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Foot and Ankle Injuries

The fibula is the key to ankle stability. External rotation stress x-rays can assess the competency of the deltoid ligament. You need to differentiate between supination/external rotation Type II and supination/external rotation Type IV. If the injury is supination/external rotation Type IV, then the patient will need surgery.

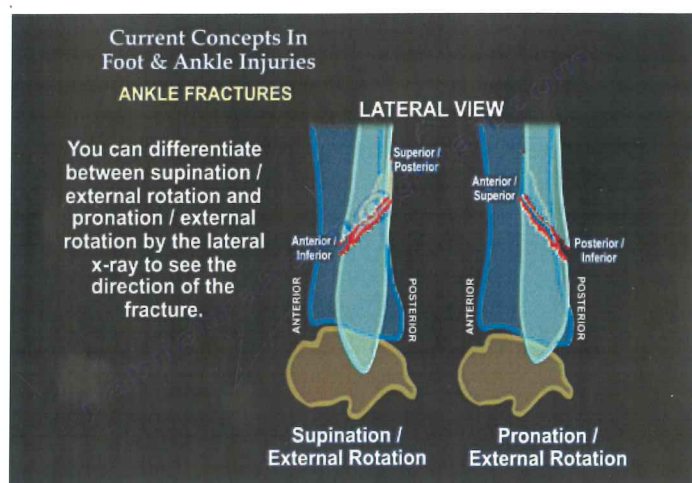
Check the medial clear space. With or without stress radiographs, if the medial clear space is more than 5 mm, then this means that the deltoid ligament is injured.

A vertical fracture of the medial malleolus is bad. You can have impaction of the anteromedial plafond. The screws need to be placed parallel to the ankle joint.

You can differentiate between supination/external rotation and pronation/external rotation by the lateral x-ray to see the direction of the fracture.

If you have an isolated lateral malleolar fracture that is nondisplaced with no talar shift, this can be treated conservatively. A displaced fracture with a talar shift will require surgery. In a talar shift, the talus moves laterally and displaces the fibula. 1 mm of displacement will decrease the tibiotalar contact by 42%. Normal braking response time will return to baseline at 9 weeks after surgery.

The posterior malleolar fixation should be done if more than 25% of the joint is involved.



Syndesmotic injuries are common in Weber C fractures, especially if there is a deltoid ligament injury. After fixation of the fracture, assess the stability intraoperatively with abduction/external rotation views. Measure it 1 cm above the ankle joint. If the tibiofibular clear space is greater than 5 mm or if there is widening of the medial clear space, then there is a syndesmotic injury. You must restore the length and rotation of the fibula before you do a syndesmotic fixation. Insert one or two screws about 2-4 cm above the joint.

Ankle Fractures and Diabetes

Make sure there is not neuropathy or charcot joint. You will do more fixation. You will do more percutaneous fixation. You will avoid infection. You will delay the weight bearing.

A pilon fracture (tibial plafond) is an axial load, high energy injury. It can occur due to a fall or from a car accident. There will be fracture of the ankle joint. The joint can be impacted and comminuted. The metaphysis is usually comminuted and shortened. There will be a bad soft tissue injury and the skin is badly bruised. The majority of the patients will have an associated fibular fracture. Typical fracture is composed of three components: a medial malleolar fragment,

anterolateral fragment (Chaput fracture – anterior inferior tibiofibular ligament is attached to this piece), and a posterolateral fragment (Volkman fracture – posterior inferior tibiofibular ligament is attached to this fragment). In case of an intact fibula, some of the ligaments are injured. Rule out syndesmotic injury variant with these injuries, either pure ligamentous or through a piece of bone that will be attached to the fibula. Treatment of a displaced pilon fracture will be a delayed open reduction internal fixation until the skin condition improves.

Continued on page 2

Use external fixation across the ankle (will reduce the soft tissue complication). Leave the external fixator in place until the soft tissue condition improves. Can take from 1-3 weeks. Then you can do limited or total fixation through a mini incision or extensile incision (depending on the situation). Limited fixation is popular and routinely used. Watch out for the superficial peroneal nerve when doing the anterolateral approach. Keep a 7 cm bridge between incisions. Soft tissue complications: You need to get the skin wrinkles before you do internal fixation.

