6 Fractures of the Talar Head

James Richman, Adam Gitlin, and Mark R. Adams

Introduction

Fractures of the talus are rare, and talar head fractures are an uncommon subset of talus fractures. Even at its highest incidence, it is involved in less than 10% of all fractures of the talus [1]. Focused examination specific to these fractures has been difficult; this is due to the rarity of the injury and their frequent association with other injuries within the foot.

Anatomy

The head of the talus articulates with the navicular, forming one component of the Chopart joint. The head is rotated 45 degrees laterally in relation to the axis of the talar neck [2]. The plantar spring ligament passes inferiorly to the talar head connecting the calcaneus to the navicular. The talar head forms its main articulation with the navicular in an area called the acetabulum pedis. Detailed by Sarrafian [19], it is composed of the anterior and middle calcaneal sections of the talus and linked to the navicular via the inferior and superomedial calcaneonavicular ligaments (Fig. 6.1). The calcaneonavicular segment of the bifurcate ligament becomes the lateral hinge. The medial side is supported by the spring ligament and posterior tibial tendon [7].

The talar head has vascular supply from two of the three main arteries that supply the talus. The superomedial portion derives its vascularity from branches of the dorsalis pedis (anterior tibial artery). These branches terminate into either directly medial tarsal branches or indirectly as branches of the anteromedial malleolar artery. The inferolateral half derives its vascular supply directly from the lateral sling. The inferior side of the talar neck that forms the anterior boundary of the tarsal sinus serves as the area where the intraosseous blood supply enters the talus bound for the talar head. Anastomotic connections via the soft tissue attachments and ligamentous structures also serve the talar head and navicular [4].

Mechanics of the Talonavicular Joint

The talonavicular joint is one of three essential joints, including the ankle and subtalar joints, which comprise the hindfoot [6]. Gait mechanics and mobility are therefore optimized by the

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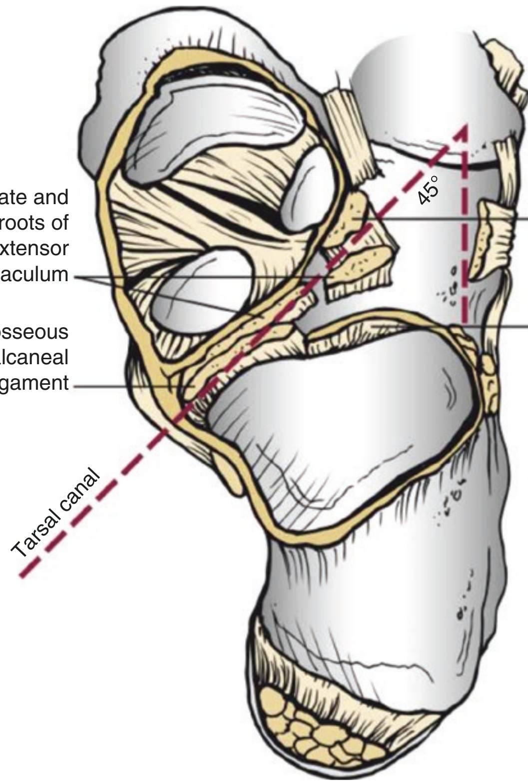

Fig. 6.1 Acetabulum pedis. This socket for the talar head allows the midfoot to swivel about the talar head [19]

preservation of range of motion in these joints. The talonavicular joint, in particular, is crucial in providing a transfer point between the hindfoot and tibia to the midfoot and structures distally.

The talus itself is contained within the malleoli of the ankle joint, between the Chopart joint and subtalar joint. This limits its ability to rotate and thus allows it to help transfer forces across the ankle and foot. The talus rotates medially in relation to the tibia during heel strike and as the forefoot comes into contact with the ground during midstance. As midstance occurs, the talus rotates internally and flexes in relation to the calcaneus and navicular at their respective joints. This allows the forefoot to contact the ground and absorb energy as the arch flattens.

As the foot transitions from midstance to push-off, the talus begins to externally rotate in relation to the rest of the foot. This rotational motion effectively locks the subtalar and talonavicular joints and allows the gastrocnemius-soleus complex to function for push-off through the foot through the hindfoot into the forefoot.

Failure to preserve the congruity of the talonavicular articulation in the setting of trauma either via articular step-off or instability risks the premature development of arthrosis, which may compromise the entire gait cycle of the patient, resulting in permanent dysfunction and disability [3].

