

**Trauma**

# Ankle fracture and MRI

J Bone Joint Surg Am. 2010;92:512-23

- MRI and ankle arthroscopy have recently drawn attention to the frequency of intra-articular injuries associated in Ankle #
- Retrospectively reviewed their experience in the treatment of acute ankle fractures with use of open reduction and internal fixation as well as routine ankle arthroscopy<sup>2</sup>.
- The authors correlated arthroscopic findings Vs Lauge-Hansen classification system.
- The prevalence of associated chondral injury was 73% (sixty-one of eighty-four). Overall, fifty-one ankles (61%) sustained a chondral injury to the talar dome, five (6%) had lesions involving the tibial plafond, and ten (12%) sustained an injury to the medial and or lateral malleolus.
- Type-IV fractures were 8.1 and 9.7 times more likely to be associated with two or more chondral lesions than their type-I and type-II fracture counterparts, respectively. T

# LISFRANC

## A, The plantar aspect

The plantar bundle of the Lisfranc ligament (pC1-M2M3),  
The first tarsometatarsal ligament (pC1-M1),  
The second tarsometatarsal ligament (pC2-M2).



## • B, The dorsal aspect

The dorsal bundle of the Lisfranc ligament (dC1-M2)  
The medial-middle cuneiform ligament (dC1-C2).



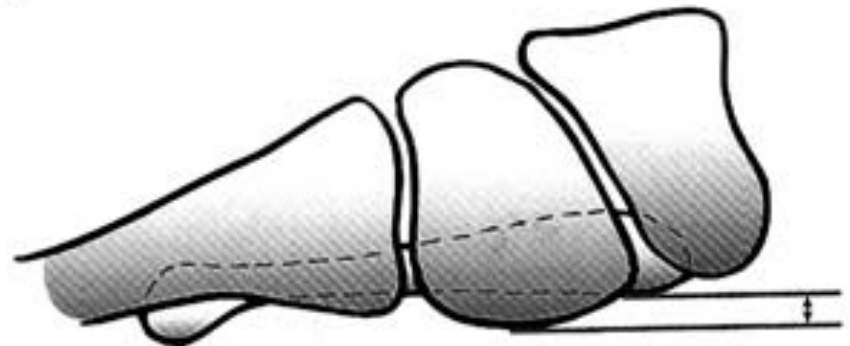
B

Normal relationship demonstrating the position of the fifth metatarsal plantar to the medial cuneiform (a positive value).

Flattening of the midfoot arch positions the medial cuneiform plantar to the fifth



