a. Neuromuscular disorders: post-polio syndrome, cerebral palsy, charcot-marie-tooth, Friedrich's ataxia, hemiplegia, myelodysplasia, spina bifida
    b. Arthritic conditions: traumatic, psoriatic, rheumatoid, or osteo- arthritis
    c. Iatrogenic: hallux varus, any procedure initiating loss of intrinsic musculature, sequelae following MTJ implant or fusion
    d. Congenital: hallux valgus, hallux varus, hallucal IPJ deformity
4. Incisional approach: two semielliptical incisions converging over the IPJ so that a skin wedge is excised en toto is one approach. Others use a curvilinear incision, such as a serpentine or L-shape which helps to eliminate the amount of dorsal epidermal contracture that can occur postop. The linear longitudinal incision medial and parallel to the EHL tendon is a more traditional approach.
5. Bone cuts: The joint surfaces should either be resected perpendicular to the neutral plane or allow for light abduction and dorsiflexion. Any osseous correction must be obtained in the proximal phalanx because it's larger and has better bone stock. Overall, close apposition of the central cancellous bone is key to successful fusion.
6. Single K-wire fixation: should be placed perpendicular to the vector of compression. The high failure rate is the lack of stability in more than one plane which allows the bones to separate and piston around the wire, distracting the fusion site.
7. Crossing K-wire fixation: developed to decrease the failure rates. By increasing the angle between the wires, there is diminished chance of external migration because the probability of purchasing stable cortical bone is increased. They should ideally cross at or as close to the arthrodesis site as possible for increased stability.
8. Disadvantages of K-wire fixation: possible lack of compression, longer period of immobilization, and decreased stability of the fusion site.
9. Cortical and cancellous bone screws: inserted by traditional AO technique, they provide better compression allowing the arthrodesis site to undergo primary bone healing and to have a quicker recovery period without callus formation. The rigid fixation enhances consolidation and decreases the immobilization time.

10. Screw types include 4.0 cancellous screw, 3.5 cortical screw, and 2.0 cortical screw. The disadvantage of the 4.0 cancellous screw is that if it's too large for the distal phalanx, compression will be compromised. The advantage of the 3.5 cortical screw is that it is more easily removed because of the smaller pitch, and it was originally used as a salvage fixation when stripping of the 4.0 screw occurred. The 2.0 screw can be oriented diagonally across the arthrodesis site and used for patients with poor bone stock.
11. There are 2 primary sites for a single longitudinally placed bone screw to purchase that will increase chance of interfragmentary compression and decrease chance of stripping the screw:
    c. Outer cortex of distal tuft of hallux
    d. Subchondral cancellous bone at base of proximal phalanx
12. Arthrodesis of the hallux IPJ can be performed as a primary procedure or with other procedures, such as tendon transfers, tenodesis procedures, and other 1st ray arthroplasties or arthrodeses.

Effect of Achilles Tendon Lengthening on Neuropathic Plantar Ulcers: A Randomized Clinical Trial
Authors: Mueller, MJ, Strube, PhD., Michael; Johnson, M.D., Jeffrey E.
Date of Publication: Journal of Bone & Joint Surgery, August 2003
Level of Evidence: Therapeutic Study, Level I-1a

Major Points of Interest:

1. Limited ankle dorsiflexion has been implicated as a contributing factor to plantar ulceration of the forefoot in diabetes mellitus.
2. The purpose of this study was to compare outcomes for patients with diabetes mellitus and a neuropathic plantar ulcer treated with a total-contact cast with and without an Achilles tendon lengthening
3. Sixty-four subjects were randomized into two groups, with treatment by immobilization in a total-contact cast alone or combined with percutaneous Achilles tendon lengthening. Measurements were made before and after treatment, at the seven-month follow-up examination, and at the final follow-up evaluation.
4. Outcome measures included time to healing of the ulcer, ulcer recurrence rate, range of dorsiflexion of the ankle, peak torque (strength) of the plantar flexor muscles and peak plantar pressures on the forefoot.
5. Twenty-nine (88%) of thirty-three ulcers in the total-contact cast group and all thirty ulcers (100%) in the Achilles tendon lengthening group healed after a mean duration 41 and 58 days, respectively.
6. At the first seven month follow-up, sixteen (59%) of the twenty-seven patients in the total-contact cast group and four (15%) of the twenty-seven patients in the Achilles tendon lengthening group available for follow-up had an ulcer recurrence.
7. At the two-year follow-up, twenty-one (81%) of the twenty-six patients in the total-contact cast group and ten (38%) of the twenty-six patients in the Achilles tendon lengthening group available for follow-up had ulcer recurrence.
8. The group treated with Achilles tendon lengthening had increased dorsiflexion that remained increased at seven months. Plantar flexor peak torque and peak plantar pressures on the forefoot during barefoot walking decreased following Achilles tendon lengthening, but returned to baseline after seven months
9. All ulcers healed in the Achilles tendon lengthening group, and the risk for ulcer recurrence was 75% less at seven months and 52% less at two years than that in the total-contact cast group.
10. Achilles tendon lengthening should be considered an effective strategy to reduce recurrence of neuropathic ulceration of the plantar aspect of the forefoot in patients with diabetes mellitus and limited ankle dorsiflexion.

The Blood Supply of the Talus
Author: Mulfinger, GL
Date of Publication: JBJS, February 1970

Major Points of Interest:

1. Extraosseous arteries(Talar blood supply is quite diffuse and arises from the following 3 major arteries)
    a. Posterior tibial artery branches
        i. The first arteries to the talus from the PT artery are from the calcaneal branches.
        ii. The artery of the tarsal canal arises from the PT artery, about 1cm proximal to the origin of the medial and lateral plantar arteries.
        iii. The Deltoid branch- supplies the medial periosteal surface of the body.
    b. Anterior tibial or dorsalis pedis artery
        i. Sinus tarsi area is supplied mainly by DP artery.
        ii. Lateral tarsal branch of DP forms and anastomotic loop with the perforating peroneal artery. Branching from this loop is the artery of the tarsal sinus.(which is larger than the artery of the tarsal canal)
    c. Peroneal and perforating peroneal arteries
        i. Small branches from peroneal artery join with calcaneal branches of the posterior tibial artery to form a plexus over the posterior tubercle area of the talus.
        ii. The perforating peroneal artery contributes to the plexus in the tarsal sinus.
2. Intraosseous arterial pattern
    a. Head(supplied from 2 sources)
        i. Medial superior half is supplied by branches from the anterior tibial or DP artery.
        ii. Lateral inferior half is supplied by branches of the artery of the tarsal sinus, the sinus tarsi anastomosis, or directly from the lateral tarsal artery.
    b. Body
        i. Mostly supplied by the anastomotic artery in the tarsal canal.
        ii. The deltoid branches enter body on medial periosteal surface and supply medial quarter or third of the body.
    c. Anastomoses (numerous)
        i. Most common anastomosis was found between the arteries entering the superior neck and those from the artery of the tarsal canal
3. In this series, it was found that the largest vessels entered the body from the tarsal canal posterior to the neck.
4. This anatomical study showed correlation with some of the clinical problems with healing of this bone.
    a. Clinically- Most fractures of the neck do not cause AVN of the body.
    b. Anatomically- with a neck fracture, most of the vessels supplying the body should remain intact.
5. Incidence of necrosis of the body rises sharply with dislocation and fracture dislocation of the body which is what would be expected if the body loses all or most of its soft tissue attachments.

***In Vitro* Determination of Midfoot Motion**

Authors: Tye J. Ouzounian M.D. and Michael J. Shereff M.D.

Date of Publication: Foot & Ankle International, December 1989

Major Points of Interest:

1. Purpose: To quantify the relative motion of each independent segmental articulation of the midfoot.
2. Materials: 10 fresh frozen below-knee amputated limbs were utilized. Lack of joint degeneration was confirmed radiographically. Superficial soft tissue and toes were removed. All ligaments and capsules remained intact. Pins were placed perpendicularly in the dorsum of the talus, navicular, medial, middle, and lateral cuneiforms, cuboid, and calcaneus. Proper placement was confirmed radiographically.
3. Methods: The ankles were immobilized in a neutral position. 1 lb weights were fastened to the distal aspect of the 1^{st} and 5^{th} metatarsals in order to simulate dorsiflexion, plantarflexion, supination, and pronation. The pins were used as markers to record the amount of motion that each bone underwent. Total motion at each articulation was determined by comparing the reference pins located on either side of the joint and using trigonometric formulas.
4. Total motion occurring through each articulation for dorsiflexion-plantarflexion/ supination-pronation are as follows:
   a. Talonavicular: 7.0/17.7
   b. Calcaneocuboid: 2.3/7.3
   c. Naviculo-medial cuneiform: 5.0/7.3
   d. Naviculo-middle cuneiform: 5.2/3.5
   e. Naviculo-lateral cuneiform: 2.6/2.1
   f. Medial cuneiform-1^{st} metatarsal: 3.5/1.5
   g. Middle cuneiform-2^{nd} metatarsal: 0.6/1.2
   h. Lateral cuneiform-3^{rd} metatarsal: 1.6/2.6
   i. Cuboid-4^{th} metatarsal: 9.6/11.1
   j. Cuboid-5^{th} metatarsal: 10.2/9.0
5. The cuboid-fourth and fifth metatarsal joints had the greatest amount of dorsiflexion-plantarflexion total motion, followed by the talonavicular, naviculo-medial, and naviculo-middle cuneiform joints.
6. Supination-pronation occurs primarily through the talonavicular, cuboid-fourth and fifth metatarsal joints.
7. Although each of the tarsometatarsal joints displayed motion, the most mobile midfoot joints were the 4^{th} and 5^{th} tarsometatarsal joints.
8. Although actual in-vivo motion is more than likely reduced due to the restricting effects of soft tissues, the relationship of relative motion between each articulation quantified in this study is probably maintained.

Wound Site as a Predictor of Complications Following Deep Nail Punctures to the Foot
Authors: Michael J. Patzakis, Jeanette Wilkins, William W. Brien, Vincent S. Carter
Date of Publication: The Western Journal of Medicine, May 1989

Major Points of Interest:

1. This study evaluated both inpatients and outpatients following nail puncture wounds to compare sites of puncture, condition of the penetrating nail, and the foot covering worn at the time of puncture
    a. Looking to develop criteria for admitting patients to hospital following nail puncture
2. Foot was divided into three zones to determine if area of foot punctured was related to outcome and hospital care needed
    a. Zone 1: from neck of metatarsals to end of toes
    b. Zone 2: from distal calcaneus to neck of metatarsals
    c. Zone 3: overlies the calcaneus
3. Nail puncture wounds in zone 1 are most susceptible to development of osteomyelitis, pyarthrosis, or both
    a. Followed by zone 3, then zone 2
4. Susceptibility of zone 1 may be due to lack of soft tissue covering, and may be due to metatarsal heads being primary weightbearing area of foot, increasing the risk of the nail puncturing bone or joint
    a. Zone 2 is more protected against nail puncturing bone or joint due to arch of foot and the soft tissue padding
    b. Zone 3 is another major weightbearing area of the foot, increasing risk of nail penetrating bone or joint
5. Most common infecting organism is Pseudomonas aeruginosa
    a. Patients wearing tennis shoes at time of nail puncture are predisposed to infection by P. aeruginosa
        i. Antibiotics given to patients wearing tennis shoes at time of injury should contain coverage for P. aeruginosa
6. Condition of the penetrating nail did not influence whether patient was admitted to hospital or not
7. Admittance to hospital should be considered for patients if:
    a. Nail puncture is in zone 1, even without evidence of infection
    b. They give a history of bone puncture in zones 2 or 3

Amputations at the Middle Level of the Foot
Authors: Pinzur, Kaminsky, Sage, Cronin, Osterman
Publication: JBJS, September 1986
Level of Evidence: 4

This article is a retrospective and prospective review exploring amputation at the most distal level in order to preserve the ability to walk.