Mechanism of Injury

There are two main injury mechanisms that result in fractures of the talar head. Compression injuries are the result of the talar head experiencing an axial load against a plantarflexed foot [2]. This axially directed force generates compression between the navicular and talar head. Energy transmitted through the metatarsals and navicular usually results in a medial-sided crush injury to the talar head. An adducted or abducted forefoot position may also result in subluxation or dislocation of midtarsal joints and has been shown to have an association with talonavicular injuries [8]. A large fracture of the talar head may also result in instability of the talonavicular joint [6].

Shear injuries occur primarily due to an inversion mechanism on the midfoot. The resultant

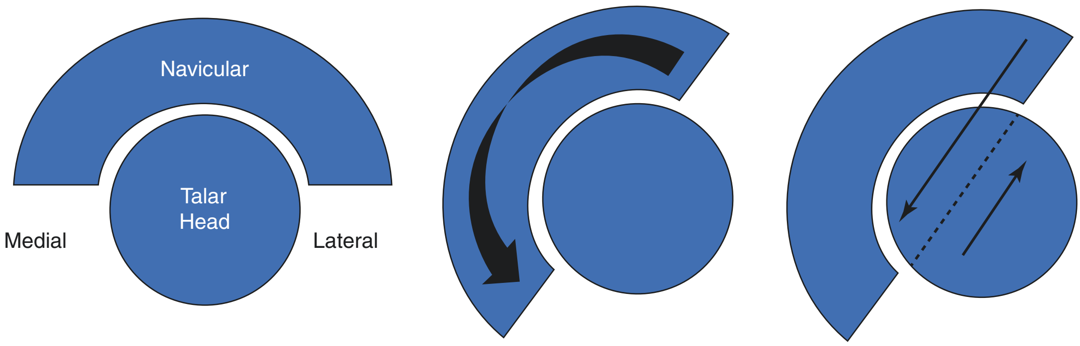

Fig. 6.2 Mechanism of talar head fracture: The navicular adducts around the talar head. With an axial load, a shear force is created across the talar head. This shear force produces the fracture as the talar head dislocates

midfoot adduction causes the navicular to shear off a portion of the medial talar head. This usually generates two distinct fragments but can result in injuries ranging from nondisplaced fractures to comminuted medial head fractures (Fig. 6.2).

Diagnosis

Patients will usually be able to recall a specific injury. They will describe their foot as being in a plantarflexed position at the time of injury[1, 8]. These injuries are typically not associated with high-energy trauma as is the case with talar neck fractures; talar head fractures associated with pantalar dislocations are the exception to this rule. Pain, swelling, and ecchymosis over the dorsum of the foot centered on the midfoot are characteristic, as is difficulty with weight-bearing. Motion at the midfoot may also elicit pain. Furthermore, a stress or insufficiency fracture of the talar head should always be in the differential for patients with chronic midfoot pain [18].

Radiographic evaluation has been controversial. Standard AP, lateral, and oblique radiographs of the foot may not maximize full visualization of the talar head and neck [5]. Other sources have felt complete appreciation of talar head and neck pathology can be shown on a Canale view [6, 10]. This view is obtained with maximum plantarflexion of the foot with 15 degrees pronation, and the X-ray tube directed 15 degrees cephalad from the perpendicular vertical axis allows for better visualization of the talar head and body. In instances where the articular injury and displacement are difficult to visualize, CT is recommended.

Treatment

Early in the history of treatment, Coltart detailed nonoperative management of most talar head injuries in a walking cast. Operative treatment was indicated when displacement of a bony fragment resulted in soft tissue compromise or block to midfoot range of motion. This was treated by excision of the fragment. Pennal advocated for nonoperative management of most fractures, as significant displacement was not common in most patients in his series. These were treated in a walking plaster cast for a period of 4–6 weeks. Small displaced fragments affecting the surface of the talonavicular joint were excised when necessary. Kenwright and Taylor, in their published series, also treated talar head fractures in a short-leg walking cast with early weight-bearing allowed. Excision of any bony fragments preventing talonavicular joint motion was performed.

Treatment of talar head fractures is dependent on the amount of articular step-off, displacement of the fracture fragments, and degree of talonavicular incongruity [12]. The talonavicular joint should be thoroughly assessed for stability during evaluation of the patient. This can be done with stress examination under fluoroscopy or plain AP radiographs of the foot in full inversion and eversion. Talar head fractures can ultimately lead to shortening of the medial column, which can limit subtalar motion and lead to varus deformity [15].

Nondisplaced fractures can be treated by casting and non-weight-bearing for a period of 4 weeks. Progressive weight-bearing can be instituted at that point until fracture healing is evident and the patient no longer exhibits any pain or discomfort.