A



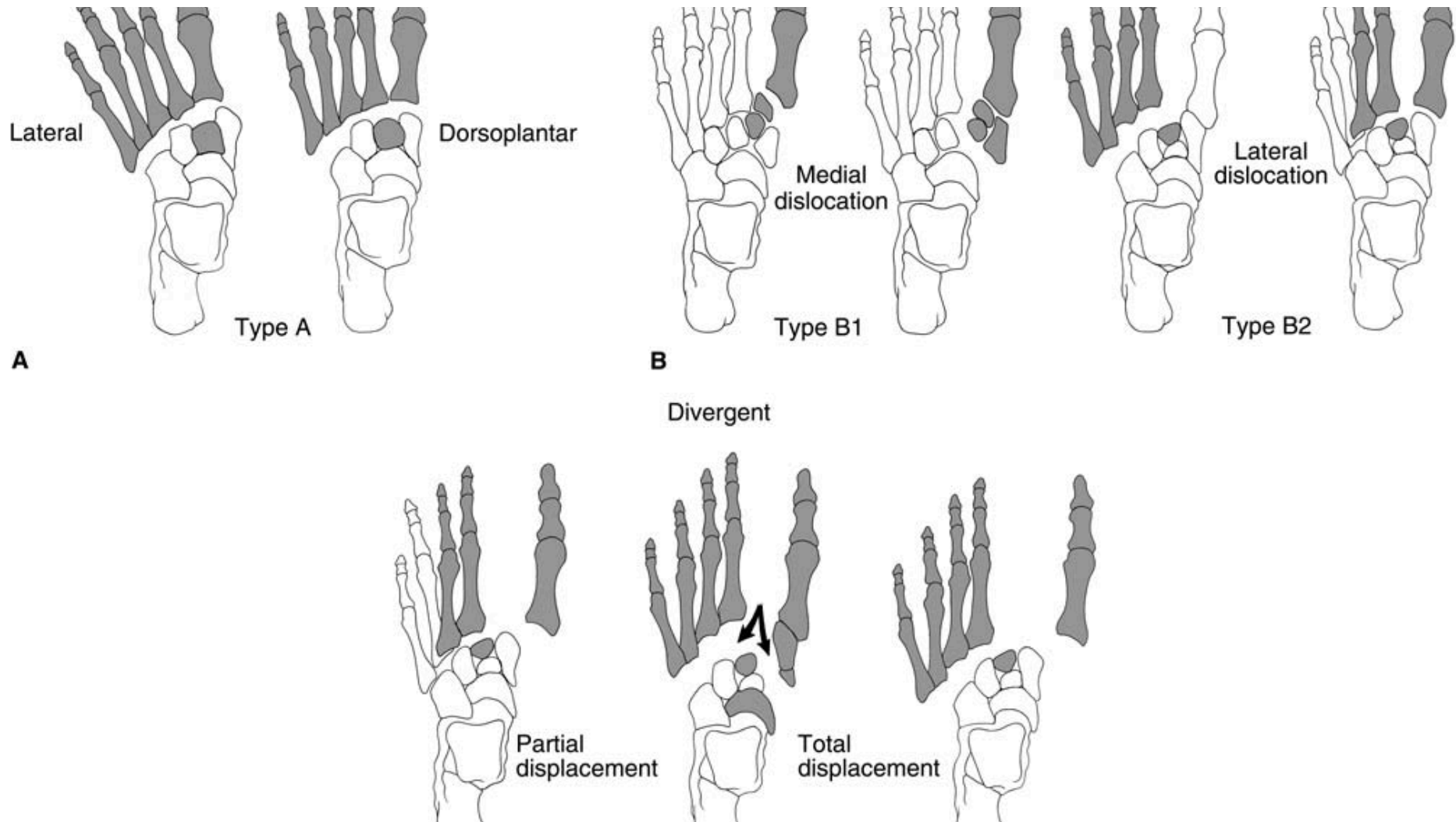
B

- Injuries TMT joint complex      1 per 55,000 each year in the US

Misdiagnosed                      20% of these injuries

- Mechanism                      1/3 rd of all injuries due to low energy injury
- Lisfrank ligament :              is 8 to 10 mm wide and 5 to 6 mm thick,

# classification



# Classification

Type A, total incongruity “homolateral.”

which involves displacement of all five metatarsals (MTs) with or without fracture at the base of the second MT.

The usual displacement is lateral or dorsolateral

Type B injuries, one or more articulations remain intact.

Type B1 represents partial incongruity with medial dislocation.

Type B2 represents partial incongruity with lateral dislocation;

Type C injuries are divergent

*Foot Ankle* 1986;6:225-242.)

# X ray

- 1. Many so-called sprains present with NWB radiographs that are difficult to interpret.
- 2. AP radiographs are used to demonstrate malalignment of the I and II TMT joints, whereas incongruity at the third and fourth joints are better visualized on a 30° oblique view.
- 3. On the lateral view, the dorsal and plantar aspects of the MTs should correspond with the cuneiform and cuboid.
- 4. Diastasis between the first MT–medial cuneiform and second MT of 2 mm greater
- 5. Avulsion of the second MT base or medial cuneiform produces a fleck sign [Myerson]



- In a randomized prospective study, Ly and Coetzee<sup>36</sup> compared ORIF with primary arthrodesis in patients with a primary ligamentous injury. They found that patients treated with primary arthrodesis had a quicker recovery and a superior return to function than did those who underwent ORIF.
- In a recent prospective study evaluating all types of Lisfranc complex injuries, no difference
- was seen in functional outcome between groups treated with ORIF versus primary arthrodesis.