Major Points of Interest:

1. Initially, high rate of success was determined in foot and ankle amputations using available criteria of clinical examination and the Doppler ischemic index as predictors of tissue viability.
2. Doppler ischemic index is derived by dividing the systolic pressure of the lower extremity by the systolic pressure of the brachial artery. Values are taken for both the posterior tibial artery and the dorsalis pedis artery, and the higher value is used.
    a. Healing is predicted at the level where the flow is pulsatile and the DI is > 0.45.
    b. DI:
        i. > 0.35 for arteriosclerosis
        ii. > 0.45 for non-diabetics
        iii. > 0.50 for diabetics
3. Serum albumin level and total lymphocyte count are also predictors of successful healing.
    a. Serum albumin indicates patient's nutritional status. (> 3.5 g/dL)
    b. Total lymphocyte count indicates patient's ability to resist infection. (> 1500)
4. Amputation healing rates are highest when the minimum Doppler ischemic index has been achieved.
    a. Serum albumin: 83.6%
    b. Total lymphocyte: 90.2%
    c. Doppler index: 96.7%
    d. This reflects the study's claim that they included patients with a minimum serum albumin of 3.0 g/dL versus the 3.5 g/dL minimum recommended in a prior study.
5. When all three factors (DI, serum albumin, total lymphocyte) were above the minimum level, healing rate was 92.2%.
    a. When one or two factors were below the minimum level, healing rate decreased to 38.5%.
6. Adequate lengthening of the Achilles tendon in patients needing a LisFranc procedure—with particular attention to adequate lengthening of the medial portion to prevent late varus angulation—is essential for best results.
7. It is possible to perform aggressive distal amputation with a high rate of success when consideration is given to the aforementioned factors of amputation healing. If necessary, nutritional supplementation can be used to increase the rate of healing.
8. The more distal an amputation can be performed, the less energy expenditure and the less physical therapy/gait-retraining is required.

Simple Solutions for Difficult Problems: A Beginner's Guide to Ring Fixation
Author: Micahel Pinzur, MD
Date of Publication: Foot and Ankle Clinics, 2008

Major Points of Interest:

1. Ring Fixation uses smooth pins, from 1.5 to 1.8mm. They are pretensioned from 50-130 kg before being affixed.
2. Surgical indications for a static frame:
    a. When standard internal fixation should be avoided due to poor soft tissue envelope, poor bone quality, or bony infection
    b. High-energy bony injury
    c. Trauma or infection with soft tissue deficiency
    d. "Damage control"
3. This is not as much of a journal article as is it a lecture on basic principles and steps in applying static external fixation. There is a simplified step-by-step instruction on how to apply a circular frame that may be beneficial to read before any case involving ex-fix.

Acquired Flatfoot in Adults Due to Dysfunction of the Posterior Tibial Tendon
Authors: Gregory C. Pomeroy, R. Howard Pike, Timothy C. Beals, Arthur Manoli
Date of Publication: The Journal of Bone and Joint Surgery, August 1999

Major Points of Interest:

1. Posterior tibial tendon (PTT) dysfunction is progressive and leads to adult acquired flat foot
    a. When PTT fails, the hindfoot does not invert properly during heel rise and toe off of gait cycle
    b. Without hindfoot inversion, midtarsal joint does not lock and abnormal stresses are placed on medial plantar ligaments, further progressing the flatfoot
2. Clinical staging by Johnson and Strom:
    a. Stage 1: pain/tenderness along PTT aggravated by activity. PTT is not elongated and no radiographic or clinical differences from asymptomatic extremity
    b. Stage 2: Elongation of PTT present and differences noted clinically and on radiographs. Deformity is still flexible
    c. Stage 3: rigid deformity. Signs of arthritis may be seen on radiographs in hind and midfoot
    d. Stage 4: valgus deformity and arthritis of the ankle, in addition to stage 3 findings
3. Radiographical evaluation can involve angular measurements to quantify progression of deformity
    a. Angle between longitudinal axis of talus and 1st metatarsal on AP radiograph to identify abduction of forefoot
    b. Talonavicular coverage angle on AP radiograph
    c. Angle between talus and 1st metatarsal on lateral radiograph
    d. Measurement between horizontal line from base of 5th met and perpendicular line to anterior-inferior corner of medial cuneiform. Base of medial cuneiform should be above base of 5th met in normal arch
    e. Total height of ankle from superior margin of talus to base of radiograph is evaluated bilaterally. Shorter height on one side is seen in asymmetrical flatfoot
4. Treatment: because it is progressive, early recognition is key to treatment
    a. Stage 1: below knee cast for 4-6 weeks can help with symptoms of tendonitis, weightbearing if no pain. After cast, custom orthotic is worn. If unsuccessful after 3-6 months, can consider exploring PTT and excising degenerative areas. Flexor digitorum longus transfer may also be considered
    b. Stage 2: conservative care mostly the same as stage 1. Can try more rigid orthotic such as UCBL. If more severe, an AFO may be utilized. Surgical correction includes FDL side-to-side transfer, in addition to spring ligament repair, medial column arthrodesis, lateral column lengthening, medial displacement calcaneal osteotomy, talonavicular and/or subtalar joint arthrodesis
    c. Stage 3: orthotic devices must be more accommodative rather than corrective as deformity is rigid. Hinged AFO can be used to help prevent progression. Surgical correction involves talonavicular, subtalar, or triple arthrodeses
    d. Stage 4: use of solid AFO for conservative treatment. Surgical treatment includes triple, ankle, or pantalar arthrodeses depending on pain symptoms

Ankle Fractures in Diabetics

Authors: Victor R. Prisk, MD & Dane K. Wukich, MD

Date of Publication: Foot and Ankle Clinics, December 2006

Major Points of Interest:

1. Many of the challenges in treating an ankle fracture in a diabetic patient are associated with their comorbidities such as, neuropathy, arthropathy, angiopathy, delayed healing, and immune dysfunction.
2. Abnormal vibratory sensation and decreased gastrosoleus reflex have been noted in about 90% of diabetics with neuropathy. Although the "gold standard" for diagnosing peripheral neuropathy is nerve conduction studies, the Semmes-Weinstein monofilament is more frequently used and can identify people at increased risk of foot ulceration with a sensitivity of up to 91% and specificity of up to 86%.
3. Peripheral neuropathy can lead to many complications that occur with ankle fractures in diabetics, especially the development of Charcot neuroarthropathy, due to the inability to sense minor traumatic events. It is theorized that normal muscle reflexes are reduced, resulting in progressive eccentric loading and joint deformity.
4. Diabetes is present in up to 41% of patients with peripheral arterial disease. All diabetics with ankle fractures should be examined closely for PVD by examining pulses; if pulses are diminished, an ankle-brachial index (ABI) can be performed. Transcutaneous oxygen pressure (TcPo2) assesses microcirculation and can also be used, especially when the blood pressure cuff around the injured ankle can't be tolerated by patients. A TcPo2 < 30 mm Hg indicates limb ischemia
5. Hyperglycemia results in the nonenzymatic glycosylation of proteins, such as collagens, enzymes, surface integrins, and receptors, which alters the mechanics of wound healing. A preoperative assessment to optimize blood glucose levels, improve nutrition, and assess angiography accurately may help limit wound healing complications.
6. The infection rate in the nondiabetic population has been shown to be 8% compared with 32% in diabetic patients.
7. Diabetic patients with an ankle fracture are at increased risk of complications with or without operative intervention. Although nondisplaced ankle fractures may be treated nonoperatively, Connolly and Csencsitz reported unsatisfactory results in 67% of patients because of complications such as uncontrolled sepsis with subsequent amputation and Charcot arthropathy. Lillmars and Meister performed a meta-analysis of five series of ankle fractures in diabetics and found that the overall complication rate in those treated with ORIF was 29% with an overall infection rate of 25%, and for those treated nonoperatively, the complication rate was 83% with an infection rate of 40%.
8. Except in certain circumstances, surgical fixation of unstable ankle fracture is the treatment of choice. If a nonoperative approach is used for a stable, nondisplaced isolated lateral or medial malleolar fracture, nonweightbearing in a total contact cast for 3 months with weekly or biweekly radiographs to monitor the stability are advised
9. In nonosteopenic diabetic patients without peripheral neuropathy, small fragment fixation with a lag screw and plate fixation of the fibula and cancellous screws for the medial malleolus may be used. In those with severe osteopenia or neuropathy, more rigid fixation should be used which can include a dynamic compression plate (DCP) for lateral fixation with syndesmotic screw fixation.
10. Very unstable fractures or fracture dislocations may require additional external and internal fixation strategies. Transarticular fixation of the subtalar and tibiotalar joints can be used alone or in combination with other techniques of internal fixation. External fixators may used instead, to provide additional stability without the use of bulky internal hardware.

Changes in Tibiotalar Area of Contact Caused by Lateral Talar Shift
Authors: Ramsey and Hamilton
Publication: JBJS, April 1976

Major Points of Interest:

1. Fractures or ligament injury about the ankle may result in a widened medial ankle mortise. Ankle injuries with significant residual talar displacement have been linked to unsatisfactory outcomes.
2. This study aimed to measure changes in tibiotalar contact as the talus is displaced laterally at 1, 2, 4, and 6mm.
3. The greatest reduction in contact area occurred during the initial 1mm of lateral displacement. The mean decrease in contact area was 42%. Contact area continued to decrease with further lateral displacement, but the rate of change was much less. Between 1 and 2mm displacement there was a 14% decrease; between 2 and 4mm, 9%; between 4 and 6mm, 3%.
4. With no talar displacement, the area of contact extended across the breadth of the talus, and was wide laterally and narrow medially.
    a. With talar displacement, the area of contact was only apparent on the medial and lateral eminences, and the pattern reversed as it was narrow laterally and wide medially.
5. As contact area decreases, stress per unit area increases. The areas remaining in contact are subjected to more force and likely more pathology. Thus, it is important to restore the normal relationship of the talus and tibia following ankle injury.

Treatment of Acute Achilles Tendon Ruptures
Authors: Khan RJK, Fick, Keogh, Crawford, Brammar, Parker
Publication: JBJS, October 2005
Level of Evidence: 1

This article is a meta-analysis aimed at exploring treatment options for acute Achilles tendon ruptures based on randomized, controlled trials.

Major Points of Interest:

1. Achilles tendon ruptures occur in previously abnormal tendons—often due to oral/topical corticosteroids, fluoroquinolone antibiotics, exercise-induced hyperthermia, mechanical abnormalities of the foot.
   a. Kannus and Jozsa, JBJS 1991: "Pre-existing histopathologic changes are present in nearly all Achilles tendons that underwent spontaneous rupture."
   b. McMaster, JBJS 1933: "Normal tendon does not fail with extreme stress."
2. Treatment options are divided into operative (open or percutaneous) and non-operative modalities (cast immobilization or functional bracing). Generally they have been used as such: open for athletes, young, fit patients; percutaneous for those who did not want an open repair, cosmesis; non-operative for elderly.
3. Open operative treatment is associated with a reduced risk of rerupture, but a higher risk of other complications (infection, adhesions, disturbed skin sensibility) versus non-operative treatment.
   a. Non-operative treatment has > 3x risk of rerupture.
   b. 1/3 of open repair had associated complication.
4. Percutaneous repair is associated with a lower complication rate versus open repair.
5. Postoperative functional bracing is associated with less complications—especially regarding adhesion formation—than postoperative casting. Functional bracing allows for early mobilization.
6. Kuwada classification of Achilles Tendon Rupture:

Type I	Partial tear of < 50%
Type II	Complete tear with defect after debridement < 3cm
Type III	Complete tear with defect after debridement 3-6cm
Type IV	Complete tear with defect after debridement > 6cm

Avulsion Fracture of the Fifth Metatarsal: Experimental Study of Pathomechanics
Authors: William R. Richli, Daniel I. Rosenthal
Date of Publication: AJR, October 1984

Major points of interest

1. A transverse fracture through the base of the 5th metatarsal is neither a Jones fracture nor an Avulsion fracture. The author believes the cause to be avulsion by the "Lateral Cord of the Plantar Aponeurosis."
2. Fresh-frozen cadaveric legs were used in combination with CT scan to create and evaluate fractures.
3. In all cases where the lateral cord was intact, plantarflexion and inversion resulted in a transverse fracture through the tuberosity. The fracture occurred "posterior" to most of the Peroneus brevis insertion.
4. Clinically, the authors state that this is a relatively benign fracture that responds to conservative treatment.

