Plate Fixation of Talus Fractures: Where, When, and How?

Abstract

Talus fractures are rare orthopedic injuries. Surgical fixation is challenging for treating surgeons. The clear majority of fractures require operative treatment. The indication and use of plates in fixation of talus fractures are reviewed. Specific applications including fractures of the lateral process, posterior fractures, extreme comminution, bone grafting, and spring plating to hold key segments are reviewed in this article.

Keywords: *Foot, fracture, internal fixation, plate, talus, trauma*
MeSH terms: *Talar joint; fracture fixation, internal; bones of foot*

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Overview

Surgical treatment of talus fractures by plate fixation adds to the stability which some complex fractures demand. As talus fractures are often associated with significant soft tissue trauma,[1-3] the timing of definitive fixation using plates has to be considered with caution. Open fractures and those presenting with dislocation that fail closed reduction should be treated with emergent surgical debridement and/or reduction.[4-7] External fixation may be applied to maintain alignment until such time as the soft tissues will tolerate definitive surgical treatment. The external fixator may be retained at the time of surgical fixation and may assist as a distractor to allow improved visualization in certain fractures. Alternatively, numerous small distractor systems exist which may be used. A headlight may be used to improve the visualization of reduction and articular alignment. K-wires and screws ranging from 2.0, 2.4, 2.7, and 3.5 mm diameter as well as 2.0 and 2.4 plates should be available. Locking plates are seldom needed in talus fractures due to the dense nature of the bone in the talus. However, severe comminution or bone loss are scenarios where locking fixation may be beneficial. Due to the odd shape of the talus and complex fracture patterns often encountered, computed tomography (CT) scanning is required for surgical planning and is best performed after reduction. Location of surgical incisions as well as anticipated fixation needs will be determined from information obtained from the CT. If closed reduction fails and must be performed in open fashion, a CT may be of benefit before reduction in the operating room. Information obtained may direct where incisions, if necessary, are made to best accommodate future definitive surgical treatment.

Lateral Process Fracture

Controversy exists in the ideal treatment of lateral process fractures. Some biomechanical studies have demonstrated that excision of large lateral process talus fractures did not affect subtalar joint stability.[8] Nevertheless, larger fractures' fragments involving a larger percentage of the articular surface are treated with surgical fixation.[9-11] Surgical excision is generally advocated for smaller fracture fragments, but simple small fragments or those without comminution may be treated with simple screw fixation. It is the larger fragments and those with comminution that benefit from plate fixation. Generally, a mini fragment 2.0 mm plate is used. This may be a straight plate used as a rim plate with screws rafting the articular surface. More frequently, a small T plate is placed on the lateral process in inverted fashion to provide additional buttress to the fracture components to prevent late collapse [Figure 1]. The surgical incision is essentially a sinus tarsi approach and runs from the just below the tip of the fibula distally for approximately 2–3 cm

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Figure 1: (a and b) Anteroposterior and lateral radiographs of ankle joint showing a lateral process talus fracture after a motorcycle accident. (c and d) Computed tomography scan more clearly defines the injury. (e and f) Fluoroscopic anteroposterior and lateral views showing Fracture fixation consisted of a mini fragment plate due to both size and comminution of the lateral process fragment

parallel to the sole of the foot and along the axis of the fourth metatarsal. The peroneal tendons and sural nerve are inferior to the incision and should be protected. The extensor digitorum brevis is elevated, and the lateral joint capsule is excised as well as the anterior talofibular ligament. Hematoma is removed with suction. Articular fragments are disimpacted and reduced by assessing the undersurface of the talus for congruity. A clear fracture read is generally present at the distal margin of the fracture as it approaches the talar neck. An external fixator or distractor may be placed from the fibula to the calcaneus to improve visualization. K-wires are inserted to hold the fragments in position. After reduction is achieved and provisionally held, a small 2.0 mm plate is slid over the K-wires. It is imperative that no <2 points of fixation are in the fracture at all times to prevent loss of reduction. Using a plate with three or more holes supporting the articular surface allows for two wires to be maintained in the plate, while a screw is inserted. Additional screws are inserted into the plate by removing a K-wire and replacing it with a screw. This ensures the maintenance of both reduction and alignment of the plate. Postoperatively, the patient is placed in a splint for 2 weeks. Range of motion is initiated after the sutures are removed. Nonweight bearing is necessary until union is achieved. Weight-bearing is advanced after union is achieved, 8 weeks in simpler fractures and may take as long as 12 weeks in more comminuted injuries.