However, the reoperation rate was significantly lower in the fusion group than in the ORIF group, in whom routine removal of hardware was performed (17% versus 79%,  $P < 0.05$ ).

- Concerns exist regarding the potential damage that may be caused by traditional screw placement across the TMT joints, possibly resulting in the late development of posttraumatic arthritis and a poor outcome.
- We consider using dorsal plating for bridging fixation of comminuted fractures with bony fragments in the TMT joints. Dorsal plate fixation has been shown to be as biomechanically sound as screw fixation.
- Although K-wire fixation minimizes the articular damage, redisplacement rates are unacceptably high.

- **CALCACEAL  
FRACTURES**

# Calcaneal fracture

- Weber et al., in a retrospective review of their experience with the treatment of Sanders type-2 and type-3 calcaneal fractures, compared outcomes following lateral plating through an extensile approach with those following the use of a limited-incision technique with percutaneous fixation.
- The limited-incision technique involved a short lateral subtalar incision with percutaneous manipulation of the posterior tuberosity with use of a Schanz pin and manual disimpaction of the fracture fragments. The fracture fragments were fixed with transverse screws across the posterior facet and percutaneous screws directed from the posterior tuberosity into the
- anterior process and the subchondral bone of the posterior facet.
- The limited-incision technique resulted in a significant reduction in operating time, saving an
- average of fifty-two minutes per operation, while producing equivalent fracture alignment and joint reduction as judged clinically and radiographically.
- The extended approach and lateral plating resulted in more wound-healing complications
- and more cases of postoperative complex regional pain syndrome.

# CALCANEAL FRACTURE

*J Am Acad Orthop Surg 2011;19:*

27-36

- MALUNION Following calcaneal fracture is high, regardless whether a patient is treated nonsurgically or surgically.
- Loss of hindfoot height,  
Varus heel position,  
Widening of the hindfoot  
Subfibular impingement and irritation of the peroneal tendon and/or sural nerve.
- Posttraumatic arthritis Subtalar joint

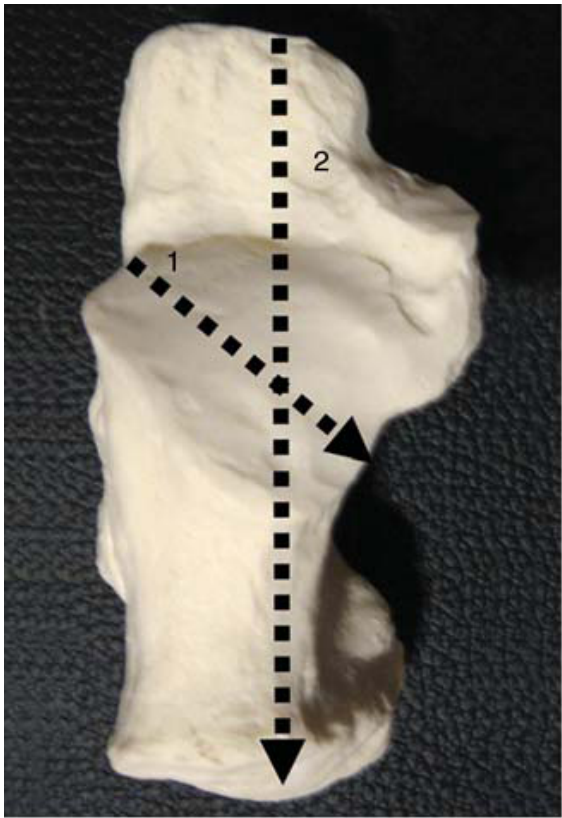
## Nonsurgical treatment

Activity modification, bracing, orthoses, and injection, is effective in many patients.