Asymptomatic occlusive arterial disease: A case report
Authors: J. Robbins, DPM, K. Ballew, DPM, C. Lowery, DPM, & E. Husni, MD
Date of Publication: JAPMA, November 1985
Level of Evidence: IV

Major Points of Interest:

1. CC: 45 y/o white male presented with painful callus sub-4th metatarsal head of right foot for about 5 weeks duration.
2. HPI: Callus had been forming for 2-3 years, but became painful during the previous 5 weeks and was getting worse. He denied a history of intermittent claudication and was taking hydrochlorothiazide for hypertensive CVD. He reported moderate alcohol and caffeine intake and smoked half a pack cigarettes/day. His father died at age 59 of heart disease.
3. PE: Vascular examination was unremarkable, except that there were no pulses palpable below the level of the femoral artery on the right side, while all pulses were palpable and normal on the left side. There was a callus at the plantar right 4th metatarsal head with a sinus tract and purulent exudates. Radiographs were unremarkable for soft tissue or bony changes.
4. Diagnosis: soft tissue infection.
5. Treatment: Placed on 500 mg bid of Duricef and Betadine soaks bid. Subsequent C&S revealed no growth of pathogenic organisms.
6. Clinical course: 5 days after initiating treatment, patient returned to clinic and mentioned symptoms of mild intermittent claudication of instep and lower leg which started after the last visit and didn't cause severe discomfort.
7. Additional vascular examination was then performed. Doppler ultrasound exam of the right lower limb showed very weak DP and PT pulses. It also revealed an ankle-arm index on the left side > 1 and only 0.6 on the right. Diagnosis: arteriosclerosis obliterans of the right lower limb
8. Patient was referred to peripheral vascular dept. and a right femoral arteriogram was performed and showed complete occlusion of the superficial femoral artery at the adductor hiatus. Collaterals reconstituted the popliteal artery. A right femoral popliteal bypass w/autogenous vein graft was performed, and the patient remained symptom free postop.
9. This case demonstrated the need for a complete vascular work-up despite lack of overt symptoms. This patient was in the early stages of arterial occlusive disease, which may develop rapidly, especially in diabetics.
10. The authors conclude that the vascular exam is the most important preop evaluation. A thorough H&P and can't be relied on exclusively. Doppler ultrasound provides a sensitive and reliable tool for evaluating peripheral vascular problems and should be part of routine preop evaluation of the peripheral circulation.

Rapid Bacterial Screening in the Treatment of Civilian Wounds
Authors: Martin C. Robson, William F. Duke, and Thomas J. Krizek
Date of Publication: Journal of Surgical Research, 1973

Major Points of Interest:

1. This study evaluated a rapid bacterial screening technique in acute traumatic wounds in civilian emergency room
2. Biggest factors in development of infection are number of organisms in the wound and time from injury
    a. Greatest risk of infection for patients presenting between 4-12 hours post injury
    b. Of the wounds evaluated, infection occurred in all that contained greater than 10^5 organisms
3. The rapid bacterial screening technique was 95% accurate in predicting critical number of bacteria
4. This screening technique should be used in patients presenting greater than 3 hours after injury

Fractures of the Lower End of the Tibia into the Ankle Joint
Authors: Ruedi and Allgower
Publication: Injury: The British Journal of Accident Surgery, October 1969

The aim of this study was to determine if surgical anatomic reduction could minimize late complications of comminuted distal tibia fractures.

Major Points of Interest:

1. Minor incongruence in the joint surface or axis can alter mechanics and lead to arthritis. Thus fractures involving the joint should be open reduced and the anatomy should be restored. Comminuted fractures however were excluded because it was thought that they were predestined for failure.
2. With axial compression, position of the foot on impact determines the type of fracture:
    a. Foot neutral: Y-shaped explosion fracture
    b. Foot dorsiflexed: anterior margin of distal tibia was avulsed
    c. Foot plantarflexed: posterior triangular fragment of distal tibia
3. ORIF performed on comminuted fractures of the distal tibia follows 4 principles:
    a. restoration of length and axis of the fibula or tibia as a first step
    b. reconstruction of the articular surface of the distal tibia
    c. filling in the defect resulting from impaction with cancellous autografts
    d. support of the medial tibia by plating to prevent a late varus deformity
4. Restoring the Fibular Fracture:
    a. 60% transverse, oblique fx of fibula: approach fibula first
    b. 15% comminuted fx of fibula: approach tibia first
    c. 25% fibula intact, w/ diastasis of tib/fib: approach tibia first, then close diastasis
5. Reconstructing Tibial Plafond:
    a. use talus as model
    b. secure temporary fixation with K-wires to determine amount of cancellous bone loss
6. Cancellous Bone-Graft:
    a. should be obtained first if taking autogenous graft (author uses from greater trochanter), although other donor sites and orthobiologics are viable options
7. Fixation of the Tibia:
    a. danger in developing a late varus deformity, thus need to stabilize medial tibia
8. Post-op Management:
    a. apply plaster splint which allows dorsiflexion of the foot
    b. no antibiotics except in open fracture or long operation time
    c. keep leg elevated and encourage active and passive dorsiflexion
    d. then protect in below knee cast, NWB status for up to 3 months
9. Study recorded 50.3 week average follow-up.
    a. Results were classified as 31 excellent, 28 good, 9 moderate, 12 poor.
    b. 90% were able to follow the same occupation as they did before the injury.
    c. 70% have been able to resume sports.
10. Other treatment modalities have only had good functional results in 40-50% of patients.
11. The authors believe that anatomic reconstruction with ORIF and cancellous bone grafting is important to achieve better results. They experienced good functional results in 73.7%.

Operative Treatment in 120 Displaced Intraarticular Calcaneal Fractures
Authors: Roy Sanders, Paul Fortin, Thomas DiPasquale, & Arthur Walling
Publication: Clinical Orthopaedics & Related Research, May 1993
Evidence Level: 4 (Case Series)

Major Points of Interest:

1. Established a classification for intraarticular fractures of the Calcaneus, the Sanders' Classification, based upon Coronal & Transverse CT Scan and assessed the ability to obtain anatomical reduction and positive outcomes in each type utilizing a Lateral approach for correction
2. On CT image, one locates the image section that shows the Posterior Facet of the Talus with greatest width and it is divided into equal sections of 1/3 by two lines (A & B) with a third line (C) being drawn at the most Medial edge to separate the location of the Sustentaculum Tali; these lines & sections then project, identically, to the Posterior Calcaneal Facet
3. Fractures along only 1 line are Type II because they form 2 fragments while those along 2 or 3 of the lines are Type III or Type IV because they produce 3 or 4 fragments, respectively; Type III fractures produce a Middle Fragment which inferiorly displaces into Calcaneal Body & Type IV fractures are "crush" injuries with entire Posterior Facet displaced into Calcaneal Body
4. Sanders' Classification:
    a. Type I = Non-Displaced (< 3mm) Intraarticular Fracture
    b. Type II = Displaced Intraarticular Fracture with 2 Fracture Fragments
        i. (Type II-A) or (Type II-B) or (Type II-C)
    c. Type III = Displaced Intraarticular Fracture with 3 Fracture Frgaments
        i. (Type III-AB) or (Type III-AC) or (Type III-BC)
    d. Type IV = Displaced Intraarcticular Fracture with 4 Fracture Fragments
        i. Type IV-ABC
5. Anatomical reduction was assessed as follows:
    a. Anatomical (no incongruity)
    b. Near Anatomic (< 3mm incongruity)
    c. Approximate (3-5mm incongruity)
    d. Failure (>5mm incongruity)
6. Regardless of Sanders' Classification of the intraarticular fracture, the Height, Width, & Length of the Calcaneal Body were re-established to within 98%, 110%, & 100% of anatomical normal values, respectively
7. Intraarticular fractures were able to be reduced to anatomical norms (first number) and had Excellent or Good results (second number) as follows:
    a. Type II = 86%,73%
    b. Type III = 60%,70%
    c. Type IV = 0%,9%
8. There appears to be an approximate 2 year learning curve for a surgeon before reliable results may be obtained in correcting Type II & Type III fractures to Excellent or Good condition; there is no such curve for Type IV as, no matter the level of experience, they are nearly never associated with positive outcomes with attempts at reduction and should undergo primary arthrodesis
9. Even with anatomical reduction a positive outcome can't be ensured because, even in such a situation, excessive damage or necrosis of the articular cartilage will lead to arthritic changes & pain which should be secondarily corrected via arthrodesis

Peroneal Tendon Injuries

Authors: Rick L. Scanlan, DPM & Richard S. Gehl, MD

Date of Publication: Clinics in Podiatric Medicine and Surgery, July 2002

Major Points of Interest:

1. There are 4 main areas of anatomical variance that may contribute to peroneal tendon pathology:
    a. Musculotendinous junction of peroneus brevis—when the junction occurs distally w/in the superior peroneal retinaculum, the increased volume may cause stenosis within the tendon sheath
    b. Superior peroneal retinaculum—laxity of this structure or separation from the fibrocartilaginous ridge located on the lateral fibula allows excess lateral and anterior motion of the peroneal tendons with subluxation and pain
    c. Peroneal trochlea—hypertrophy of this can impede the normal gliding motion of the tendons w/in their sheaths causing pain and inflammation
    d. Retromalleolar sulcus—this posterior surface of the fibula can vary in its anatomical shape, affecting the stability of the peroneal tendons as they course around the fibula; convexity or narrowing of this sulcus can cause subluxation of the peroneal tendons.
2. Clinical exam: active eversion of the foot against resistance tests the integrity and function of peroneus brevis tendon. Active PF of the 1st ray against resistance isolates the peroneus longus. Visible subluxation or palpable snapping/popping of the peroneal tendons can be reproduced with the foot dorsiflexed with active eversion of the foot against resistance.
3. Multiple diagnostic studies can be performed to evaluate lateral ankle pain:
    a. Radiographs—to evaluate presence of fracture, either from the lateral fibula or from the 5th metatarsal base and/or presence of accessory ossicles such as os peroneum.
    b. Tenography—considered for diagnosis of stenosis w/in the tendon sheath or for ruptures of the peroneal retinaculum.
    c. Ultrasound—examines tendon abnormalities, peritendinous fluid, partial or complete ruptures, or thickening of the tendon that can be seen with chronic tendonitis.
    d. CT—assesses tendon ruptures, dislocation, tenosynovitis, and stenosis or impingement of the tendon w/in the sheath. Bone abnormalities can also be appreciated.
    e. MRI—"gold standard" for evaluating soft tissue injuries involving tendons; allows for visualization of midsubstance and subtle longitudinal splitting of the tendons.
4. Peroneus brevis tendonitis is usually symptomatic from the lateral malleolus distally to its insertion at the base of the 5th metatarsal. With peroneus longus tendonitis, there's tenderness over the lateral calcaneus, often extending distally to the plantar cuboid. Both can cause exacerbation with rising on the ball of the foot, running, cutting, jogging, or walking on uneven surfaces.
5. Peroneal tendonitis or tenosynovitis pain may be demonstrated with passive plantarflexion and inversion or with active dorsiflexion and eversion of the foot. Treatment generally consists of all conservative regimens, including orthosis with a lateral heel wedge or an AFO. For recalcitrant cases after implementing conservative treatment, surgical debridement with tenosynovectomy can be considered.
6. Partial or complete peroneal tendon ruptures are commonly associated with chronic tenosynovitis. There should be a high index of suspicion for tendon tears in those diagnosed with tenosynovitis who don't respond to conservative treatment. Peroneus brevis tendon tears are much more common than peroneus longus tendon tears and usually occur in the area of the retromalleolar sulcus, whereas peroneus longus tears usually occur just distal to or through the os peroneum w/in the cuboid groove.