A stress fracture of the navicular usually occurs in the central third. It occurs in athletes, especially baseball players. The risk of avascular necrosis is high. The stress fracture may not heal. The patient will have midfoot pain and swelling. X-rays may be normal or show a fracture. CT scan is better to show the fracture. MRI will increase the signal in T2. Treatment includes casting and non-weightbearing. Perform an ORIF in athletes, if there is a nonunion, if conservative treatment fails, or in displaced fractures.

Zone I proximal tubercle fractures, treatment is usually nonoperative (use a boot or a fracture shoe).

Zone II fracture (Jones fracture) at the 4th and 5th metatarsal articulation which is the junction between the metaphysis and the diaphysis. Zone II fracture occurs within the vascular watershed area and may lead to nonunion. Treatment of zone II fracture is nonweightbearing if the patient is not an athlete and the fracture is

not displaced. Perform a screw fixation for zone II fracture in athletes or if the fracture is displaced. Use a 4.5 screw, the length should be appropriate (please consider the curvature of the metatarsal so that you do not displace or distract the fracture). The patient may return to sports after radiographic healing of the fracture.

Zone III fracture is a stress fracture with occurs in athletes and usually requires surgery. Check the patient for cavovarus foot deformity.

Open fractures of the calcaneus may lead to amputation. There are two basic fragments of calcaneal fractures; anteromedial (sustentacular) fragment and the posterolateral (tuberosity) fragment. The two fragments are created by the primary fracture line. The secondary fracture line can cause joint depression or "tongue type" fracture. The calcaneocuboid joint could be injured in a large number of patients. The spine may be injured in about 10% of the cases. Compartment syndrome may occur in about 10% of the cases, which could give the patient claw toes. The outcome correlates with the number of fragments, the more fragments, the worse the outcome. Surgery is worse in men, manual laborers, patients older than 50 years of age, smokers, zero Bohler angle fractures, and obese patients. When you perform an ORIF or displaced intraarticular fractures, you need to wait for the wrinkle test (wait up to 2 weeks). If you perform an arthrodesis, you may do a distraction bone block for the subtalar joint in patients with arthritis (distraction arthrodesis).

Compartment Syndrome

Compartment syndrome of the foot is usually associated with high energy trauma, crushing injury, Lisfranc injury and calcaneal fractures. There are 9 compartments in the foot that can usually be

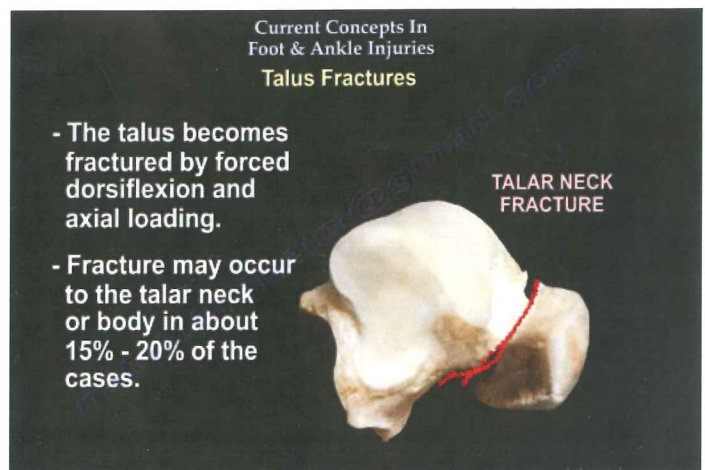
released by two dorsal incisions. Sometimes an additional medial incision is needed. The patient may have claw toes if the diagnosis is missed.

Talus Fractures

70% of the talus is covered by cartilage. The talus can become fractured by forced dorsiflexion and axial loading and may occur in the talar neck or body in about 15%-20% of the cases. Lateral process fracture could be missed thinking it is an ankle sprain (snowboarder's fracture). CT scan is helpful for this fracture. The posterior process is difficult to see, therefore difficult to diagnosis. Surgery is difficult. In talar neck fractures, the artery of the tarsal canal from the posterior tibial artery is the most important. The deltoid branch of the posterior tibial artery may be the only blood supply in Type III talar neck fractures.