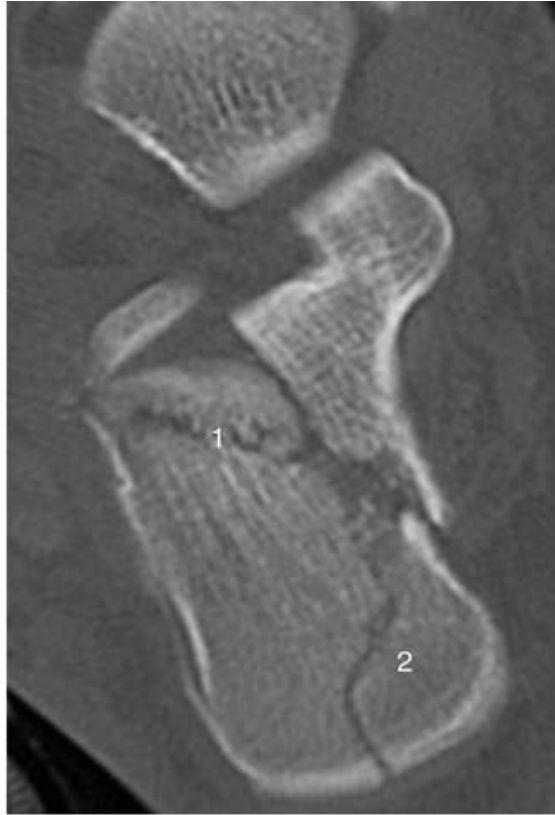
## Surgical treatment

Simple ostectomy, subtalar arthrodesis with or without distraction, or corrective calcaneal osteotomy.