7. The tendon ends of complete ruptures should be reapproximated under physiologic tension and repaired, generally using absorbable suture with a modified Bunnell suture technique. Longitudinal splitting of the tendon can be repaired in a simple running fashion. When the degenerated tendon portion approaches 40-50%, a tenodesis procedure should be considered, where the distal and proximal portions are anastamosed to the healthy neighboring tendon.
8. Acute tendon subluxation/dislocation is difficult to distinguish from an ankle sprain. Violent dorsiflexion and eversion of the ankle often cause the subluxation, and this typically occurs in sports requiring cutting and lateral motion such as skiing, ice skating, and basketball. Pain is localized to the posterolateral aspect of the fibula and the anterior drawer sign is negative. Chronic subluxation usually presents as chronic lateral ankle pain, and there is tenderness along the course of the tendons and posterior to the fibula.
9. Eckert and Davis proposed a classification for peroneal tendon subluxation in 1976 based on surgical exploration of 3 types of acute tendon subluxation injuries. This classification can't be applied clinically because the injury pattern can 't be accurately determined before surgery, with the possible exception of Grade III injuries.
10. The goal of repair of peroneal tendon subluxation is to anatomically reduce the tendons and to correct the underlying etiology of the recurrent subluxation. Surgical repair techniques include anatomically repairing the superior peroneal retinaculum, groove-deepening of a shallow, flat, or convex retrofibular sulcus, bone-blocking to provide a barrier to prevent subluxation, roof reconstructing procedures using part of the Achilles tendon, peroneus brevis, or peroneus quartus, and rerouting procedures to place the peroneal tendons underneath the CFL.

The Antiglide Plate for Distal Fibular Fixation: A Biomechanical Comparison with Fixation with a Lateral Plate

Authors: John J. Schaffer M.D. and Arthur Manoli II M.D.
Date of Publication: JBJS, April 1987

Major Points of Interest:

1. Purpose: To compare the relative static strength of fixation using a posterior anti-glide plate compared to that of a lateral plate for fixation of a short oblique fracture of the distal fibula.
2. The authors believe that the posterior antiglide plate may have several advantages over the more commonly used lateral plate for fixation of a short oblique distal fibular fracture. Such advantages include:
    a. Dissection of a smaller area
    b. Less operative time
    c. Minimal bending of the plate
    d. Less potential for penetration of a screw into the joint
3. Materials and Methods: 24 fresh frozen cadaveric legs that were disarticulated at the knee were used. The limbs were placed in an apparatus that mechanically produced fractures by supinating and externally rotating the foot and also measured the amount of torque that was needed to produce a fibular fracture.
4. Materials and Methods: Fourteen fibulas were reduced anatomically and internally fixated with an antiglide plate, while ten fibulas were reduced and anatomically internally fixated using a lateral plate. Torque was then re-applied to each foot in order to measure the amount of torque needed to cause failure of fixation. The stiffness of the fixation system as well as the amount of energy required for failure of fixation were also calculated.
5. Lateral plate fixation failed when an average of 64.3% of the original torque was produced. Antiglide plate fixation failed when average torque reached 77.2% of the original torque needed to produce the fracture. This difference was significant ($p < 0.01$).
6. The stiffness of the lateral plate fixation (4.8 newton-meters per degree) and the energy absorbed until failure (290 newton-meter degrees) were both significantly less ($p < 0.05$) than the values from the antiglide plate (14.9 newton-meters per degree and 364 newton-meter degrees, respectively).
7. Conclusion: Fixation with an anti-glide plate demonstrated superior static biomechanical properties, compared to lateral plate fixation. It is considered to be useful for treatment of short oblique fractures of the distal part of the fibula.

The Results of Arthrodesis of the Ankle for Leprotic Neuroarthropathy
Authors: Tohry Shibata, MD, Koichi Tada, MD, Kagawa and Chohzo Hashizume, MD
Date of Publication: JBJS, June 1990

Major Points of Interest:

1. 24 patients who had arthrodesis of one or both ankles to treat Neuroarthropathy (Charcot joint) were followed for 9 years in order to evaluate the treatments efficacy and identify reasons for why fusion might fail in certain patients.
2. Author's used a Kuntscher intramedullary nail for ankle arthrodesis and staples or k-wires to control rotation. Fusion was obtained in nineteen (73%) of patients. Patients were put in an above-the-knee cast was worn for 2 months followed by a below-the-knee cast for four months. Patients were allowed to weight bear after 1 month. Intramedullary nail was removed one year after solid fusion was obtained.
3. Of the seven joints that did not fuse, all were Eichenholtz stage 3 (reconstructive phase). Four stage 0 ankles and the one stage 2 ankle all fused.
4. Patients who showed solid fusion no longer had clinical symptoms at time of last follow up.
5. Successful arthrodesis is much more difficult to achieve in stage 3 than it is in earlier stages (Eichenholtz)
6. Most common reason for lack of fusion was postoperative infection.
7. Suppression of abnormal movement and progression of destructive changes make arthrodesis a favorable procedure in neuroarthropathy

Compartment Syndrome of the Foot in Children
Authors: Scott Silas, MD, John Herzenberg, MD, Mark Myerson, MD
Date of Publication: JBJS, March 1995

Major Points of Interest:
1. A retrospective review of medical records of seven children and teenagers, crush injury was the most frequent cause of compartment syndrome.
2. There are 9 individual compartments: 1 medial, 1 lateral, 3 central, and 4 interosseous
3. "Pressure measurements should be obtained in the central and Interosseous compartments as these are more sensitive indicators of occult compartment syndrome in the foot."
4. Symptomology includes a child with chronic pain and loss of protective sensation in a child.
5. Compartment syndrome should be considered in ANY child with a crush injury, even if radiographic findings are absent.

Fracture of the Body of the Talus
Author: Sneppen, O
Date of Publication: Acta. Orthop. Scand., 1977

Major Points of Interest:
1. It is widely known that severe fractures of the body of the talus have a serious prognosis.
2. Results of the displaced intra-articular fractures appear to depend to some extent upon what degree of reduction is obtained.
3. Researchers found a high frequency of osteonecrosis and osteoarthritis. Also, there were significant late subjective complaints and rehabilitation difficulties.
4. Treatment should have a great emphasis on an exact reduction and stable fixation whenever possible.
5. Most authors have indicated a good prognosis in minor, mainly non-displaced fractures. This study revealed a far more serious prognosis for the small, mainly non-displaced fractures of the posterior and lateral tubercles.
6. In the author's opinion. The above fractures seem to be negligible, but they form a link to more extensive regional injuries involving the talocrural and especially the subtalar joint.
7. In treating fractures of the posterior and lateral tubercles, the authors feel that it is important to strive for rapid normalization of the function of the talocrural and subtalar joints. This normalization should be done by brief immobilization followed by energetic active training of foot movement.
8. Since above fractures involve a weight-bearing joint surface, weight-bearing should not be allowed until solid union of the fractures is obtained.

Incidence of DVT Following Surgery of the Foot and Ankle
Authors: Gregory Solis, MD, Terence Saxby, FRACS
Date of Publication: Foot & Ankle International, May 2002

Major Points of Interest:

1. 201 patients completed a survey of potential DVT risk factors and had bilateral duplex ultrasound performed from the popliteal vein distally.
2. Procedures were classified as forefoot, midfoot, hindfoot, and ankle based on Mizel et al.
3. 33.5% of patients were immobilized postoperatively.
4. Seven out of 201 (3.5% total population) had true DVT. None of these 7 patients had clinical symptoms associated with DVT (pain, palpable cord, swelling or Homan's sign).
5. Risk factors = hindfoot surgery with our without immobilization, increased age and tourniquet time. BMI was only found to be a risk factor for "occlusive DVT"
6. DVT following foot and ankle surgery is rare, but more prevalent than previously suggested. However, they are mostly asymptomatic and do not progress proximally.
7. Authors agree with Mizel et al that, "routine DVT prophylaxis is not indicated in patients undergoing foot and ankle surgery."

Jones's Fracture: Fracture of Base of Fifth Metatarsal
Author: Stewart, I.M.
Date of Publication: pp 190-198, 1960

Major Points of Interest:

1. Jones's Fracture takes its origin from Sir Robert Jones who suffered the injury while dancing (1902)
2. Author postulated that fracture occurs due to powerful soft tissue attachments to the base of the 5th metatarsal, making it easier for the bone to fracture rather than dislocate. Attached structures:
    a. Joint capsule
    b. Calcaneometatarsal band of plantar fascia
    c. Peroneus brevis
    d. Peroneus tertius
    e. Flexor digiti minimi
    f. Abductor digiti minimi
    g. Interosseous muscles
3. Author classifies Jones's fractures based on location(s)
    a. Fracture at the junction of shaft and base
        i. Comminuted
    b. Fracture at the Styloid process
        i. With joint involvement - found to be most common

Are isolated, non-displaced medial malleolus fractures always benign in patients with diabetes?
Authors: Wenjay Sung, DPM, Sherunda Smith, DPM, MPH, & Dane Wukich, MD
Date of Publication: The Journal of Diabetic Foot Complications, January 2009

Major Points of Interest:

1. Purpose: to present a case report of an isolated non-displaced medial malleolus fracture that progressed to significantly dislocated, unstable, trimalleolar ankle fracture with acute Charcot arthropathy over short period of time.
2. HPI: 57 y/o female presented to the ED complaining of left ankle pain. She had a non-displaced medial malleolus fracture after twisting her ankle while walking down stairs. PMH: IDDM w/neuropathy, hyperlipidemia, CAD w/bypass grafting, CVAs, metastatic melanoma, and osteoporosis. Treatment: splinted (radiographs showed excellent anatomic alignment) and given a walker; instructed to be NWB and follow-up in one week.
3. At follow-up visit, the ankle was grossly unstable and had a medial malleolar ulceration. Radiographs revealed unstable fracture dislocation with significant displacement of the medial malleolus fracture fragment. There was severe edema and increased skin temperature about the ankle as well as absence of protective sensation. Diagnosis: acute Charcot arthropathy and acute cellulitis.
4. Treatment: IV antibiotics, I&D of ulcer, TAL, closed reduction of the fracture, and multiplane external fixator with Steinmann pin across ankle joint, and bone stimulator used postoperatively. Patient instructed to remain NWB for 3 months.
5. External fixator was removed after 12 weeks and a total contact cast was applied. At 2 years follow-up, she had a clinically stable ankle joint and a propulsive, plantigrade foot.
6. Although studies suggest successful outcomes with non-operative treatment of isolated, non-displaced fractures of the medial malleolus, there remains an uncertainty associated with the soft tissue injury that may lead to a late subluxation of the ankle.
7. Significant changes in ankle contact characteristics due to soft tissue injury may occur prior to radiographic evidence of damage. Deltoid ligament injury can lead to ankle instability, resulting in complications such as nonunion, malunion, arthritis, and ankle dislocation.
8. This patient could initially be characterized as having Stage 0 Charcot due to the diabetic sensory neuropathy and acute non-displaced fracture. Although treated appropriately, the lack of protective sensation and pain feedback may have masked the severity of her injury.
9. Although an isolated non-displaced medial malleolus fracture is typically benign, clinicians treating diabetic patients w/neuropathy may need to take extra precaution for these seemingly minor injuries.
10. The treatment protocol can be adjusted for this patient population by prolonging their period of NWB, followed by a prolonged period of protected WB. The amount of follow-up should also be doubled for all diabetic ankle fractures in an attempt to prevent complications.

