Ankle Fractures

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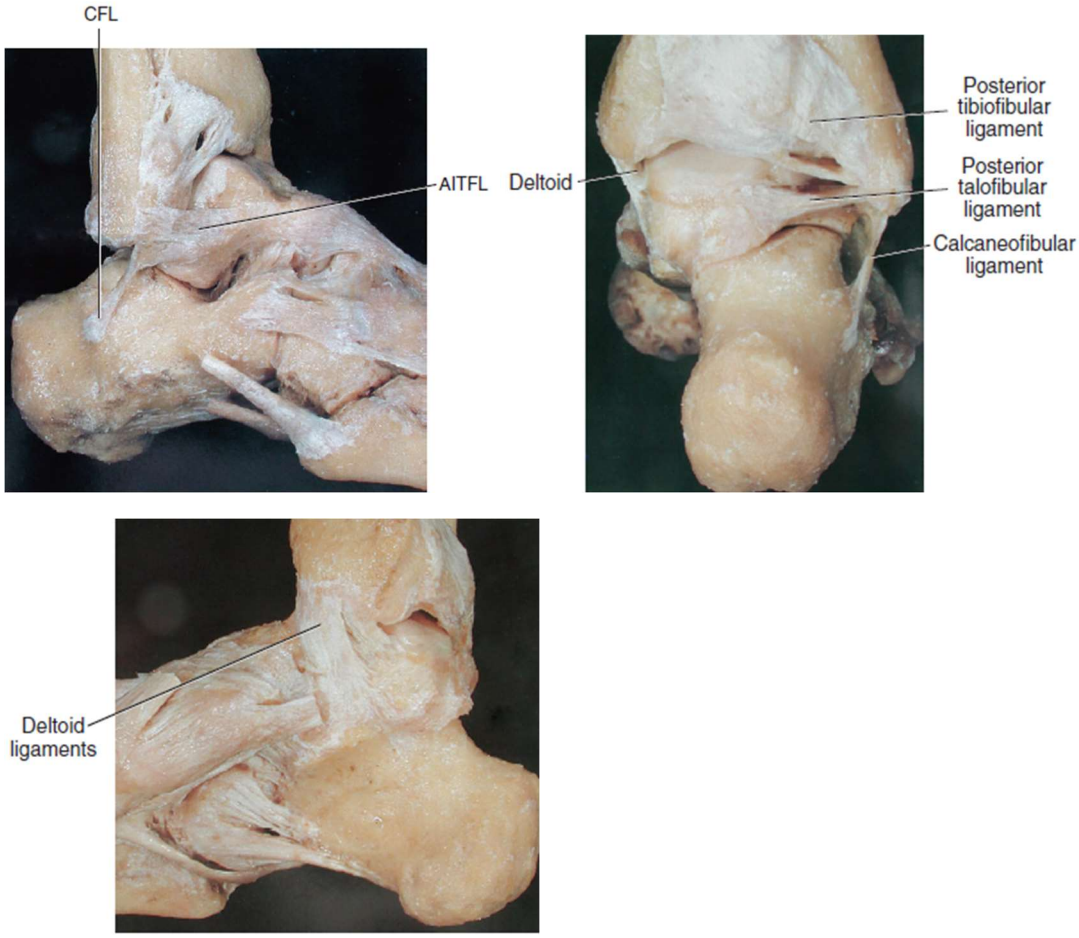
Epidemiology

Ankle fractures are common fractures in the adult population. Majority of ankle fractures occur after low velocity injuries happening during simple falls and sporting activities. Open ankle fractures especially in the elderly can be predominantly due to simple falls. Due to advances in diagnostics and medical care, the population is rapidly ageing; and more ankle fracture distribution curves are seen in the elderly and associated with osteoporosis. Aside from osteoporosis, another risk factor for ankle fractures is obesity. Obese women beyond 55 years old were significantly more likely to sustain an ankle fracture than nonobese women. Another risk factor for ankle fractures is alcohol consumption and it was reported that 29% of patients were found to have consumed alcohol 4 hours prior to their fracture.