# Primary[1] fracture/Secondary [2]



A

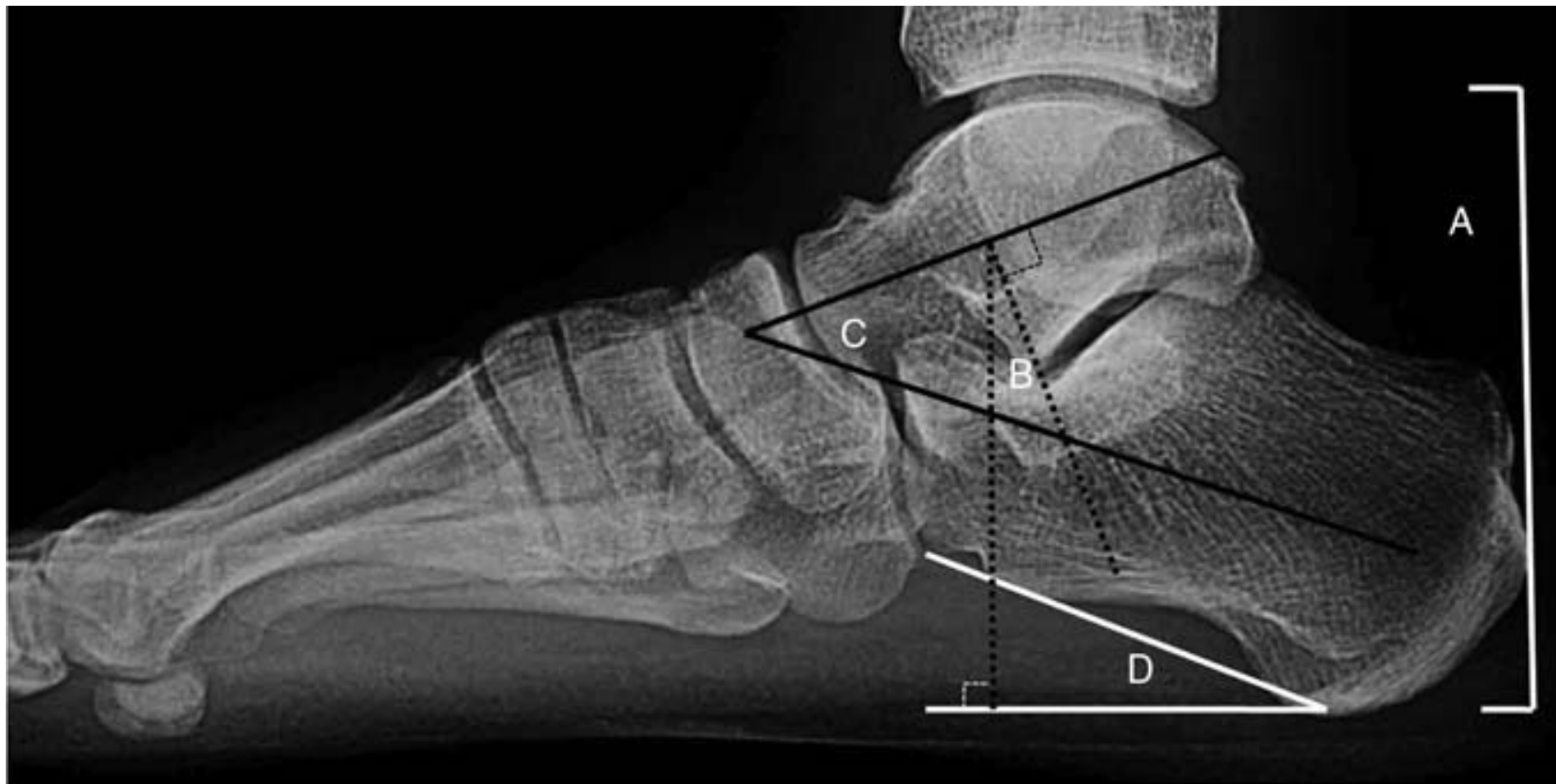


B



C

- The primary fracture line (1) crosses the posterior facet of the subtalar joint.
- Axial CT scan (B) and Harris axial radiograph (C) showing the location of the primary fracture line.



Weight-bearing lateral radiograph of a healthy foot demonstrating normal

Hindfoot height

**(A) is measured from the most superior portion of** the dome of the talus to the most plantar aspect of the calcaneus

Talar declination angle **(B)**,

**a line is** drawn along the longitudinal axis of the talus, and a second line is drawn perpendicular to the first line. The talar declination angle is measured between this second line and a vertical line that is extended downward from the junction of the first two lines.

The lateral talocalcaneal angle **(C)**

**is** created at the junction of a line drawn along the longitudinal axis of the talus and a line drawn along the longitudinal axis of the calcaneus.

The calcaneal pitch **(D)**

**is the angle subtended by a line drawn tangential to the plantar** surface of the calcaneus and a horizontal line representing the floor.

# Heel Widening/Subfibular Impingement

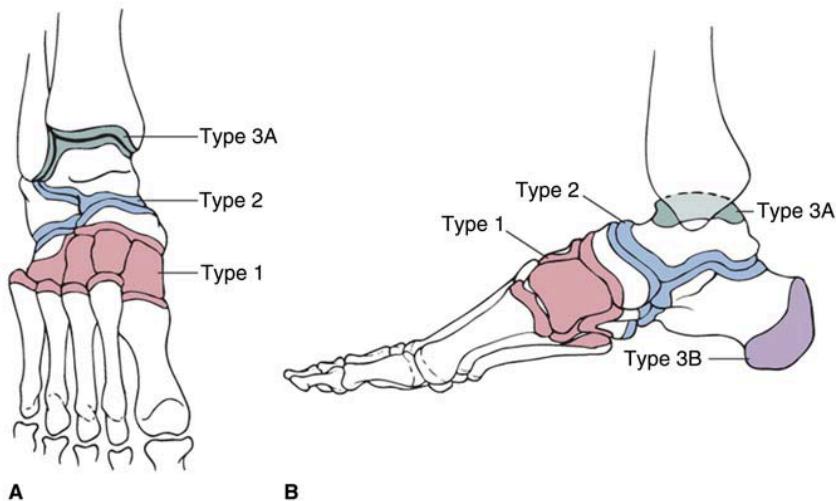
- Displacement of the lateral wall of the calcaneus results in heel widening, which may lead to encroachment on the peroneal tendons and sural nerve.
- In cases of severe displacement, painful calcaneofibular abutment may occur.<sup>6</sup> Even moderate displacement can cause peroneal impingement, tendinitis, and tears.
- High-energy injury may cause frank dislocation of the peroneal tendons.
- Injury to the sural nerve may be caused by tension or impingement.
- Iatrogenic sural nerve injury resulting in neuroma formation may be the result of previous surgical treatment.