Timing of Definitive Fixation for Comminuted Talar Fracture in Patients with Multiple Injuries
Authors: Wenjay Sung, DPM, Michael Ryan, DPM, Ivan S. Tarkin, MD
Date of Publication: The Foot and Ankle Online Journal, August 2009

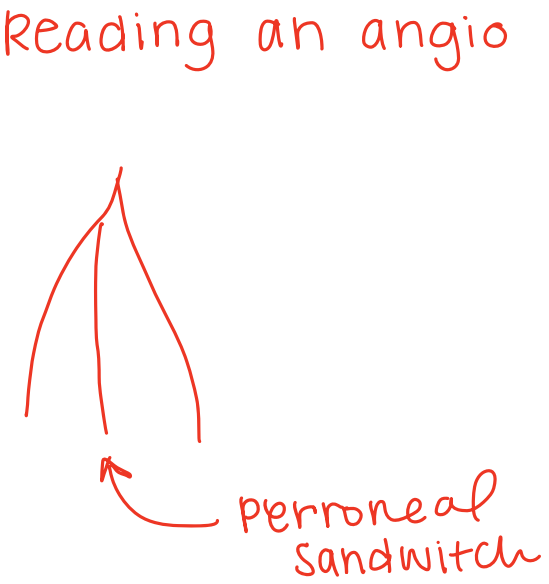
Major Points of Interest:

1. Comminuted talar fractures are commonly the result of high-energy trauma and frequently associated with multiple injuries.
2. The most life threatening injuries must be treated first; however, the foot and ankle cannot be overlooked. Delayed fixation of comminuted talar fractures increases the chances of osteonecrosis.
3. Treatment goals should include anatomic reduction, preservation of motion, joint stability, and minimization of complications. In poly-traumatized patients, these goals remain valid although the timing of talar fracture fixation in this patient population remains controversial.
4. Valler, et al., found no correlation between surgical delay and development of osteonecrosis, but did find a significant association of osteonecrosis with comminuted fractures.
5. The blood supply of the talus is vulnerable after traumatic injury due to its retrograde blood supply, especially comminuted fractures involving the neck and body.
6. Irreversible osteochondral injury to the tibiotalar, subtalar, and talonavicular joints can lead to early post-traumatic arthrosis.
7. Delicate care of the soft tissue is vital to the traumatized limb. External fixation is commonly implemented for compromised soft tissue structures and gross instability. External fixation will keep the fractures stable until a more definitive treatment, such as internal fixation, can be done at a later time period.
8. By allowing for inflammatory mediators to decrease the hope is to prevent a “second hit phenomenon.” The application of this concept to foot and ankle trauma has the potential to help prevent postoperative complications.
9. Tran and Thordarson determined that patient functional outcomes were significantly worse off in poly-traumatized patient with foot and ankle injuries than those without. It is therefore critical to implement aggressive care for poly-traumatized patients with comminuted talar fractures.

Angiosomes of the Leg: Anatomic Study and Clinical Implications
Authors: Taylor, M.D., Ian; Pan, M.D., Ren
Date of Publication: Journal of the American Society of Plastic Surgeons, September 1998

Major Points of Interest:

1. Plastic surgery, specifically flaps, should be planned based on known vessels to the area.
2. This study explored the vascular contribution to the skin, muscles and bones derived from the popliteal, anterior tibial, peroneal and posterior tibial arteries between the knee and the ankle.
3. Arterial supply to the skin, muscles, and periosteum of bones of the leg was examined in twelve fresh cadaveric lower limbs over a 2-year period.
4. Frequently, the connections between adjacent angiosomes occurred within tissues and not between them.
5. The skin, bones and most muscles received branches from two or more angiosomes, revealing important anastomoses through which the circulation is reconstituted when a source artery is interrupted by disease or trauma.
6. The muscles of the anterior compartment of the leg were supplied from one angiosome, helping to explain the variable clinical pictures and syndromes seen in cases where circulation is compromised or interrupted.
7. This study provides information that can help in the design or redesign of flaps in the leg for local or free transfer.
8. The information reveals the pathways through which the supply to the remaining tissues is reconstituted when one of the source arteries is harvested with a free flap, especially when multiple tissues are included in the transplant.



Fractures of the Base of the Fifth Metatarsal Distal to the Tuberosity
Author: Torg, JS
Publication: JBJS, February 1984

Major Points of Interest:

1. Fractures of the proximal end of the 5th metatarsal may involve the tuberosity or a 1.5 cm long segment of bone distal to the tuberosity. It is important to understand the response to treatment differs between these fractures.
2. In acute fractures with no intramedullary sclerosis, the treatment of choice is immobilization in a non-weight-bearing plaster boot for 6 to 8 weeks.
3. Radiographic evidence of intramedullary sclerosis partially obliterating the medullary cavity in patients such as athletes who require expedite healing, surgical means is preferable.
4. The purpose of surgical treatment is to: (1) re-establish the continuity and (2) facilitate healing of the fracture by inserting an inlay bone graft.
5. Poorly organized sclerotic intramedullary bone that forms when union is slow contributes to the frequent delay in healing, re-fracture, and non-union after this injury.
6. Complete union is achieved only when the medullary canal is recanalized.
7. If radiographs demonstrate non-union with dense sclerotic bone adjacent to the fracture line and a completely obliterated medullary cavity, medullary curettage and autogenous inlay bone-grafting are recommended in all athletes and should be considered in symptomatic non-athletes.
8. Delayed union and non union are treated by 2 basic surgical techniques: (1) intramedullary fixation using a screw and (2) a sliding or inlay bone graft.
9. The procedure of choice for delayed union and non-union is intramedullary curettage and inlay bone-grafting because it is technically simple, not associated with perioperative complications, and resulted in 95% rate of union compared to intramedullary screw fixation.

Overtightening of the Ankle Syndesmosis: Is It Really Possible?
Authors: Paul Tornetta III MD, Jeffrey E. Spoo MD, Fletcher A. Reynolds MD, Cassandra Lee BS.
Date of Publication: JBJS, April 2001

Major Points of Interest:

1. Purpose: To determine whether compression of the distal tibiofibular syndesmosis with the ankle in plantarflexion restricts ankle dorsiflexion.
2. Methods: 17 cadaveric ankles were fully examined in this study (19 were originally used). Initial range of ankle motion was measured after transecting the tendinous portion of the Achilles tendon. All capsular and ligamentous structures of the ankle and subtalar joint remained intact.
3. Methods: A 2-mm K-Wire was placed into the distal tibia in the sagittal plane and a second K-Wire was placed in the talar neck. The angle between the K-wires and the ankles during maximal dorsiflexion were measured both before and after compression of the syndesmosis. The syndesmosis was compressed using a 4.5mm fully threaded cortical lag screw and washer with the ankle in a plantarflexed position.
4. Results: The difference between maximal ankle dorisflexion before and after syndesmotic compression averaged $0.5^\circ \pm 1^\circ$, which was not found to be significant. Therefore, there was no difference between values for maximal dorsiflexion before and after compression of the syndesmosis.
5. Conclusion: Maximally dorsiflexing the ankle during syndesmotic fixation in order to prevent over-tightening and thus loss of dorsiflexion is not required. It is more likely that anatomic reduction of the syndesmosis is the key aspect for syndesmotic fixation and that the degree of ankle dorsiflexion during the fixation is unimportant.

Surgical Treatment of Talar Body Fractures
Author: Vallier, HA
Date of Publication: JBJS, September 2003

Major Points of Interest:

1. This study aims to characterize talar body fractures, to describe one treatment approach, and to evaluate clinical, radiographic, and functional outcomes of operative treatment. This was the first study to assess functional outcomes of patients with talar body fractures with use of the FFI and the MFA scales.
2. Most common mechanism of injury was falls from a height and motor vehicle accidents.
3. The authors suggest that urgent reduction of dislocations of the talar body may help maintain the remaining blood supply, thus decreasing likelihood of osteonecrosis.
4. Increased rates of osteonecrosis and collapse were found with open fractures. Open fractures were associated with worse functional outcomes.
5. High MFA scores, indicating more diminished function, were found and suggest that fractures of the talar body are associated with poor outcomes in relation to other hindfoot or midfoot injuries.
6. Talar body fractures are often severe injuries. ORIF with small-fragment and mini-fragment implants may restore congruity of the ankle and subtalar joints.
7. In this study, early complications were not uncommon and most of the patients had x-ray evidence of osteonecrosis and/or post traumatic arthritis.
8. Associated talar neck and open fractures more commonly resulted in osteonecrosis or advanced arthritis.
9. In this study, most of the patients returned to their previous level of employment, though worse functional outcomes were noted for patients with advanced posttraumatic arthritis and with osteonecrosis of the talar dome that had progressed to collapse.
10. Authors stressed the importance of counseling patients regarding these devastating injuries and informing them of their prognosis and potential complications.

Diagnosis and Treatment of First Metatarsophangeal Joint Disorders. Section 1: Halllux Valgus
Author: Vanore, JV
Publication: JFAS, May-June 2003

Major Points of Interest:

1. Hallux valgus deformity is an inherited, progressive deformity often associated with certain foot types, with symptoms aggravated by shoe wear.
2. Hallux valgus deformity may be classified into stages 1, 2, and 3. These stages are based on the progression and degree of deformity of HA and the IM angle.
3. Although conservative measures may be used initially to reduce the symtomatology associated with this deformity, surgical repair is often necessary to correct the hallux valgus and its associated deformities.
4. Hallux valgus can present with numerous associated findings that are part of a syndrome of forefoot derangement and may include: hammertoe deformity of the 2nd toe, plantar callus, central metatarsalgia, pronated foot type, ankle equines, and/or ingrown toenail.
5. Stage 1 hallux valgus deformity is defined as an IM angle <12° and an HA angle <25°. Typically, soft tissue tendon balance and exostectomy with/without a distal osteotomy are performed.
6. Stage 2 deformities have an IM angle ≤16° with an HA angle of ≥25°. The joint congruency must be evaluated. Capsule-tendon balancing is performed with or without osteotomy of the 1st metatarsal and/or proximal phalanx. When hypermobility of the 1st ray is encountered or is in the presence of sever deformity, a metatarsal cuneiform arthrodesis may be considered.
7. Stage 3 deformities have an IM angle that is usually >16^{o} and an HA angle ≥35^{o}. The MTP joint may be deviated or subluxed. Severe deformities often present with associated findings in addition to hallux valgus. Capsule-tendon balancing with an osteotomy of the 1st metatarsal and/or proximal phalanx, double soteotomy of the 1st metatarsal, or metatarsal cuneiform arthrodesis are options for correction of the deformity.
8. In certain situations, 1st MTP joint resection arthroplasty, with or without a joint implant, or arthrodesis may be performed, as in the case of patients with rheumatoid arthritis or degenerative joint disease or in patients requiring revision surgery.

Energy Cost of Walking of Amputees: The Influence of Level of Amputation
Authors: Waters, Perry, Antonelli, Hislop
Publicaton: JBJS, January 1976

Major Points of Interest:

1. Study Premise:
    a. Energy cost of walking was measured at three levels of amputation: above the knee, below the knee, and at the Syme's level. It was compared to that of normal, healthy persons, and it was compared between vascular and traumatic amputees.
2. Gait velocity, cadence, and stride length progressively decreased as the level of amputation became more proximal both in traumatic and vascular amputees. This is thought to be an adaptation to normalize energy costs.
    a. Gait velocity, cadence, and stride length were less for each level of amputation in the vascular amputees versus the traumatic amputees. This is primarily figured to be due to the age differences among subjects (vascular- old; traumatic- young)
3. Oxygen consumption as percent of their maximum aerobic capacity was normal in all amputees—with exception of above knee vascular amputees (elevated). This reflects the idea that the patients modified their walking speeds to keep energy costs within normal limits.
    a. This is important because oxygen demand above 50% maximum aerobic capacity calls upon anaerobic (inefficient) pathways for energy, and is associated with more rapid fatigue. Thus, below knee and distal amputations are essential for the older amputee with vascular disease to decrease the demand on the heart.
4. Energy cost per meter increased as the level of amputation became more proximal both in traumatic and vascular amputees. Values were also greater in vascular versus traumatic amputees. This reflects a loss in gait efficiency.
5. Rate of oxygen consumption, heart rate, and respiratory quotient were significantly increased in all amputees when walking with crutches and without a prosthesis.
6. Amputation should be performed at the lowest level in order to preserve function.