Anatomy

The ankle mortise is a very congruent joint and composed of the dome of the talus articulating superiorly with the tibial plafond and extending to the medial malleolus, and laterally with the distal fibula. There is a natural 15 degrees external rotation axis of the ankle joint because the medial malleolus is positioned more anterior compared to the more posterolateral distal fibula. Stability of the ankle joint is provided by the interplay of the bony structures and the medial and lateral ankle ligament complexes.[14] The lateral ligaments are comprised of the anterior and posterior talofibular (ATFL and PTFL), and the central calcaneofibular ligaments (CFL). The weakest among the ligaments is the ATFL and mainly responsible for preventing anterior translation of the ankle joint (insert picture of lateral ligaments). The medial/deltoid ligament complex is composed of 6 bundles/bands of ligaments divided into a superficial and deep portion. The superficial portion is comprised of the tibionavicular, tibiospring, tibiocalcaneal, and superficial posterior tibiotalar ligaments. Only 2 bands are in the deep portion, the anterior and posterior deep tibiotalar ligaments. The strongest, largest, and thickest of all the ligament bundles is the deep posterior tibiotalar ligament. Another important structure in the ankle joint is the syndesmosis joint. It is a fibrous joint between the lateral distal tibia and medial aspect of the distal fibula. It is held together strongly by 4 ligaments, namely, the anterior inferior tibiofibular, posterior inferior tibiofibular, inferior transverse, and interosseous ligaments.



Physical Examination

In assessing a patient with ankle fractures, a detailed history, a focused physical examination, and adequate radiographic imaging are required. The nature of the injury, whether low or high energy, including the direction of the force and position of the ankle at the time of injury are all relevant. For high energy mechanisms, associated injuries need to be assessed and possible soft tissue injuries in the injured ankle. Patient factors such as uncontrolled diabetes should be evaluated preoperatively to prevent possible wound complications due to poor vascularity and immunologic impairment. History of smoking, alcohol abuse, and psychiatric illnesses should all be obtained from the patient.

Clinical examination should begin with inspection of the skin and taking note of areas of bruising/hematoma, color, abrasions/lacerations, blisters, swelling, and tenting. The deformity of the joint should also be noted as it might be a fracture dislocation of the ankle joint that needs immediate reduction. Palpation should start from the fibular head going down the lateral aspect of the leg until the lateral ankle before switching to the medial side. The syndesmotic area should also be palpated for pain as well as the lateral

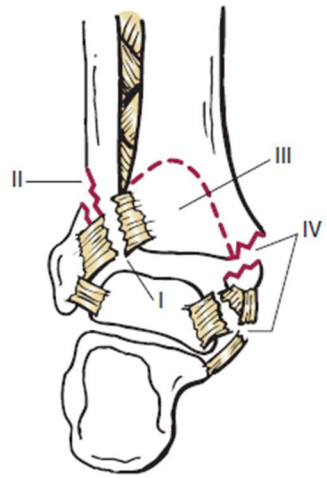
and medial talar dome. Up to 70 percent of patients would have osteochondral lesions of the talar dome after sprain and fractures and this should always be mentioned to patients. The movement of all toes and the ankle joint should be assessed to rule out possible tendon ruptures. The neurovascular structures such as the pulses of the dorsalis pedis and posterior tibialis arteries need to be palpated. Distribution of the superficial peroneal and posterior tibial nerves to the foot must also be assessed. Special attention should be placed on the integrity of the Achilles tendon and this should be carefully palpated as well. Palpation of skeletal structures should be extended towards the foot especially the midfoot area from lateral to medial. Lisfranc joint injuries, lateral talar process, and 5^{th} metatarsal base fractures can also be injured with similar mechanisms during ankle sprain. The presence of a hematoma in the plantar aspect of the midfoot pertains to a midfoot/Lisfranc injury.