# Varus Heel

- The fractured calcaneal tuberosity usually assumes a varus position
- The motion of the subtalar and the transverse tarsal joints is coupled; thus, a varus hindfoot
- locks the transverse tarsal joint. As a result, the talonavicular joint becomes inflexible during gait, and the foot loses its natural shock absorbing effect through eversion of the heel in early stance phase.
- Varus hindfoot can accelerate wear in the adjacent joints of the foot and may lead to eccentric loading of the ankle, with increased loads on the medial side of the joint.

# Charcoats Arthropathy

- neuroarthropathy is a common cause of morbidity in persons with diabetes mellitus and sensory neuropathy.
- Prevention of disease progression remains the mainstay of treatment, with surgical intervention usually reserved for refractory cases.
- Late deformities are often complicated by chronic ulceration, infection, and osteomyelitis.
- Eichenholtz classification, and
- Advances in surgical treatment have demonstrated new options for limb salvage. Pharmacologic therapies directed toward decreasing bone resorption have also shown promise for treatment, but clinical application remains theoretical.
- *J Am Acad Orthop Surg* 2009;17: 562-571



- AP **(A)** and lateral **(B)** drawings demonstrating Brodsky's anatomic
- classification of the Charcot foot. Type 1 involves the tarsometatarsal and
- naviculocuneiform joints. Type 2 involves the subtalar and/or the Chopart
- joint. Type 3A involves the ankle joint. Type 3B involves fracture of the
- posterior calcaneal tuberosity.

# Posttraumatic Arthrosis

- Displacement of as little as 2 mm can alter contact pressures on the subtalar joint.<sup>8</sup> Anatomic reduction of this joint has been shown to improve outcomes and diminish the likelihood of posttraumatic arthrosis. **Patients who sustain high-energy injury may develop posttraumatic arthrosis regardless of anatomic reduction.**
- **Irreversible damage to the articular cartilage may occur at the time of initial injury.** Thus, posttraumatic arthrosis may develop in nonsurgically managed calcaneal fractures, in surgically treated fractures with nonanatomic alignment, and in cases of anatomic reduction in which the initial impact caused irreversible damage to the cartilage.

# Pain

## **Lateral Pain**

- 1. Peroneal tendon problems, subtalar arthrosis, calcaneocuboid arthrosis, symptomatic hardware, and/or sural nerve problems.
- In contrast, reproduction of pain with palpation of the calcaneocuboid joint localizes the pathology to this joint. Calcaneocuboid arthrosis may occur as frequently as subtalar arthrosis does, but it is less frequently symptomatic.

## **Anterior Pain**

- Pain over the dorsum of the foot and pain that is localized to the anterior ankle is most commonly caused by anterior impingement of the talar neck on the distal tibia resulting from loss of calcaneal height. Talar neck impingement resulting from loss of talar declination may occur when the talar neck comes into contact with the anterior lip of the tibia.