In instances with displacement, articular incongruity, and/or talonavicular subluxation, surgical fixation is recommended [9]. The main goals for fixation include restoration of the articular surface and medial and lateral column lengths. Medially based injuries including crush and coronally oriented fractures are best approached from a medial extensile or anteromedial incision. As there is difficulty in accessing lateral injuries via a medial approach due to the extent of soft tissue dissection, a dorsolateral incision is preferred for lateral injuries.

Reduction is performed under direct visualization and provisionally held using nonthreaded Kirschner wires. Options for fixation include cortical screws, headless compression screws, and bioabsorbable fixation for areas of small or comminuted articular fragments. Cortical screws are then placed in lag technique across the fracture site. In instances where substantial shortening of the medial column is present, a small external fixator may be placed for restoration of column length and disimpaction of the fracture itself. Proximally, pins may be placed into the talus or calcaneus and into the navicular or medial cuneiform distally. When substantial comminution is present, the external fixator may be left in place to allow for preservation of column length.

Postoperatively, patients are made non-weight-bearing in a well-padded short-leg splint. Pharmacological prophylaxis for deep venous thrombosis is administered until the patient is mobilizing well with the aid of crutches or a walker. They are seen for wound evaluation at 1 week postoperatively and 3 weeks for removal of sutures. They are transitioned into a removable splint as early as 1 week, and motion exercises are initiated. Patients are maintained non-weight-bearing for 12 weeks, and between weeks 12 and 18, progressive weight-bearing occurs in a walking boot. The patient is transitioned to a normal shoe during that time as well; compression socks and orthotics are prescribed as supplementary aids. After week 18 the patient starts doing strengthening and proprioceptive training. The patient is counseled that they can expect to see gradual improvement over the course of 2 years. Additionally, patients should expect to notice a difference in their ability to ambulate over uneven ground, and residual pain is not uncommon.

Outcomes

There are few studies that directly report the outcomes of talar head fractures. Much of the evidence comes from studies of talus fractures as a whole where the authors include a small subset of talar head fractures. The first study that mentions these fractures is from the British Royal Air Force from 1940 to 1945 in which they identified six talar head fractures out of a total of 228 talus injuries reviewed [8]. Four of these six cases occurred in flying accidents where the pilots' feet were in a plantar flexed position. All of the talar head fractures were treated nonoperatively with no mention of outcomes. Another study out of England from 1949 to 1968 reported on 58 civilian injuries around the talus of which there were two talar head fractures noted [11]. One patient was treated nonoperatively, and the other required removal of a displaced dorsal fragment because it was thought that it would restrict midtarsal motion. Both patients regained full function with one patient reporting a good outcome and the other an excellent outcome. They also identified ten midtarsal dislocations with eight of these patients having an associated fracture that in some cases involved the corner of the talar head. Eight of these ten patients had a satisfactory result, and it is unclear whether patients with an associated talar head fracture had worse results. In another subset of patients with pantalar dislocation of the talus, they reported one patient with an associated fracture of the talar head and posterior tubercle. This patient was closed-reduced and pinned with a Kirschner wire for stability. Weight-bearing was restricted for 12 weeks, and the patient had a satisfactory result with minimal symptoms reported at 11-year follow-up.

A more recent study of operatively treated talus fractures from 2002 out of Germany identified 80 talus fractures treated between 1994 and 1997 [16]. This study grouped talar head fractures with distal talar neck fractures, osteochondral flakes, and talar process fractures. Fifteen patients were included in this group with no further demarcation of fracture type. In this subset of patients, approximately half regained full mobility of their subtalar and ankle joints, whereas the other half reported limited mobility of those joints; no patients reported complete stiffness. Also, among operatively treated nondisplaced talar head fractures, no patients developed osteonecrosis. In terms of functional scores, out of 15 patients, eight reported good to very good Hawkins scores, whereas 11 reported good to very good Mazur scores (Mazur scores give more weight to pain, while Hawkins weighs function and pain equally). Of note, only one of the patients required a talonavicular arthrodesis.

The only study to deal directly with talar head fractures comes out of the United Kingdom in 2015 [17]. This study was a systematic review in which eight cases of isolated talar head fractures were identified. Four of the injuries were sports related, two were inversion injuries in a standing position, and two were unreported. There were no comparative studies identified. These cases came from six studies; five were case reports and one was a case series of three patients. Only three patients were treated operatively in the acute setting. There was no incidence of AVN. One patient had a missed talar head injury that resulted in a malunion requiring an osteotomy to restore the talonavicular joint. This patient was able to return to his preinjury activity level 3 months after the surgery. Two of the operatively treated patients reported pain with prolonged activities. The other operatively treated patient was asymptomatic at 1 year with full return to activity.