Evaluation

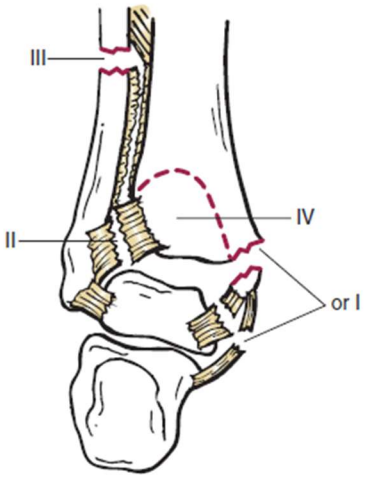
The three standard radiographs ordered are anteroposterior (AP), lateral, and a mortise view of the ankle. If during physical examination there is tenderness on the tibia or fibular proximally, a full-length leg APL radiograph should be obtained. The mortise view is taken with the leg internally rotated by 15 degrees to bring forward the distal fibula on the same axis of the medial malleolus and remove the overlap of the distal tibia and fibula on AP view.

Classification

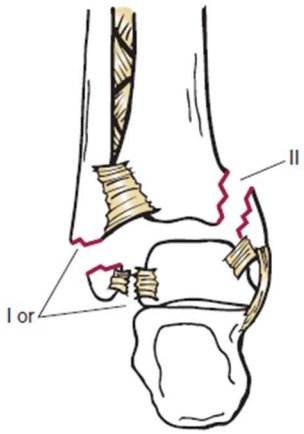
The three (3) common classification systems used for ankle fractures are the Lauge-Hansen, Danis-Weber, and AO/OTA Classification systems. Lauge-Hansen classification describes the mechanism of how different ankle fracture configurations arise based on the position of the foot and direction of deforming forces at the ankle during injury. Four injury schemes and their stages were reported: supination-external rotation (SER), pronation-external rotation (PER), Supination-adduction (SAD), and pronation-abduction (PAB).