What are the types of talar neck fractures? Hawkins's Classification: Type I – nondisplaced and 10% AVN. Type II – fracture with subtalar dislocation or subluxation. 50% AVN. Type III – fracture with subtalar and tibiotalar subluxation or dislocation. 90% AVN. Type IV – fracture with subtalar and tibiotalar dislocation and talonavicular subluxation. 90-100% AVN.

Get an x-ray of the AP, lateral and canal view. In the canal view, the



foot is 15° pronated with maximum plantar flexion. X-ray beam is directed 75° cephalad.

Continued on page 3

How do you treat talar fractures? Reduce the dislocation, it usually requires surgery (ORIF). If the talar fracture is open and the talus is extruded, then you will reposition it in its place and you will do a reduction and fixation.

What are the complications? Subtalar arthritis is the most common complication occurs up to 50%. Varus Malunion is due to medial comminution and is a preventable complication. Patients will have a decrease eversion. Treatment is a talar neck opening medial wedge osteotomy. Avascular Necrosis (AVN) – Hawkins’s sign: subcondylar lucency seen at 6 weeks on the mortise view x-ray. A lack of Hawkins’s sign means AVN of the talus is present.

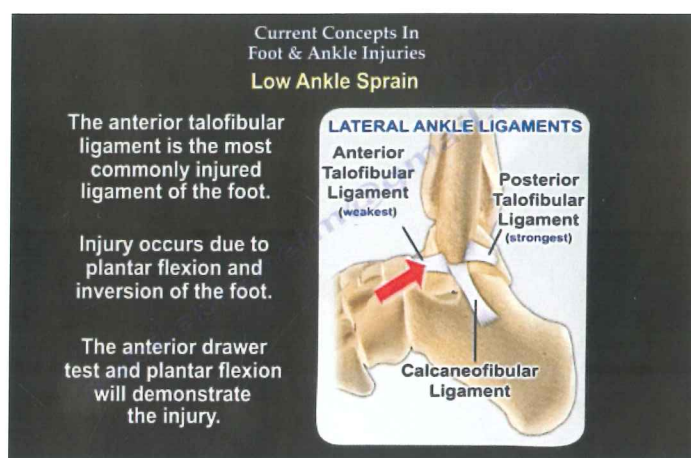
Ankle Sprain

There are two important ligaments in a low ankle sprain: the anterior talofibular ligament and the calcaneofibular ligament. A low ankle sprain is a big problem in athletes. Check for associated injuries. May need an MRI to rule out OCD lesion or peroneal tendon injuries. Also check for cavovarus foot. Also rule out a fracture of the 5th metatarsal base, anterior process fracture of the calcaneus, or a lateral or posterior process of the talus fracture. The anterior talofibular ligament is the most commonly injured ligament of the foot. Injury occurs due to plantar flexion and inversion of the foot. The anterior drawer test and plantar flexion will demonstrate the injury. A calcaneofibular ligament injury occurs due to dorsiflexion and inversion. You will find talar tilt and the drawer laxity will be in dorsiflexion. Get the standard AP, lateral and mortise view x-rays. You can also get stress view x-rays. There are two types: varus in low ankle sprains (can see the talar tilt) and external rotation valgus stress views in high ankle sprains. Treatment will include early functional rehab. Reconstruct the ligament if conservative treatment fails and the patient continues to complain of ankle stability. Make sure that you do not have superior retinaculum injury, which gives you peroneal tendon subluxation, and check that you do not have an OCD lesion. This is probably the time that you should get an MRI. Check for any malalignment such as cavovarus foot before any ligamentous reconstruction, which must be corrected before the reconstruction, otherwise the reconstruction will fail. Use the coleman block test to differentiate between flexible and rigid hindfoot varus.