Lateral Plate Fixation for Talus Neck Fractures

Talar neck fractures account for 50% of talus fractures.[12] Plate fixation for talar neck fractures has been well described.[5,13-15] In more severe talar neck fractures, comminution is typically present both dorsally and medially along the dominant fracture line. Accurate reduction is necessary to prevent shortening of the neck and prevention of a varus malunion.[16] In most neck fractures, there is a clear reduction possible at the lateral aspect of the talar neck where the fracture fails in tension. More severe neck fractures may have comminution both medially and laterally. All neck fractures ideally require both medial and lateral incisions to assess rotation and obtain an accurate reduction. A pointed reduction clamp may be placed on the distal portion of the talus just proximal to the talar head with one tine inserted in the medial incision and one tine inserted in the lateral incision. K-wires are inserted into the distal portion of the talus both medially and laterally. Using the reduction clamp to control the distal segment, the fracture line on the lateral aspect of the neck of the talus is reduced and a K-wire is advanced to provide provisional fixation. Rotation is assessed medially, and if correct, a K-wire is advanced along the medial side of the talus. If severe comminution is present, fully threaded wires may be used to prevent shortening. A lag screw may be placed laterally if there is no communition present. A small plate

is then placed along the confluence of the lateral process and talar neck. This is typically a 2.0 or 2.4 mm plate. Screws inserted in the proximal portion of the plate are directed into the body of the talus and the distal screws are directed into the neck of the talus. The lateral plate serves as a tension band preventing medial shortening as well as prevents rotation from occurring. Fixation on the medial side may consist of a positional screw to prevent shortening and rotation of the medial side or a small plate in cases of severe comminution. Low rates of malunion have been associated with the use of plates in comminuted neck fractures.[13,17]

Medial Plate Fixation for Talar Neck Fractures

Fixation of the medial side in talar neck fractures is necessary. Most talar neck fractures present with comminution of the dorsal and medial aspect of the neck of the talus. Anatomic reduction is critical, as varus malalignment results in marked decrease in subtalar motion as the hindfoot is locked in an inverted position.[16] Talar neck malalignment also increases peak pressures across the subtalar joint, predisposing it to subtalar arthritis.[18] The goal of medial fixation in talus fractures is to prevent varus and extension from occurring. If screws are used, they should be inserted in nonlag fashion to maintain the length of the medial side. A mini fragment plate may be used along the medial neck of the talus. A plate along the medial talar neck bridges the zone of comminution and prevents shortening. If severe comminution exists, the plate will also assist in holding the comminuted fragments in correct position. Plate placement is limited to the small extraarticular area between the medial side of the talar dome and the talar head. Impingement of the plate on the medial malleolus during dorsiflexion and plantar flexion and on the navicular during inversion-eversion must be avoided. After the plate is positioned, K-wires are inserted through the proximal and distal ends of the plate. The ankle and subtalar joint are then put through a range of motion to ensure no plate

Figure 2: (a and b) Mortise and lateral radiographs of ankle joint of a 44-year-old female showing a comminuted talus fracture with associated dislocation as a result of a motor vehicle collision. (c and d) Fluoroscopic view showing the patient was treated with closed reduction and external fixation at presentation. (e and f) Computed tomography scan showing a fracture of the neck with associated fracture of the lateral process and dorsal comminution of the neck. (g-i) Fluoroscopic views of ankle showing that the patient had fixation of the talus including lateral mini fragment plating along the neck as well as a small plate used as a washer to hold in a key piece along the dorsal neck. (j and k) Fluoroscopic views of ankle showing 4-year post injury after the distal tibial and fibular hardware had been removed

impingement is occurring. Screws are then placed in the plate, completing fixation. Medial plate fixation provides equivalent stability to posterior to anterior directed screws.[19]