Supination–external rotation stages I - IV

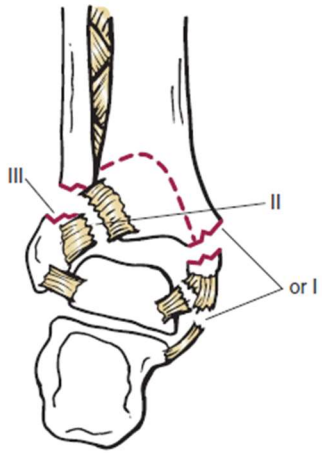


Pronation–external rotation stages I - IV



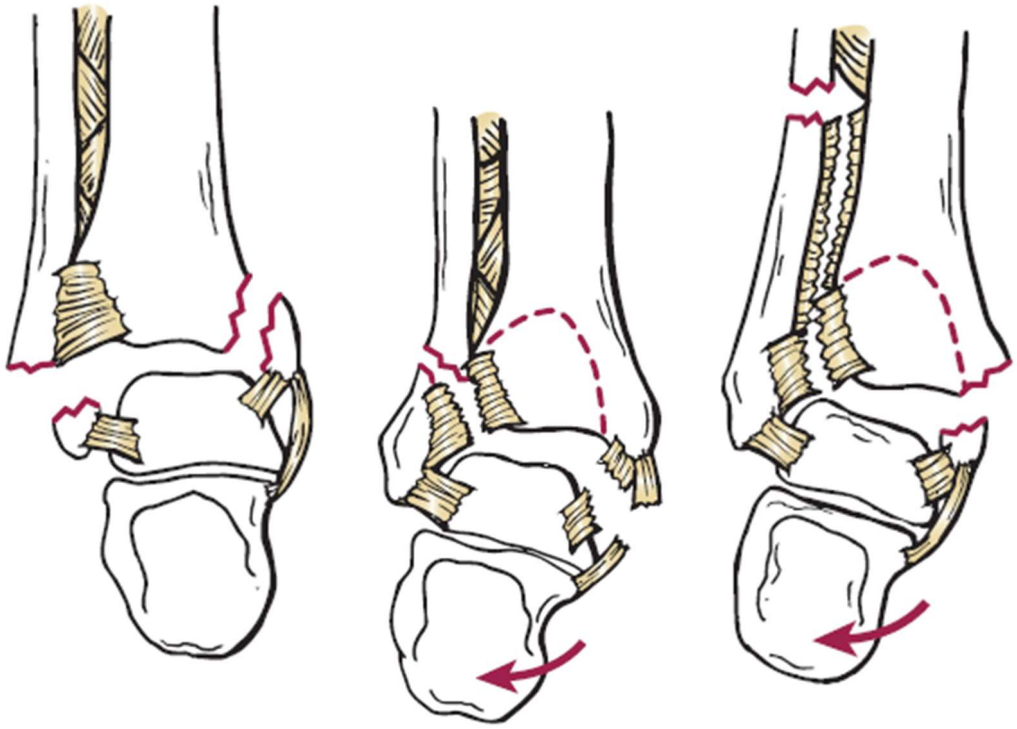
LAUGE-HANSEN

Supination–adduction stages I and II

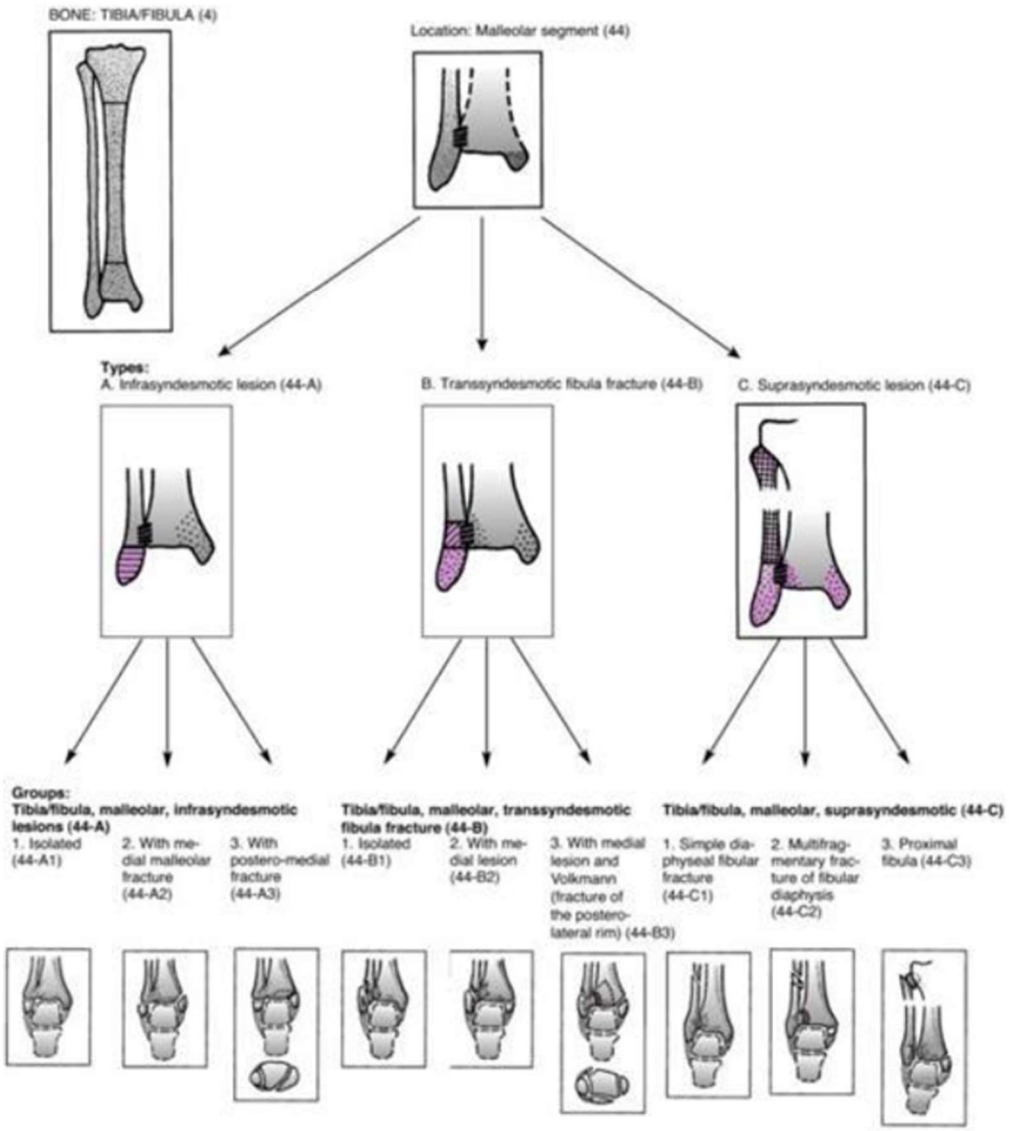


Pronation–abduction stages I - III

Danis-Weber classifies ankle fractures into 3 groups depending on the level of the lateral malleolar fracture, whether the lateral malleolar fracture is below (A), at the level of (B), or above (C) the syndesmosis joint.



Further work on the Danis-Weber system and in combination with the Lauge-Hansen classification by the AO/ASIF group lead to the development of the AO classification of ankle fractures which was later adopted by the Orthopaedic Trauma Association (OTA). It is based on the location of fracture lines and degree of comminution to describe the severity and degree of instability of a fracture pattern. The severity and the involvement of the syndesmotic ligament increases from AO-OTA Type A to C fracture patterns. The instability also increases from AO-OTA type A to C.



Management

There are various of ankle fracture patterns based on the different fracture classification systems and each would have a corresponding treatment. To obtain the best functional results of any given treatment, the articular joint surfaces should be anatomically reduced; the reduction maintained; and the joint mobilized as soon as possible without losing its reduction. Fractures, especially ankle fracture dislocations, should be reduced as soon as possible before formation of significant hematoma and swelling. Early reduction also prevents potential vascular injury and neuropraxia due to gross deformity. Moreover, it can prevent skin necrosis that can arise from prolonged stretching and tenting of the skin from gross deformity and from displaced fracture edges, respectively.