High Ankle Sprain (Syndesmotic Injury): External rotational force –

There are two types of subtalar dislocations; medial and lateral. The key joint that is dislocated is the talonavicular joint. The medial dislocation occurs 60%-80% of the time and lateral occurs 20% of the time. The lateral subtalar dislocation is more open than the medial dislocation. The lateral dislocation also has more associated fractures and the foot appears pronated. The medial dislocation appears supinated. Treatment is a closed reduction plus a short leg cast. The physician should get a post reduction CT scan.

What if the joint becomes irreducible? On the medial side, you will have extensor digitorum brevis entrapment and the peroneal tendons. On the lateral side you have the tibialis posterior tendon.



may have an OCD or peroneal tendon injury with a high ankle sprain. The patient will have lateral ankle pain proximal to the anterior inferior tibiofibular ligament. On the medial side, there may be tenderness or swelling. The patient will be unable to bear weight. The squeeze test will probably be positive. Compression to the tibia and fibula at the mid-calf level will cause pain at the syndesmosis. You will find the syndesmotic injury by doing either the external rotation stress test or the gravity test. These tests will check the competency of the deltoid ligament. Conservative treatment will be utilized for mild cases. The recovery takes twice the time for an ankle sprain. Surgical fixation is done for unstable injuries. It is usually done with two screws (3.5 or 4.5 diameter) placed 2-4 cm above the joint. You may use three or four cortices.

Metatarsal Fractures

The first metatarsal fracture occurs in children who are less than 4 years old. The fifth metatarsal fracture occurs in adults. There are three types; avulsion fracture, Jones fracture and stress fracture. Fracture of the third metatarsal rarely occurs by itself. Fracture of the second metatarsal is usually a stress fracture, which can occur at the base proximally in dancers, or it can occur at the shaft, which is called a march fracture. Although the march fracture occurs in the second metatarsal, it can also occur in the 3rd or 4th metatarsal. When you have a stress fracture of the metatarsal, you may need to

do a metabolic workup. Also look for cavovarus deformity of the foot. Remember, the first metatarsal bears about 40% of the body weight and the second metatarsal is the longest. Treatment will include a boot or fracture shoe. If the fracture is open, surgery will be performed. If there is a first or fifth metatarsal fracture, surgery is done for any displacement. Surgery is done for multiple metatarsal fractures or for sagittal plane deformity of the fracture more than 10 degrees. Maintain the length of the metatarsal to avoid transfer metatarsalgia.



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Lisfranc Injury

Occurs due to disruption of the articulation between the medial cuneiform and the base of the second metatarsal. This condition is easily missed. If it is missed, it will produce progressive foot deformity, chronic pain and the patient will have an altered gait as well as a major disability. The Lisfranc ligament runs from the medial cuneiform to the base of the second metatarsal on the plantar aspect of the foot. Always check these patients for compartment syndrome. Standing weight bearing x-rays may be needed to see the injury. Sometimes you may get a CT scan. You need to look at the lateral x-ray to see if dorsal subluxation is present. Not all cases will have a dorsal subluxation. When you look at the AP and oblique views, you want to find that the medial base of the second metatarsal is aligned with the medial side of the middle cuneiform. Also, you will not see a widened space between the first and second metatarsals. In the oblique view, you will find the line from the medial aspect of the base of the fourth metatarsal to the medial cuboid will line up. Also check for a bony fragment called the "fleck sign". This is usually present within the first intermetatarsal space due to avulsion of the Lisfranc ligament. That could be diagnostic of a Lisfranc injury. Treatment is surgical for the instability and ORIF for bony lesions, anatomic reduction is needed. When there is a ligamentous injury, you will do a primary arthrodesis of the medial tarsometatarsal joints. An arthrodesis is used in purely ligamentous injuries, in chronic cases, or when there is arthritis, which is a major complication of a Lisfranc injury. In general for acute or chronic cases that need a fusion, use screws in the first, second, and third tarsometatarsal joints and fuse these joints. Use K-wires in the fourth and fifth tarsometatarsal joints and do not fuse these joints. Fusion is only done in the first, second and third tarsometatarsal joints. If there is a bony injury, reduce the joint and fix it. If there is a ligamentous injury, fuse the joint.

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Dr. Ebraheim, Amanda Critton, Julie Anderson and Ellen Finch do not have any relationships with industry to disclose.

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