Recent trends in Management of Tibial Plafond Fractures

Essay

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By

Peter Fayez Fakhry Kelada
M.B.B.Ch

Under supervision of

Dr. Ahmed Mohamed El Badrawy
Assistant Professor of Orthopedic Surgery
Faculty of Medicine
Ain Shams University

Dr. Hany Nabil El Zahlawy
Lecturer of Orthopedic Surgery
Faculty of Medicine
Ain Shams University

Ain Shams University
Faculty of Medicine
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Peter Fayez Fakhry Kelada

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List of Abbreviations

ATA	Anterior tibial artery
AT	Achilis tendon
ATBF	Anterior tibiofibular ligament
ATF	Anterior talofibular ligament
BRAMIF	Balloon reduction and minimally invasive fixation
CF	Calcaneofibular ligament
DD	Deep deltoid ligament
EHL	Extensor hallucis longus
ER	Extensor retinaculum
FDL	Flexor digitorum longus
FHL	Flexor hallucis longus
FR	Flexor retinaculum
IO	Interosseous ligament
LCL	Lateral collateral ligament
MCL	Medial collateral ligament
PA	Popliteal artery
PTA	Posterior tibial artery
PTBF	Posterior tibiofibular ligament
PTF	Posterior talofibular ligament
ROM	Range of motion
SD	Superficial deltoid ligament
TA	Tibialis anterior
TTBF	Transverse tibiofibular ligament
TP	Tibialis posterior
NPWT	Negative Pressure Wound Therapy

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Introduction

The term **"Plafond"** is French for ceiling and refers to the relation of the distal tibial articular surface to the talus. Therefore, a plafond fracture refers to any fracture line traversing the weight-bearing articular surface of the distal tibia.(1)

“Pilon” fracture is an important and more complicated subtype of plafond fractures. It refers to the talus acting like a hammer driving into the weight – bearing surface of the distal tibia.(2)

Tibial plafond fractures account for fewer than 10% of all lower-extremity fractures and are more common in male than female patients. Pilon fractures in particular constitute only approximately 1% of lower-extremity fractures and 7% to 10% of tibial fractures. However, the frequency of these fractures maybe on the rise.(3)

Tibial plafond fractures are high-energy injuries and the primary component of force is vertically directed through the talus into the distal tibia. This vertical compressive force may act singularly on the distal tibia, or may represent a component of complex forces, including shear and/or rotation.(4)

Assessment of the degree of energy causing the fracture and careful planning of the joint reconstruction will lead to acceptable results in most cases. High-energy plafond fractures should be treated with great care and respect because the risk of complications is high and the likelihood for good functional ankle is less predictable.(5)

A whole spectrum of treatment options have been advanced over years. Most authors would agree the goal of treatment of any displaced intra- articular fracture should be an anatomic restoration of the joint to the shaft, and early restoration of motion, and hence, functional recovery. Also it has been stated that the status of the soft tissues is one of the most important factors that influence the treatment and prognosis of the patients.(6, 7)

Regarding treatment the traditional techniques were: casts, pins in plaster, fibular fixation alone and open reduction and internal fixation (ORIF) which often results in unacceptable function of the ankle and higher rate of wound breakdown, infection, poor anatomical alignment and subsequently post traumatic osteoarthritis.(8, 9)

Recently, Percutaneous placed lag screws maintain the reduction of the joint, and graft supports the impacted intraarticular fragments. Once the distal tibia is reconstructed at the level of the joint, the remaining fracture is treated as a distal tibial fracture with external fixation. Both hybrid frames that use tensioned wires (Ilizarov apparatus) and do not cross the joint, and spanning half pin frames, have been recommended. The main advantage of this approach is the low rate of soft tissue problems.(10)

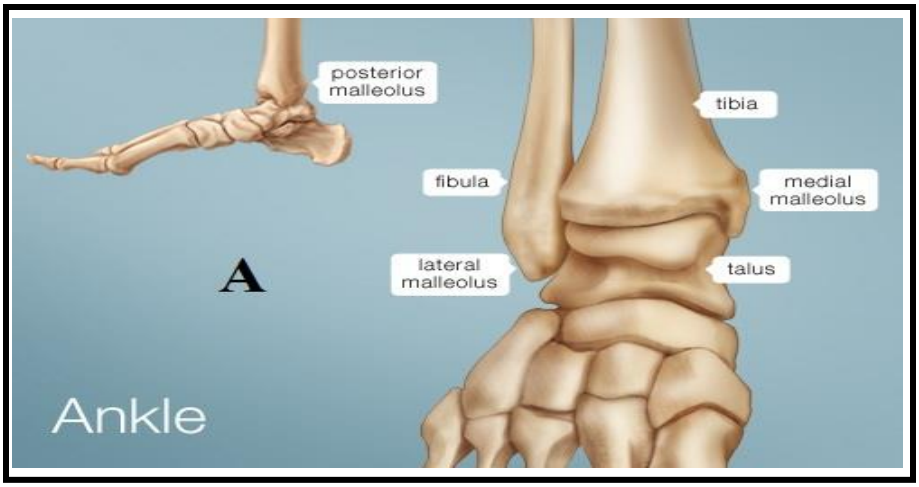
The use of external fixation, instead of fixation with a plate, decreases the prevalence of early complications. This technique for high grade tibial plafond injuries has resulted in effective stabilization of these fractures. Although this approach may not prevent the post traumatic sequelae that inevitably results, it does provide adequate stability and allows early motion. Furthermore, because this technique of external fixation limits additional surgical insult to the soft tissues and to biology of fractures healing, the number of major complications appears to be minimized.(10)