Spring Plates and Plates as a Washer

Plates may be used as spring plates to hold key segments in position. These fracture segments may consist of fragments which are extraarticular but essential for anatomic reduction such as on the dorsal aspect of the neck [Figure 2]. Occasionally, a fragment will contain a combination of extraarticular and articular surface. A spring plate may be used to hold these segments in position. The plate is usually a shorter plate. The plate is over-bent so that when a screw is inserted in the plate, it straightens out, exerting continuous pressure on the surface as it tries to regain its curved shape. In addition, small plates can be used as a washer to hold fragments in position that are too small for screw fixation alone.

Plate Fixation for Securing Bone Graft

In severe open fractures, there may be loss of bone necessitating bone grafting. Recreating the overall shape of the talus is imperative to functional outcome. Plate fixation over areas where cancellous bone graft has been inserted will help prevent migration of bone graft out of the area of application. Loose cancellous graft in the subtalar joint will interfere with future joint function and potentially damage to the articular surface from particulate debris. Larger defects requiring tricortical grafting require improved stability for incorporation. Plates can be used to provide length stable fixation, prevent rotation, and hold the graft in position [Figure 3]. Tricortical segments held with screws are subject to rotational forces and may fracture at the time of drilling or screw insertion and risk loss of structural integrity.

Posterior Fractures

Fractures of the posterior portion of the talar body are amenable to plate fixation. These fractures are often unrecognized but generally do poorly with nonoperative treatment.[20] The patient is positioned prone for addressing these fractures. A rolled blanket is placed under the contralateral hip to internally rotate the limb improving access to the posteromedial ankle. A second rolled blanket