Conservative Treatment of Acute Lateral Ankle Sprains
Authors: Weber, Jason M., DPM & Maleski, Richard M., DPM
Publication: Clinics in Podiatric Medicine and Surgery, 2002

Major Points of Interest:

1. The correct method of treating acute inversion ankle sprains is controversial. Treatment options include: surgical repair or reconstruction, rigid or semi-rigid casting, bracing, strapping, elastic bandaging, injectable steroids, NSAIDs and RICE etc…
2. ATFL is the weakest and most easily injured of the three collateral ligaments.
3. There are multiple classifications for ankle sprains that exist, usually progressing from Grade I-III in severity.
4. Recent meta-analysis concludes that surgical followed by functional treatment is superior to only functional treatment; however, surgery is not recommended for routine use due to the morbidity and expense of surgery. Nonetheless, most agree that when conservative treatment fails, secondary operative reconstruction of the ruptured ligaments can be performed with good results, even years after the acute injury.
5. Immobilization may have a role in treatment of older/inactive patients, but it is not the treatment of choice in most cases.
6. Functional treatment of ankle sprains with bandaging, early motion and weight bearing yields superior results than immobilization.
7. Functional rehab has three phases:
    a. Phase 1: Protection, rest, ice, compression and elevation until patient is able to bear weight comfortably ad the swelling and tenderness have decreased.
    b. Phase 2: Geared towards strengthening the peroneal and anterior group of muscles, until motion is restored.
    c. Phase 3: Involves re-establishing motor coordination through proprioception exercises, functional condition and endurance training.
8. You must look for other causes if residual morbidity in the form of chronic pain, swelling and instability of the ankle are present.
9. Conclusion: Functional treatment is the treatment of choice for grades I, II and even III lateral ligament injuries of the ankle, and early mobilization has been shown to get patients back to work and daily activities faster than immobilization.

Calcaneal Stress Fractures
Authors: Weber, Jason M. et. al.
Publication: Clinical Podiatric Medicine and Surgery, 2005

Major Points of Interest:

1. Stress fractures of the calcaneus are not as common as those occurring in the metatarsals, tibia and fibula. Due to their relatively uncommon incidence when compared with these other stress fractures and other causes of heel pain, such as plantar fasciitis, they are often misdiagnosed or overlooked.
2. Stress fractures have been categorized as fatigue or insufficiency fractures. Fatigue fractures are those that occur in normal bone, whereas insufficiency fractures are those that occur in diseased bone.
3. Bilateral incidence is not uncommon. When one is treating bilateral calcaneal stress fractures, investigation into metabolic bone disease should be considered.
4. Physical examination typically reveals pain with medial to lateral compression of the heel. The heel may be warmer than the surrounding tissues or the contralateral heel; edema can range from a fair amount of swelling to none. Ecchymosis is typically not observed, due to the fact that the cortex remains intact.
5. Stress fractures occurring in areas of primarily cancellous bone present radiographically as focal sclerosis. The sclerotic zone is oriented at right angles to the trabecular pattern of the calcaneus; best visualized on lateral films.
6. Bone scans remain the gold standard of diagnosing stress fractures. Calcaneal stress fractures typically display diffusely increased uptake especially in the posterior half of the calcaneus.
7. MRI is highly sensitive and relatively specific in diagnosing stress fractures. Because of its noninvasive nature and its superior specificity, some prefer MRI over bone scan in the evaluation of stress fractures. Hemorrhage and intraosseous edema associated with stress fractures may be visualized as high signal intensity on T2 and STIR images.
8. The current authors' treatment of stress fractures of the calcaneus includes relative rest, protected weight bearing in a rocker-bottom walking boot lined with a cushioning material, physical therapy, and COX-2 anti-inflammatory medications. The walking boot reduces and redistributes pressure and serves as a reminder to the patient to reduce his or her activity. Symptoms typically improve within the first 2 weeks, and most patients are fairly asymptomatic by 3 weeks. Treatment is typically continued for 6 weeks. Other beneficial treatment options include external bone stimulation and strict nonweight bearing, but neither is typically necessary.
9. Conclusion: The majority of plantar heel pain is diagnosed as plantar fasciitis or heel spur syndrome. When historic or physical findings are unusual or when routine treatment proves ineffective, one should consider an atypical cause of heel pain. Stress fractures of the calcaneus are a frequently unrecognized source of heel pain. In some cases they can continue to go unrecognized because the symptoms of calcaneal stress fractures sometimes improves with treatments aimed at plantar fasciitis.

Thromboembolism Following Foot and Ankle Surgery: A Case Series and Literature Review
Authors: Wukich, M.D., Dane; Waters, D.P.M., Dana
Date of Publication: Journal of Foot & Ankle Surgery, 2008

Major Points of Interest:

1. Venous thromboembolism following major orthopedic procedures of the hip and knee is well documented and patients are routinely prophylaxed due to knowledge of this complication with proximal procedures.
2. Foot and ankle surgery is considered a low-risk procedure for the development of venous thromboembolism.
3. Deep venous thrombosis prophylaxis is rarely administered, which is supported by the literature regarding deep venous thrombosis following foot and ankle surgery.
4. This study reviewed current literature for risk factors and occurrence of thromboembolism after foot and ankle surgery.
5. This study also restrospectively reviewed patients who developed venous thromboembolism after forefoot, midfoot, hindfoot and ankle procedures.
6. Only 4 of a consecutive series of 1000 patients (0.4%) developed a deep venous thrombolism and 3 of 1000 (0.3%) developed nonfatal pulmonary emboli over the course of 1.5 years.
7. The authors report each patient with complicating venous thromboembolism had at least 2 identifiable risk factors.
8. Combining the authors' series with conclusions from current literature provides a total incidence of 0.83% or 53 patients with diagnosed venous thrombolism among 6357 patients who underwent foot and ankle surgery.
9. The incidence of venous thromboembolism following foot and ankle surgery is rare (less than 1%).
10. The need for routine propylaxis postoperatively is not supported by any high level of evidence studies.

Rigid Stabilization of Partial Incongruous Lisfranc Dislocations: A Cannulated Solid Screw Technique
Authors: Dane K. Wukich, MD, Dekarlos M. Dial, DPM
Date of Publication: The Foot & Ankle Online Journal, June 2009

Major Points of Interest:

1. Review the Hardcastle classification of Lisfranc fractures-dislocations.
    a. This article focuses on the partial incongruent Lisfranc dislocations. The authors share their surgical technique, specifically for lateral displacement injuries affecting only the second metatarsal (Type B2). Their technique is also useful for patients with symptomatic subtle diastasis.
    b. The most common Lisfranc injury in the athlete is the partial incongruous injury (Type B1 & B2)
2. Multiple methods for stable anatomic reduction and internal fixation for Lisfranc injuries; screw fixation has emerged as the superior fixation method and is the current recommendation.
    a. Disadvantages of screw fixation include articular cartilage damage and screw breakage.
    b. The authors claim that their technique preserves cartilage congruity and provides stabilization until ligamentous healing is restored.
3. In a cadaveric study, dorsal plating versus screw fixation showed no difference in resisting tarsometatarsal displacement.
4. Highlights from their surgical technique (Note these are just highlights and not the full detail of the article):
    a. This technique allows for direct visualization of the injury, anatomical reduction, articular cartilage preservation, and rigid solid screw stabilization.
    b. Technique is not advised for patients with neuropathic arthropathy, peripheral vascular disease, insensate feet, open physis, complex dislocations, and open fracture dislocations.
    c. Stress radiography (stress abduction) is essential.
    d. The Lisfranc ligament integrity is evaluated. A ruptured Lisfranc ligament, fibrotic tissue and or bone fragments can impede anatomical reduction and must be debrided and or excised (care is taken to protect NV bundle esp. deep plantar artery).
    e. Reduction is accomplished usually a bone tenaculum and a 1.2 mm guide wire is placed from proximal plantar to distal dorsal through the far cortex of the 2nd metatarsal base. They remove the guide wire so that it exits dorsal/distally. This is done because if the wire fails/breaks that it is easier to retrieve using this technique.
    f. A cannulated 2.5 mm drill bit is used as a guide/over drill and internal fixation is achieved utilizing a 4.0 mm solid screw.
    g. Post op. protocol
        i. Jones compression dressing with a posterior splint for 1st 7 days.
        ii. Short leg NWB cast for 2 weeks.
        iii. Day 21 sutures removed and another short leg cast is applied.
        iv. Pts are NWB for a further 6 weeks, followed by protected WBing in a walking boot with progression to normal shoe gear as tolerated.

Safety of Total Contact Casting in High-Risk Patients with Neuropathic Foot Ulcers
Authors: Wukich, M.D, Dane K.; Motko, R.N., John
Date of Publication: Foot & Ankle International, August 2004

Major Points of Interest:

1. Total contact casting is effective in offloading the plantar aspect of the foot in patients with diabetes and neuropathic ulcers by transferring load from the forefoot and midfoot to the hindfoot.
2. These patients are considered at high risk for skin-related complications during total contact casting due to sensory neuropathy.
3. The purpose of this prospective study was to determine the frequency of complications during treatment of neuropathic ulcers using total contact casting.
4. Thirteen patients with 18 neuropathic ulcers were treated with a consecutive series of 82 total contact casts.
5. Fourteen minor complications occurred during the consecutive series of 82 casts (17%).
6. Among the 14 complications, 13 were due to skin irritation. The final complication was due to a tight cast. These complications required no alteration in treatment protocol.
7. Fifteen of the 18 neuropathic ulcers healed with total contact casting at an average of 5.2 weeks.
8. The authors feel that total contact casting can be used safely in high-risk patients with neuropathic problems, but minor complications should be anticipated.
9. Major complications that interfere with the treatment of the plantar ulcer can be minimized with careful technique, close follow-up and thorough patient education.

Charcot Arthropathy of the Foot and Ankle: Modern Concepts and Management Review
Authors: Wukich, Dane K. & Sung, Wenjay
Publication: Journal of Diabetes and Its Complications, 2008

Major Points of Interest:

1. Charcot arthropathy remains a poorly understood disease, although recent research has improved the level of knowledge regarding its etiology and treatment. The effects of Charcot arthropathy are almost exclusively seen in the foot and ankle, and the diagnosis is commonly missed upon initial presentation.
2. Diabetic Charcot arthropathy typically presents as a warm, swollen, and erythematous foot and ankle. The appearance of the extremity may be indistinguishable from infection, and almost all afflicted patients have severe peripheral neuropathy. It is this lack of protective sensation that delays identification of bony stress injuries that may overload the insensate limb, leading to an active Charcot process.
3. The current majority of clinicians believe that a combination of theories may contribute to the pathogenesis of this disease. The debate between “neurovascular" and “neurotraumatic" remains a mystery of Charcot arthropathy.
4. Eichenholtz (physiological stages) and Sanders & Fryberg classifications (based on anatomical patterns of Charcot).
5. The goals for every patient undergoing treatment for an acute or quiescent Charcot process should be to maintain or achieve structural stability of the foot and ankle, to prevent ulceration, and to preserve a plantigrade foot.
6. Most clinicians agree that the indications for surgical intervention in Charcot arthropathy include, but are not limited to, recurring ulcer(s), joint instability, pain associated with malalignment, offending exotosis, and potential skin complications from inability to brace or from a nonplantigrade foot.
7. Maintain a high index of suspicion in diabetic patients with peripheral neuropathy who experience pain or edema with or without a history of trauma and recognize ACA and promptly offload the affected limb.
8. There is fair evidence for the arthrodesis of unstable Charcot deformity of the foot and/or ankle as indicated in patients who fail nonoperative treatment. There are Level 4 studies with a consistency of successful results.
9. There is not enough evidence available to determine any advantage of internal fixation over external fixation, and vice versa, in the surgical reconstruction of Charcot deformities.
10. There is good evidence to support the use of tendo-Achilles or gastrocnemius muscle lengthening to decrease forefoot pressure and to improve ankle equinus. There is one Level I study and several Level III and IV studies with a consistency of successful results.