Aim of the work

The purpose of this study is to discuss the different types of tibial plafond fractures and recent trends in management such as external fixation & arthroscopy in addition to highlight on the pre and post-operative care that should be done for those patients.

Anatomy of the Ankle Joint

The ankle is a complex joint consisting of functional articulations between the tibia and fibula, tibia and talus, the fibula and talus, each supported by a group of ligaments. The tibia and fibula form a mortise, providing a constrained articulation for the talus. The articular surface of the distal tibia (tibial plafond) and the mortise is wider superiorly and anteriorly to accommodate the wedge-shaped talus. The shape of the joint alone provides some intrinsic stability, especially in weight bearing (Fig. 1). [11]



(Fig. 1) Anatomy of the Ankle Joint. [11]
A- Anteroposterior view.

Stability of the talocrural joint depends on both joint congruency and supporting ligamentous structures.

BONE

The medial malleolus is an extension of the distal tibia. The inner surface is covered with articular cartilage and articulates with the medial facet of the talus. The distal inner surface of the malleolus is divided by a longitudinal groove into a large anterior colliculus and a smaller posterior colliculus, each an attachment site for aportion of the deltoid ligament. There is also a groove on the posterior surface where the posterior tibial tendon passes behind the malleolus and the tendon sheath is attached. [12]

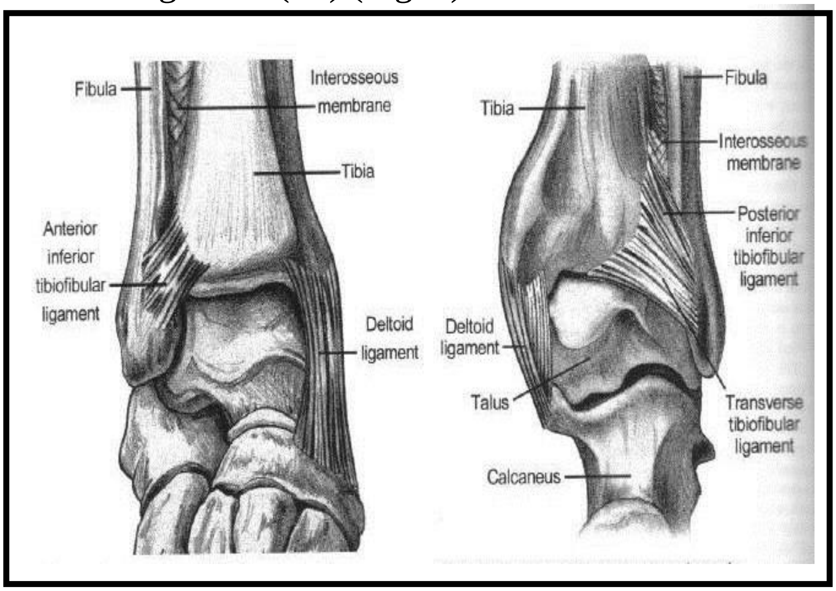
The fibula provides the lateral support of the ankle. Just above the ankle joint, the fibula sits in a groove formed by a broad anterior tubercle and a smaller posterior tubercle of the tibia. There is no articular surface between the distal tibia and fibula, even though there is a small amount of motion between these two bones. The medial border of the fibula is covered by articular cartilage from the level of the tibial plafond to a point approximately halfway down its remaining length. The distal end is tapered and has a posterior groove for the peroneal tendon.[13]

The talus has a curved head, an intermediate neck portion, and a large trapezoidal body. It articulates with the navicular, calcaneus, tibia, and fibula. The body of the talus is almost entirely covered by articular cartilage. The superior surface is convex from front to back and slightly concave from side to side. The dome of the talus is trapezoidal, and its anterior surface is an average of 2.5 mm (range, 0 to 6 mm) wider than the posterior surface. The articular surfaces of the malleoli (the mortis) are also wider anteriorly and support the talus.[14]