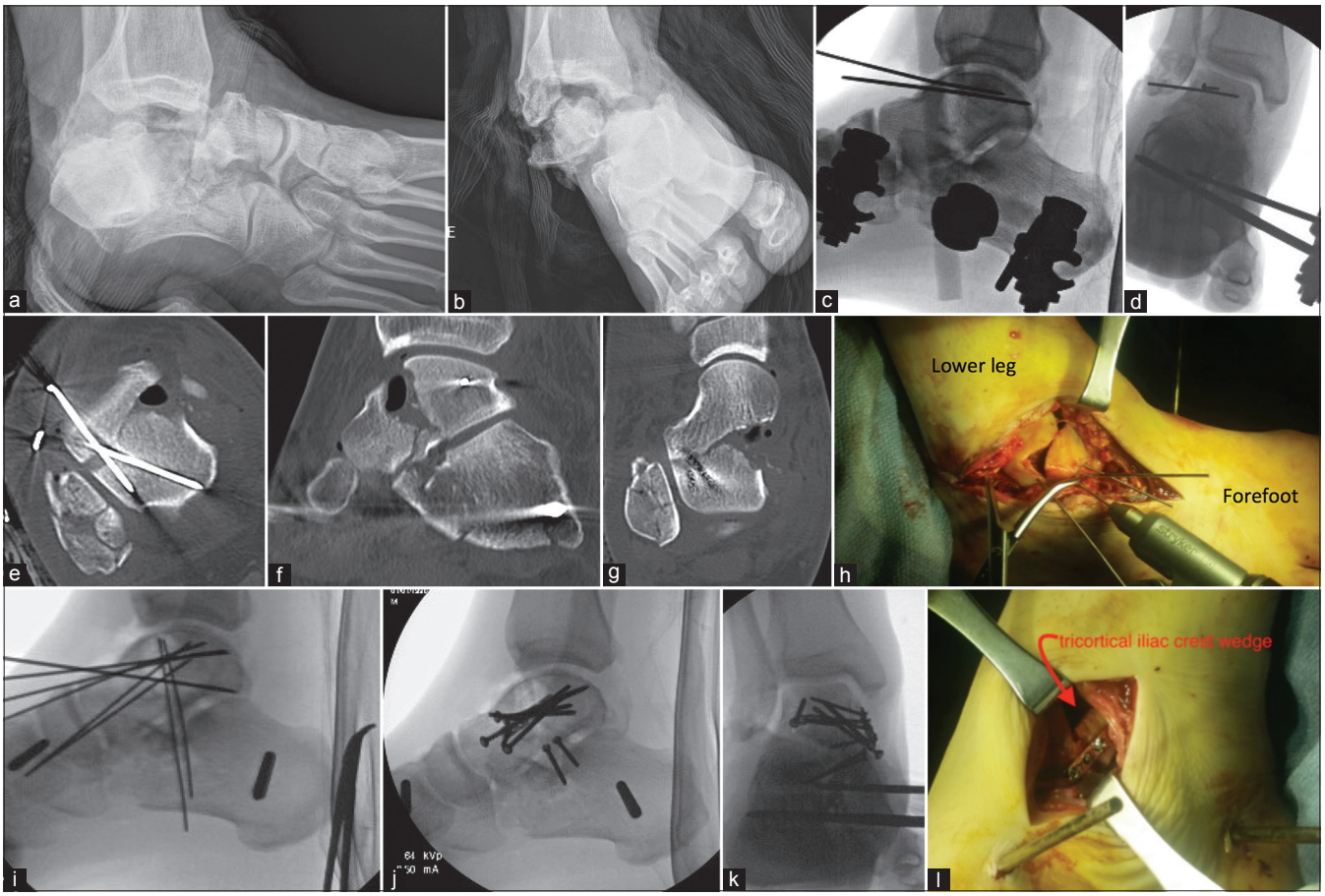

Figure 3: (a and b) Lateral and mortise views radiographs of ankle joint showing a severe fracture dislocation as a result of a motor vehicle collision. (c and d) Fluoroscopic views of ankle showing the fracture was open and was treated with emergent debridement, reduction, and provisional stabilization with K-wires and an external fixator.(e-h) Computed tomography scans and surgical image demonstrating traumatic loss of bone at the time of the open injury. (i-k) Intraoperative fluoroscopic views of ankle showing films demonstrating the reduction including provisional fixation with K-wires, as well as a final fixation with plates and screws. (l) The patient had a significant amount of bone loss along the medial neck, so a tri-cortical iliac crest wedge was used to fill the void and held in place with a mini fragment plate and screws

is placed under the mid portion of the tibia to flex the knee. This will elevate the surgical foot slightly off the operative table improving the ability to obtain lateral imaging without obstruction from the contralateral foot. Posterior talus fractures are treated through a posteromedial approach utilizing the interval between the flexor hallucis longus and the Achilles tendon.[21] Excessive medial retraction should be avoided to prevent injury to the medially located neurovascular bundle. Simple fractures may be treated with interfragmentary screws. Washers are not needed with screw fixation as the talus is dense bone and is inadequate to address the small comminuted fragments often seen in these fractures. Mini fragment plating along the extraarticular portion of the posterior talus best addresses the comminution frequently seen in these injuries. Often, the plate will lie in the groove for the flexor hallucis longus and the low profile of the mini fragment implants will limit irritation to the tendon. Anatomic reconstruction is necessary for both the ankle and subtalar joints and prevents instability. Plate application follows the standard principles already reviewed with other plating techniques including anatomic reduction, provisional K-wire fixation, sliding the plate over K-wires, and carefully replacing the wires with rigid screw fixation. A medially placed distractor or external fixator may aid in direct visualization of the articular reductions. Postoperatively, it is crucial to encourage early range of motion of the great toe, as the flexor hallucis longus is prone to scarring down at the posterior aspect of the talus, resulting in markedly restricted motion. Nonweight bearing is necessary for 12 weeks postoperatively. Range of motion exercises of the ankle and subtalar joint is started at 4–6 weeks postoperatively. The hardware is only removed if it causes irritation to the flexor hallucis longus, which is rare.

Conclusion

The goals of operative treatment of talus fractures include preservation of blood supply, anatomic reduction, restoration of articular congruity, and stable fixation. Knowledge of a wide variety of fixation techniques will assist the treating surgeon in managing these rare fractures. Plate fixation is applicable in a wide variety of talus fractures, especially where there is comminution, to hold bone grafts in place, or even to maintain surface congruity in cases of comminution

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Conflicts of interest

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