Ankle joint incongruity is poorly tolerated for it leads to abnormal loads on the articular cartilage. After closed reduction, the superior, lateral, and medial clear spaces should be assessed. If there is a difference of more than 2 mm in the measurement between clear spaces or if one clear space is more than 4 mm; it is deemed unsatisfactory and open reduction should be done. Up to 2 mm of displacement of the malleoli and 1 to 2 degrees of talar tilt seem to lead to a satisfactory outcome.[27] If the closed reduction was decided to be acceptable, the ankle is placed into cast immobilization with frequent follow-ups to check for maintenance of reduction.

The timing of surgery is another important aspect in treating ankle fractures. This entails proper recognition and immediate management of soft tissue injury around the ankle

joint. Abrasions should be cleansed and dressed. Surgery should be performed within hours if there is presence of abrasions. If delayed for at least 12 to 24hrs, these abrasions are already colonized by bacteria and surgery is contraindicated until they have resolved. The best time to do surgery is before true swelling or fracture blisters developed. This is because the initial swelling that happens after a fracture is because of hematoma and not because of edema. Open reduction releases this hematoma and allows tension free primary closure of the incision sites. Once edema and significant fracture blisters developed, ORIF is now contraindicated because the soft tissue is now compromised. The extremity needs to be splinted properly with gentle reduction, elevation, and cold compress. Delayed surgery is acceptable, and it should be postponed until the soft tissue injury has resolved. The abrasions should have re-epithelialized, the fracture blisters are dry, and there is skin wrinkle sign on the operative sites.

The goal of surgery is to restore the anatomy and stability of the ankle mortise. As previously mentioned, incongruity in the ankle joint is poorly tolerated. Available fixation techniques depend on the degree of injury of the soft tissues around the ankle. For traumatic open ankle fractures, a combination of external fixator and k-wires could be used to fix the fracture. For closed elective ankle fractures, the combination of plates and screws is the standard of fixation.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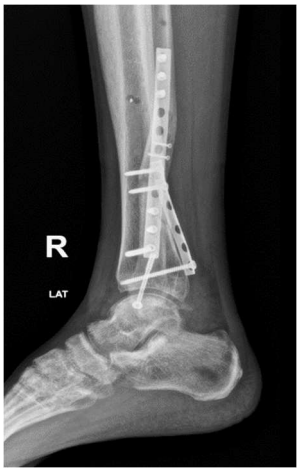
MORTISE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