The medial and lateral articular facets of the talus are continuous with the superior articular surface, and the lateral facet is larger than the corresponding facet on the fibula. The majority of the talar neck has no articular surface and serves as the site of access for much of the blood supply to the rest of the talus. The multiple articular facets and lack of muscular attachments are evidence of the role of the talus in connecting the leg to the foot.[14]

LIGAMENTS

Three distinct groups of ligaments support the ankle joint: the syndesmotic, medial collateral ligament (MCL), and lateral collateral ligaments (LCL). The syndesmotic ligament complex maintains the integrity between the distal tibia and the fibula and resists the axial, rotational, and translational forces that attempt to separate these two bones. It is made up of four ligaments: the anterior tibiofibular ligament (ATBF), the posterior tibiofibular ligament (PTBF), the transverse tibiofibular ligament (TTBF) and the interosseus ligament (IO) (Fig. 2).[14]



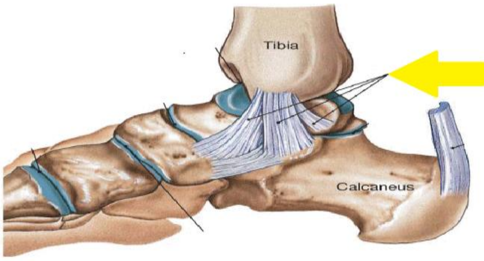
(Fig. 2) The syndesmotic ligament of the ankle.[14]

The ATBF ligament originates on the anterior tubercle and anterolateral surface of the tibia and runs obliquely to the anterior fibula. The PTBF ligament originates on the posterolateral tubercle of the tibia and inserts on the posterior fibula. It is stronger and thicker than its anterior counterpart. Because of this difference, torsional or translational forces usually cause an avulsion fracture of the posterior tibial tubercle, leaving the PTBF ligament intact, while the weaker ATBF ligament usually ruptures.[14]

The TTBF ligament is often considered part of the PTBF ligament complex and acts to deepen the posterior aspect of the ankle joint. The IO ligament is an extension of the interosseous membrane and is the key transverse stabilizer of the tibiofibular articulation. The ligament is triangular with a proximal apex and a broad distal base and is thinner in its midportion because of a perforating synovial pouch from the ankle joint. The interosseous membrane runs between the tibia and fibula to the level of the proximal tibiofibular joint. It stabilizes the fibula, provides additional attachment sites for muscles, and may have some loadbearing function.[14]

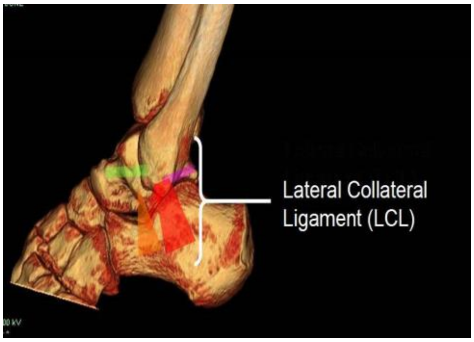
The medial ligamentous support of the ankle (Fig. 3) is provided by the superficial deltoid (SD) ligament and deep deltoid (DD) ligaments. The SD ligament originates primarily from the anterior colliculus of the medial malleolus and extends in three bands to the navicular and along the plantar calcaneonavicular (spring) ligament, to the sustentaculum tali of the calcaneus, and to the medial tubercle of the talus. The tibionavicular portion suspends the spring ligament and prevents inward displacement of the head of the talus, while the tibiocalcaneal portion prevents valgus displacement. The SD ligament is also partially covered by tendon sheaths and crural fascia.[15]

The DD ligament originates on the posterior border of the anterior colliculus, the intercollicular groove, and the posterior colliculus. It is oriented transversely and inserts into the entire nonarticular surface of the medial talus. The DD extends the function of the medial malleolus and prevents lateral displacement of the talus.(12) The SD and DD ligaments are responsible for resistance to eversion and external rotation stress.(16)



(Fig. 3) Medial collateral ligament A- bands of the superficial deltoid B- position of the deep deltoid ligament.(16)

The LCL is made of three separate structures (Fig. 4). They are not as strong as the medial ligaments, because lateral support for the ankle is also provided by the fibula.(17)



(Fig. 4) lateral collateral ligament with adjacent tibiofibular ligament.(17)

The anterior talofibular ligament (ATF) is the weakest of these ligaments. It connects the anterior fibula to the neck of the talus and prevents anterior subluxation of the talus when the ankle is in plantarflexion. The midportion of this ligament is confluent with the capsule of the ankle. This area