Biotenodesis Screw for Fixation of FDL Transfer in the Treatment of Adult Acquired Flatfoot Deformity
Authors: Wukich, Dane K. et. al.
Publication: Foot & Ankle International, July 2008

Major Points of Interest:

1. Posterior tibial tendon dysfunction (PTTD) is categorized into 4 stages. In stage II PTTD, patients present with a flexible planovalgus deformity. A flexor digitorum longus (FDL) tendon transfer with an adjunctive bony procedure (calcaneal osteotomy) is the most common method of surgical correction. Myerson et al retrospectively reviewed the results of 129 patients that underwent FDL transfer and medial displacement osteotomy of the calcaneus and found that such treatment in those with stage II PTTD yielded excellent results.
2. The purpose of this study was not to report the results of FDL transfer and calcaneal osteotomy for stage II PTTD, but rather to introduce an alternative method of fixation for the transferred FDL tendon using a biotenodesis.
3. They have observed that the recommended technique using a biotenodesis screw for FDL tendon transfer can be somewhat difficult, especially when attempting to place the appropriate amount of tension to the transferred tendon. We present an alternative method of reattaching the transferred FDL tendon utilizing the biotenodesis screw.
4. The manufacturer's recommended technique relies on interference fixation of the biotenodesis screw with the FDL tendon. As the screw is inserted into the navicular, it is vital to achieve accurate tension of the transferred tendon with the screw using the suture loop handle provided by the manufacturer. Utilizing that technique, the authors have experienced difficulty with maintaining proper tension of the FDL tendon into the navicular.
5. The authors preferred technique differs in that they do not use the suture loop handle when the FDL tendon is transferred through the navicular. The points of fixation include the interference fit in the osseous tunnel, as well tendon-to-tendon fixation at the insertion. These points of fixation allow for bone-to-tendon healing and tendon-to-tendon healing, making the repair less dependent on one point of fixation.
6. Twenty-five consecutive adult patients with stage II PTTD underwent FDL tendon transfer using a biotenodesis screw for fixation and a medial displacement calcaneal osteotomy, as well as other adjunctive procedures for other deformities.
7. Results: Proper tension and secure fixation of the transferred FDL tendon was achieved with this technique in 24 of the 25 patients. 92% of patients reported satisfaction with the procedure performed. The one intraoperative failure occurred in a patient who underwent simultaneous fusions of the naviculo-cuneiform and a first metatarsocuneiform joint, that patient was satisfied with the result at 1-year follow-up.

Correction of Metatarus Primus Varus with an Opening Wedge Plate: A Review of 18 Procedures
Authors: Wukich, Dane K,. MD, Roussel, Andy J., DPM, Dial Derkarlos M., DPM
Publication: The Journal of Foot & Ankle Surgery, 2009
Level of Clinical Evidence: IV

Major Points of Interest:

1. The opening base wedge osteotomy is a safe and useful surgical alternative for correction of moderate to severe hallux valgus (HAV) deformities with substantial metatarsus primus varus (MPV).
2. When the deformity is combined with a first IM angle of >14 degrees, or metatarus primus varus deformity, a diaphyseal or proximal osteotomy is often indicated. The opening base wedge osteotomy is a difficult procedure and the following complications can be noted: dorsiflexion of the 1st met. can result in metatarsalgia and/or hallux rigidus, whereas overcorrection of MPV can lead to hallux varus. Furthermore, inadequate fixation can result in fracture of the osteotomy, and delayed union or nonunion.
3. The authors combined the modified McBride bunionectomy with a proximal first metatarsal opening base wedge osteotomy. Fixation was achieved without bone grafting with a titanium fixation plate specifically designed for opening proximal osteotomies.
4. To assess the outcomes, both preoperative and postoperative weight-bearing radiographs of 18 procedures (16 patients) were measured to compare changes in the following radiographic variables: IM angle, 1st metatarsal protrusion distance, and Seiberg Index.
    a. Seiberg Index (SI): Measured using the perpendicular distance in mm from the dorsal aspect of the 2st met. shaft to the dorsal aspect of the 1st met. shaft, at the level of the 1st met neck and at the point 1.5 cm distal to the 1st met. base. The proximal measurement was then subtracted from the distal measurement to get the SI. A negative SI indicated plantar declination of the 1st met, and a positive value indicated dorsal angulation of the 1st met.
5. Results: IM angle decreased by a mean 9 degrees (range, 2-15), the hallux valgus angle decreased by a mean of 13.5 degrees (range, 0-56), and the change in 1st metatarsal protrusion distance was +2.6mm (range, -0.8 to 6.6). The preoperative and post operative change in the SI was not statistically significant. AOFAS Hallux Metatarsophallangeal-Interphalageal score, the postoperative scores were statistically significantly higher than the preoperative scores. 2 recurrences (11.11%) and 14 of 16 (87.5%) patients were satisfied with their operation.
6. Conclusion: The opening wedge osteotomy using the Low Profile Plate System is a reproducible, safe, and effective technique for reconstruction of moderate to severe HAV with MPV. It provides stable fixation, thus allowing early weight bearing with functional rehabilitation. Caution must be exercised when using this technique in patients with a long 1st met. or preoperative stiffness of the 1st MPJ. The results of this study support the use of the opening wedge plate for correcting moderate to severe HAV with MPV.

Failed Intramedullary Screw Fixation of a Proximal Fifth Metatarsal Fracture (Jones Fracture) in a Division I Athlete: A case report

Authors: Dane K. Wukich, MD, Bora Rhim, DPM, Dekarlos M. Dial, DPM

Date of Publication: The Foot and Ankle Online Journal, June 2009

Major Points of Interest:

1. A Jones fracture has been defined as an acute fracture occurring in the proximal portion of the fifth metatarsal base at the metaphyseal and diaphyseal junction. The treatment of Jones fractures continues to remain controversial and challenging. The type of screw fixation in the treatment of Jones fractures is controversial. Many surgeons support intramedullary screw fixation for Jones Fractures.
2. The authors present a case report of a Division I competitive basketball player who sustained a proximal 5th metatarsal fracture. His initial treatment involved open reduction and internal fixation (ORIF) with a small diameter intramedullary screw. The patient developed a nonunion and required autogenous bone grafting with larger diameter screw fixation. Selection of screw type and diameter deserves thorough consideration.
    a. The 5th metatarsal shaft bowing and intramedullary canal width deserve special attention. If unrecognized, variations in 5th metatarsal diaphyseal anatomy could lead to intraoperative morbidity. Pre-operative lateral and oblique radiographs allow assessment of severe lateral bowing of the shaft.
    b. When utilizing intramedullary screw fixation for Jones fractures, we interpose the screw over the metatarsal under fluoroscopy. This facilitates accurate intramedullary screw selection and avoids potential intraoperative fracture.
3. Optimal screw selection for operative treatment in competitive athletes with 5th metatarsal Jones fracture has not been determined. Cannulated screw fixation has been a popular method of fixation and has gained wide acceptance. Due to increased failure rates in elite athletes from refracture, delayed union, and non union, Wright, et al., recommended using a larger solid screw in competitive athletes to counter the higher amount of torsional stress placed on the fracture site.
4. In conclusion, intramedullary screw fixation provides excellent stabilization in proximal 5th metatarsal fractures. The 5th metatarsal diaphyseal anatomy and patient body mass deserve thorough consideration in selecting a screw that affords adequate endosteal purchase and stability.

Postoperative Infection Rates in Foot and Ankle Surgery: A Comparison of Patients with and without Diabetes Mellitus

Authors: Wukich, Dane K., MD, et. al.
Publication: The Journal of Bone and Joint Surgery, Volume 92
Level of Evidence: Prognostic Level II

Major Points of Interest:

1. Patients with diabetes mellitus may be at increased risk for infection following foot and ankle surgery. This study aimed to determine whether patients with a diagnosis of diabetes mellitus have an increased rate of infection following foot and ankle surgery compared with a population of patients without diabetes.
2. The study also sought to demonstrate whether patients with complicated diabetes (presence of neuropathy, a history of ulcers, Charcot neuroarthropathy, or vascular disease) are at greater risk of postoperative wound infection than are patients with uncomplicated diabetes or patients without diabetes.
3. Their hypotheses were that the infection rate for the general population would be lower than that for those patients with diabetes mellitus, and that diabetic patients with more advanced disease would be at even higher risk for postoperative infection.
4. They conducted a retrospective review of the charts of 1000 patients who had orthopaedic foot and ankle surgery.
5. The overall infection rate in this study was 4.8%. 52% of all infections occurred in their diabetic study group, which represented only 19% of the patient population. Postoperative infections occurred in significantly more persons with diabetes (13.2%) than in those without diabetes (2.8%). Diabetic patients were five times more likely to experience a severe infection requiring hospitalization compared with patients without diabetes.
6. After removing the patients with neuropathy from the analysis, there was no longer a significant association between diabetes and infection. The presence of complicated diabetes increased the risk of postoperative infection by a factor of ten compared with the risk for patients without diabetes and by a factor of six compared with the risk for patients with uncomplicated diabetes. They did not identify a significantly increased risk of infection in patients with uncomplicated diabetes compared with that in patients without diabetes.
7. Patients with diabetes mellitus are at increased risk of severe infection compared with those without diabetes. Patients with uncomplicated diabetes did not have an increased risk of postoperative infection compared with patients without diabetes, whereas patients with complicated diabetes had a significantly higher rate of postoperative infection.

Complications Encountered with Circular Ring Fixation in Persons with Diabetes Mellitus
Authors: Wukich, Dane K., MD et. al.
Publication: Foot & Ankle International, October 2008
Level of Evidence: IV, Retrospective Case Study

Major Points of Interest:

1. The purpose of this study was to identify and report the complications associated with the use of circular ring external fixation in diabetic patients, and to compare the frequency of complications with patients without diabetes. They hypothesized that complication rates would be higher in the diabetic population.
2. External fixation has potential advantages of being less invasive than internal fixation, reducing surgical morbidity, allowing monitoring of wounds or plastic reconstructive procedures, and allowing for gradual correction of deformities. A major disadvantage of traditional internal fixation is hardware failure in patients with poor bone quality.
3. A number of complications can occur when external fixators are applied to the foot and ankle including nerve or vessel injury, tendon impingement, skin traction, joint stiffness, edema, wire breakage, infection and pain. The most common complication reported in the literature is pin tract infection.
4. Retrospectively, 56 consecutive patients underwent midfoot, hindfoot and/or ankle surgery were treated with circular ring fixation. It included 33 diabetic patients in the study group, and 23 non-diabetic patients in the control group.
5. Results: Diabetics have a 7-fold risk for any wire complication compared to patients without diabetes. Women are protected from wire complications with a risk reduction of 78% compared to males. They found no adverse effects of BMI, obesity, age, smoking, neuropathy, or Charcot neuroarthropathy on a satisfactory recovery.
6. The limitations of this study included its retrospective design, small sample size, lack of preoperative or postoperative scoring, and no standard postoperative protocol. It is unclear whether they had adequate power to identify all risk factors for complications.
7. Conclusion: Minor complications are common and close follow-up is important to prevent major complications. In particular, patients with diabetes experience a greater number of complications. During their preoperative consultations, all patients are informed that virtually 100% of them will experience a complication during treatment. These fine wire complications do not require a change of treatment in the vast majority of patients.