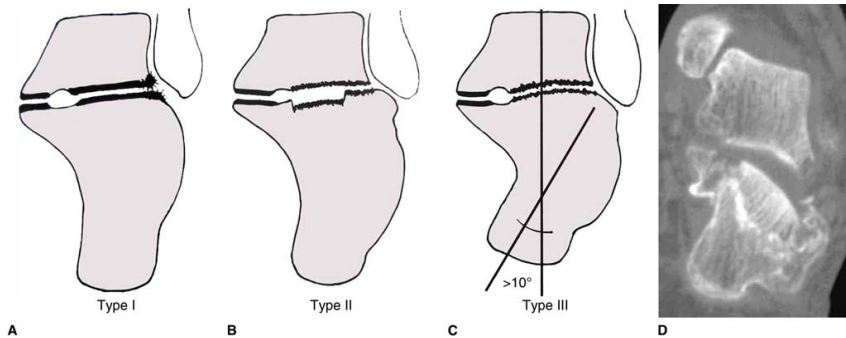
## **Plantar Pain**

- Plantar foot pain or heel pain may result from plantar exostosis or, more typically, from injury to the heel pad. Plantar exostoses from a malunited calcaneus are readily visible on lateral radiographs..

- Chronic heel pain may be caused by injury to the soft tissues that attach the heel pad to the calcaneus or to the heel pad itself. The surgeon may observe atrophy of the heel pad, which may be a result of the original injury.
- **Medial Pain**
- Result of tarsal tunnel syndrome or FHL tendon problems. Displacement of the tuberosity resulting in valgus deformity may place tension along the tibial nerve as it traverses the tarsal tunnel.
- **Complex Regional Pain Syndrome**
- A selective diagnostic injections using a local anesthetic (1% lidocaine and 0.5% bupivacaine) may be helpful in deter-

# Stephens and Sanders CT classification of calcaneal malunion

- **A, Type I malunion demonstrating a large lateral wall exostosis, no malalignment, and little or no subtalar arthrosis.**
- **B, Type II malunion demonstrating lateral wall exostosis, significant subtalar arthrosis, and varus malalignment  $\leq 10^\circ$ .**
- **C, Type III malunion is similar to type II but with varus malalignment  $>10^\circ$ .**
- **D, Coronal CT scan demonstrating type III malunion.**



# Lateral Wall Decompression

- Lateral decompression is best used in
- cases with large lateral wall exostoses
- and little or no subtalar arthrosis
- An extensile lateral approach, a subtalar Ollier approach, or a posterolateral longitudinal incision.
- The lateral wall is dissected subperiosteally and is excised using an osteotome.
- Bone wax
- A separate peroneal tenolysis or exploration may be required.
- +/- sural neurolysis
- Stephens and Sanders<sup>18</sup> reported six excellent results and one good result in their original series of patients treated with lateral decompression.
- More recently, Clare et al<sup>19</sup> reported an average postoperative AOFAS hindfoot score of 68.2 (maximum, 100) at 2-year follow-up in five Stephens type I malunions managed with lateral decompression.

# In Situ Subtalar Arthrodesis

- For symptomatic calcaneal malunion with minimal deformity but with significant subtalar arthritis (Stephens type II)
- Patients who do not report anterior ankle pain and who have no pain anteriorly
- on forced passive ankle dorsiflexion or while squatting are candidates
- branches of the sural nerve.
- The subtalar joint is reduced to approximately 5° of valgus and fixed using large-fragment, partially threaded screws.
- In situ subtalar fusion is associated
- with high rates of union (>90%) and
- patient satisfaction, improved pain
- and function, and low complication
- Rates.

## **Distraction Bone Block Arthrodesis**

- Distraction bone block arthrodesis is
- indicated in patients with calcaneal
- malunion who develop symptomatic
- subtalar arthrosis, loss of hindfoot
- height, and symptomatic anterior ankle
- impingement resulting from loss
- of talar declination (Stephens type II)
- The subtalar joint is distracted using a large distractor or laminar spreader

# Triple Arthrodesis

- Arthrodesis of the subtalar, talonavicular, and calcaneocuboid joints (ie, triple arthrodesis) may be indicated when the hindfoot pathology involves the talonavicular joint and/or the calcaneocuboid joint.
- Triple arthrodesis also may be indicated in the patient with preexisting deformity in conjunction with calcaneal malunion.