Overall, the literature is sparse on outcomes of talar head fractures with little to guide the surgeon in determining treatment and counseling patients on expected results of treatment. Therefore, the surgeon must rely on his or her knowledge of the anatomy and biomechanics of the talonavicular joint to determine the appropriate treatment course based on the fracture pattern encountered.

Complications

Complications usually arise when occult or distinct injuries are missed, most typically associated with the evaluation of patients with multiple injuries. While the risk for osteonecrosis is generally low and has been described as less than 10%, the arthritis that results becomes problematic. This arthritis is typically treated with arthrodesis of the talonavicular joint. An arthrodesis is the final common pathway for missed injuries as well, as these can result in post-traumatic arthritis of the talonavicular joint.

Conclusion

While rare, injuries to the talar head present their own unique issues in the treatment of foot and ankle trauma. As the talonavicular joint is an essential joint, there is a low threshold for surgical correction of incongruity. In addition, their treatment must take into account other concomitant foot injuries.

Case Presentation

This case is a 36-year-old female status post motor vehicle collision with a closed fracture dislocation of the right talus. Imaging noted that the talus was displaced posterolaterally and externally rotated 90 degrees, with dislocations of the tibiotalar, subtalar, and talonavicular joints (Fig. 6.3). The talar neck was sitting adjacent to the posterior distal fibula. The talar head fracture was identified on CT scan; the head fragment was from the medial talar head, dislocated from the talonavicular joint and displaced under the tibial plafond (Fig. 6.4)

Closed reduction of the talus was attempted and was unsuccessful. The decision was made to proceed with immediate reduction of the displaced talus and operative fixation of the fracture.

The patient was taken to the operating room and positioned supine on a table with a radiolucent extension distally. A small bump was placed under the ipsilateral hip. To aid with closed manipulation, a 5.0-mm centrally threaded pin was placed through the posterior calcaneus. Closed reduction was repeated with the patient paralyzed. The talus was pushed anterior to the fibula from its posterior position but still remained dislocated laterally (Fig. 6.5)

An anterolateral approach to the talus was marked in line with the fourth metatarsal extending proximally between the tibia and fibula. Dissection