The Key Role of the Lateral Malleolus in Displaced Fractures of the Ankle
Authors: Isadore G. Yablon M.D., Frederick G. Heller M.D., Leroy Shouse M.D.
Date of Publication: JBJS Am., March 1977

Major Points of Interest:

1. Purpose: To investigate the reason why late degenerative arthritis develops in some patients who sustain displaced bimalleolar ankle fractures
    a. Investigates whether fixation of the medial or lateral malleolus dictates better anatomical alignment of the talus, thus reducing talar tilt (which causes degenerative arthritis)
2. Clinical Methods: 53 patients who sustained abduction-external rotation ankle injuries were studied (excluded open fractures).
    a. 42 patients had bimalleolar fracture
        i. 17 patients had medial malleolus reduced and fixed with a screw
        ii. 14 patients underwent incomplete reduction of talus and lateral malleolus
        iii. 10 patients had lateral malleolus exposed and reduced under direct visualization.
    b. 11 patients sustained lateral malleolar fracture and torn deltoid ligament
        i. Treated by ORIF of lateral malleolus; Deltoid ligament not repaired.
3. Laboratory Methods
    a. Fresh cadaveric ankles were used to assess ankle stability following:
        i. Isolated division of deltoid ligament
        ii. Isolated division of fibular collateral ligaments
        iii. Transverse osteotomy of medial malleolus at the level of the ankle joint (all ligaments intact)
        iv. Short oblique osteotomy of lateral malleolus (all ligaments intact)
        v. Simulated external rotation-abduction fracture (medial malleolar osteotomy at level of joint and oblique osteotomy of lateral malleolus)
4. Clinical Results:
    a. Patients with accurate reduction of lateral malleolus with 4-hole plate showed anatomical reduction of talus radiographically.
    b. 14/17 patients with medial malleolar reduction had residual talar tilt
5. Laboratory Results:
    a. Isolated division of deltoid ligament --- no lateral ankle instability resulted
    b. Isolated division of fibular collateral ligaments --- marked talar instability + 30 deg of external rotatory instability
    c. Transverse osteotomy of medial malleolus --- 10 deg of external rotatory instability + little valgus instability
    d. Short oblique osteotomy of lateral malleolus --- Marked rotatory and valgus instability
6. Clincal discussion:
    a. All symptomatic patients with incomplete reduction of the lateral malleolus had a residual talar tilt
7. Laboratory discussion
    a. Division of the Deltoid ligament alone or medial malleolus does not create a large degree of instability of the ankle
    b. When manually trying to reduce a displaced bilmalleolar fracture, impingement of the lateral malleolus on the proximal fibular fragment can prevent the talus from resuming its anatomical position

8. General Conclusions:
    a. Repositioning of the talus can be achieved by forcibly internally rotating the ankle but it stretches the fibular collateral ligament. Once external immobilization is discontinued, however, the ligaments remained stretched and talar instability may ensue, causing future degenerative arthritis.
    b. For unstable bimalleolar fractures or those in which the lateral malleolus is fractured and the deltoid ligament is torn, the talus will remain attached to the lateral malleolus.

Operative Treatment of Syndesmotic Disruptions Without use of a Syndesmotic Screw: A prospective clinical study

Authors: Ken Yamaguchi M.D., Christopher H. Martin M.D., Scott D. Boden M.D., and Panos L. Labropoulos M.D.

Date of Publication: Foot & Ankle International, August 1994

Major Points of Interest:

1. Purpose: To evaluate the validity of treatment guidelines established by Boden et al. that suggest reduction of the syndesmosis does not require a syndesmotic screw in patients sustaining a Weber type C fibular fracture both with and without deltoid tears.
2. The guidelines suggested by Boden et al. were developed using a cadaveric study. Their underlying premise was that intact soft tissues (particularly the interosseous membrane) should convey enough stability to the syndesmosis once medial malleolar and fibular fixation is achieved to prevent tibiofibular diastasis. The guidelines are as follows:
    a. Transsyndesmotic fixation is unnecessary in Weber type C injuries associated with medial malleolar fractures and no deltoid tear.
    b. If there is a deltoid tear, syndesmotic diastasis is demonstrated only if the fibular fracture is more than 3.0-4.5cm above the tibiotalar joint. Therefore, Transsyndesmotic fixation is not necessary if there is a deltoid tear with a fibular fracture that is less than 3.0-4.5 cm above the tibiotalar joint.
3. Materials and Methods: 21 patients with Weber type C ankle fractures underwent treatment based on the above guidelines. All fractures were treated using open reduction internal fixation according to traditional AO guidelines. 3 of the 21 patients met the criteria for syndesmotic screw fixation. Following surgery, all patients were placed in a non-weightbearing short-leg cast for 4 weeks, followed by 2-4 weeks of being in a weight-bearing cast. Patients were then placed in a splint for an additional 4 weeks.
4. Materials and Methods: Radiographic evaluation was implemented to measure anterior and posterior tibiofibular spaces, medial clear space, and syndesmotic space. Stress views were also taken in 10/21 patients in order to reproduce a pronation-external rotation force analogous to the cadaveric study by Boden et al.
5. Results: Follow-up ranged from 1-3 years during which time, radiographic evaluation revealed anatomic reduction of the fibula and medial malleolus in each case. For 16 of the 18 patients who did not receive a syndesmotic screw, follow-up static view radiographs revealed no increase in syndesmotic space measurement compared to the post-operative radiographs. Two patients had an increase in syndesmotic space of 1.0mm. Medial clear space revealed less than 1mm of widening in any case.
6. Results: In the 10 patients who underwent stress views, the syndesmotic space on average, increased by about 0.4mm. Five patients had no measurable widening. No patient had widening greater than 1.0mm.
7. Conclusion: No clinically significant widening of the syndesmosis or medial clear space was observed on static or stress view radiographs in the patients who did not require treatment with a syndesmotic screw.
8. Conclusion: Findings of this study are consistent with those of Boden et al.'s cadaveric study where transsyndesmotic fixation of Weber type C ankle fractures is not required when: 1) rigid fixation of the medial and lateral fractures is achieved, 2) fibular fracture is within 4.5cm of the joint and 3) there is a deltoid ligament tear.
9. It is suggested that given these guidelines, transsyndesmotic fixation is unnecessary in many cases and the need for such fixation may be evaluated before surgery by assessing the integrity of the deltoid ligament and level of the fibular fracture.

Predislocation Syndrome: Progressive Subluxation/Dislocation of the Lesser Metatarsophalangeal Joint
Author: Yu, JV
Publication: JAPMA, April 2002

Major Points of Interest:

1. Yu and Judge Stages of Predislocation Syndrome:
    a. Stage 1: Mild edema plantar, and often dorsal, to the MPJ. Extreme tenderness is present when the joint is manipulated. No anatomical malalignment is noted clinically.
    b. Stage 2: Moderate edema with noticeable deviation of the affected digit both clinically and radiographically. The affected toe does not purchase the ground and is quite evident in stance evaluation.
    c. Stage 3: Moderate edema is present about the entire circumference of the MPJ and extends into the toe. More pronounced deviation and possible subluxation/dislocation of the toe are present.
2. Instability of the lesser MPJ is often the sequel of a chronic inflammation resulting from increased and abnormal weightbearing stresses about the lesser MPJ.
3. The end result of this derangement is attenuation or rupture of the plantar plate, capsule, or collateral ligaments with subsequent subluxation or dislocation of the digit.
4. Although the 2nd digit is the most commonly and most profoundly affected (ie, crossover 2nd toe deformity), the adjacent 3rd and 4th digits can also be affected. Additionally, one or more lesser digits can be simultaneously involved.
5. In early predislocation syndrome, conservative treatment with anti-inflammatory medication, shoe modification, padding, and taping may be successful in prevent progression of the deformity.
6. In long standing deformity of the lesser MPJ, surgical intervention is warranted when painful fixed subluxation or dislocation is present and conservative treatment modalities have failed or when prolonged conservative care is not desirable.

A Retrospective Study of Patients with Diabetes Mellitus After Partial Foot Amputation and Hyperbaric Oxygen Treatment

Authors: Zgonis, D.P.M., Thomas; Garbalosa, Ph.D., Juan

Date of Publication: Journal of Foot & Ankle Surgery, July/August 2005

Major Points of Interest:

1. Hyperbaric oxygen therapy (HBOT) is an effective adjunct to therapies aimed to improve limb salvage and reduce length of hospital stay and wound care expenses for patients dealing with diabetic foot ulcers, refractory osteomyelitis and necrotizing soft tissue infections.
2. Transcutaneous partial pressure of oxygen (TcPo2) is an indirect measure of underlying tissue oxygen tension and provides information regarding local tissue oxygenation available for healing.
3. A TcPo2 level of 30 to 40 mmHg is a reliable and successful predictor of wound healing for above-the-knee or below-the-knee amputations, but knowledge regarding the role and efficacy of HBO and TcPo2 as predictors of wound healing in partial foot amputations is not elaborate.
4. This study retrospectively reviewed 35 patients (40 feet) having received HBOT after partial foot amputation between 1990 and 2000, specifically identifying pre-operative TcPo2 levels, number of hyperbaric treatments, time to final outcome, use of revascularization procedures and post-operative outcomes.
5. Twenty eight subjects or 70% had a successful outcome, defined by complete healing and absence of ulceration at the amputation site and no need for additional surgical procedures to heal the amputation site.
6. Twelve subjects or 30% had a failed outcome, defined by lack of healing or presence of an ulcer at the site of amputation or requirement for additional surgical procedures to heal the amputation site.
7. The level of amputation, use of revascularization procedures, time to final outcome and number of hyperbaric treatments were not significantly different among successful or failed outcome groups.
8. The mean preoperative TcPo2 levels were greater in the successful (24 mmHg) than in the failed (11 mmHg) outcome groups.
9. All patients with a TcPo2 level greater than 29 mmHg had a successful outcome. Patients with a successful postsurgical outcome had a mean of 20 HBO treatments and took 44 days to final outcome, while those with a failed postsurgical outcome had 16 HBO treatments and took 216 days to final outcome.
10. This study supports the current literature indicating that the presence of TcPo2 levels above 29 mmHg is a strong predictor of a successful outcome in these patients.

Lisfranc Arthrodesis

Authors: Zgonis, D.P.M., Thomas; Burns, D.P.M., Patrick

Date of Publication: Clinics in Podiatric Medicine and Surgery, 2004

Major Points of Interest:

1. Lisfranc fracture-dislocation is a debilitating injury that requires early diagnosis and proper treatment. Increased awareness and the use of proper imaging techniques can quickly identify these fractures.
2. The eponym, Lisfranc, has been used to describe injuries to the tarsometatarsal joint complex, which is composed from the bases of the five metatarsals and its articulations with the three cuneiforms and cuboid.
3. Injuries to the Lisfranc's joint can be direct or indirect with the indirect mechanism far more common and is associated with an acute abduction or plantarflexion of the forefoot.
4. A high index of suspicion is required for the diagnosis of tarsometatarsal complex injury. History and physical examination, radiographs, stress views, CT scanning, and MR imaging can be used to diagnose any trauma related to the Lisfranc joint.
5. The Hardcastle classification is commonly used today. Type A (total) includes incongruity of the entire tarsometatarsal joint and displacement on a sagittal or coronal plane. Type B (partial) can be divided into a partial incongruity with medial displacement of the first metatarsal or in combination with one or more lesser metatarsals two through four. Type B (partial) can also be a partial incongruity with lateral displacement that affects one or more of the lesser four metatarsals without including the first. Type C (divergent) is divided into a partial or total incongruity. The first metatarsal is displaced medially, and any combination of the lesser metatarsals is displaced laterally.
6. Early diagnosis of the injury with prompt treatment is paramount. The tarsometatarsal joint is complex and must be reduced accurately. Once reduction is noted, percutaneous pins or screws can be placed across the joints for the more simple types of injury. Open reduction of Lisfranc injuries, the first ray is initially addressed followed by the Lisfranc ligament complex. Stabilization of the lateral column is the final step.
7. Patients are immobilized in a cast non–weight bearing for 8 to 12 weeks. Some physicians begin early range of motion at 2 weeks and partial weight bearing as early as 6 weeks based on radiographic healing.
8. Many patients will still develop posttraumatic arthritis despite proper reduction and fixation,
9. In cases where diagnosis is delayed or traumatic arthritis is severe, arthrodesis of the joint should be performed to eliminate pain and achieve a stable midfoot.