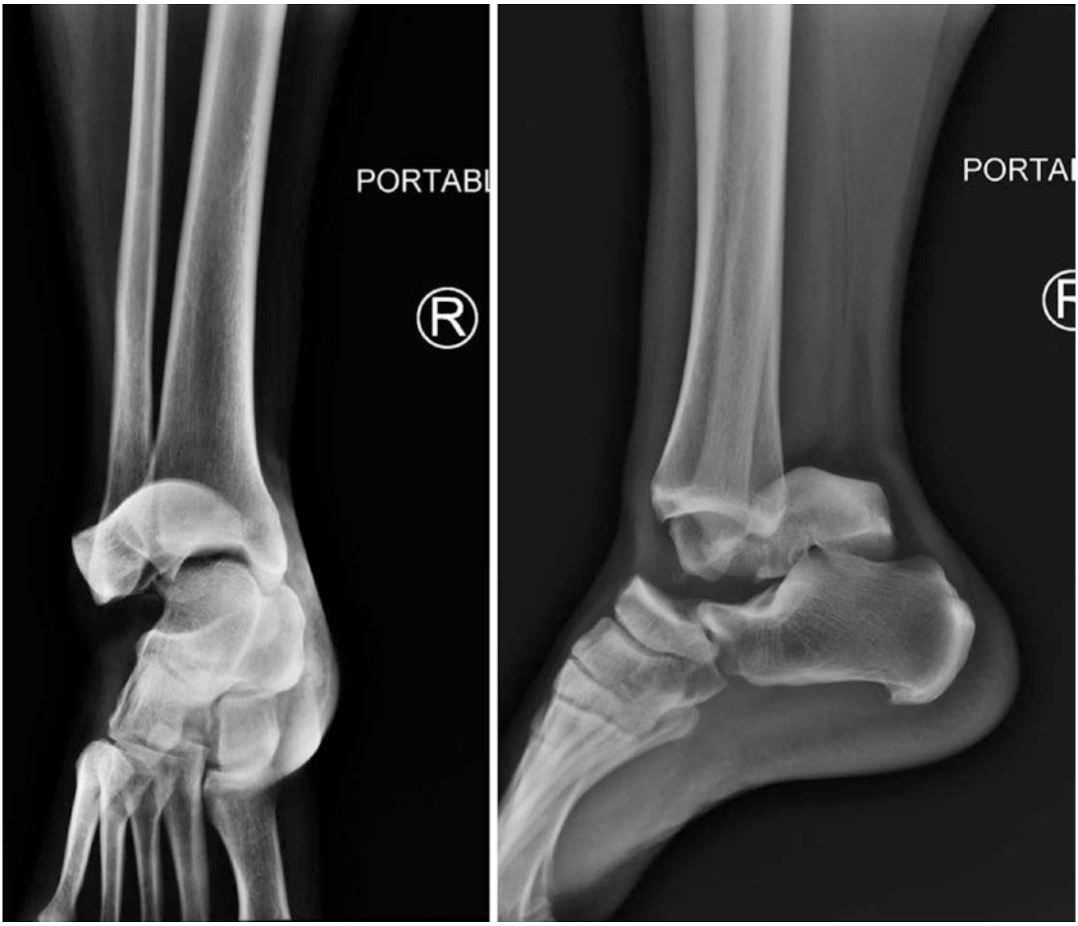

Fig. 6.3 AP and lateral radiographs of the right ankle showing a displaced dislocated talus posterior and lateral to the ankle joint

was carried down to the level of the capsule where traumatic disruption was encountered. The talar head was found extruded through the capsule and buttonholed around the displaced peroneal tendons (Fig. 6.6). Dissection was carried further distally and the extensor digitorum brevis elevated anteriorly to allow for reduction of the talus.

Further extension of the capsulotomy allowed for direct visualization of the displaced talar head fragment that was located between the tibial plafond and posterior facet of the calcaneus. The capsule was tagged anteriorly to act as a retractor and facilitate future repair. There were multiple small osteochondral fragments that were irreparable based on their size and one large free fragment (Fig. 6.7). These fragments were removed and placed on the back table. The talus was maintained in a dislocated position through the anterolateral wound to facilitate access to the head for anatomic reduction.

The large medial fragment was affixed to the lateral head with a 1.25-mm Kirschner wire that was predrilled into the fragment on the back table. Further, a 2.5-mm Schanz pin was placed in the intact talus to allow for controlled manipulation given that the talus was unstable from the pantalar dislocation (Fig. 6.8). The talar head was then definitively fixed with two 2.4-mm screws with low profile heads via lag technique (Fig. 6.9).

Next, the talus dislocation was reduced and the stability of the joints was assessed. The subtalar joint was unstable in supination and varus, indicating that this was a medial subtalar joint dislocation initially. Substantial tibiotalar instability was also noted, as there was significant talar tilt with a varus force applied to the hindfoot. A medial frame was applied with pins in the posterior calcaneus and distal tibia; it was tensioned into valgus to protect the repair of the lateral ligamentous and capsular

Fig. 6.4 Axial, sagittal and coronal cross-sectional images of the right ankle show a dislocated talus posterior and lateral to the ankle joint with a displaced talar head fracture fragment left in the joint

Fig. 6.5 The intraoperative fluoroscopy images above demonstrate placement of a calcaneal transfixion pin to allow for more controlled manipulation of the calcaneus for reduction of the talus

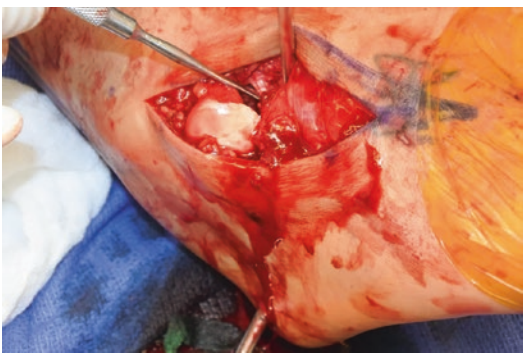

Fig. 6.6 Upon incising through the dermis of an anterolateral approach the talar head was seen extruded through the traumatic arthrotomy. A defect in the medial talar head can be seen in the location of the freer. (Photograph courtesy of Michael S. Sirkin, MD)

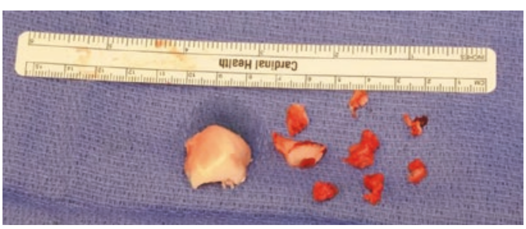

Fig. 6.7 The free talar head fragments were removed and placed on the back table

Fig. 6.8. One fragment was large enough for fixation with two 2.4 mm screws placed with a lag technique

Fig. 6.9. Fixation occurred prior to reduction of the pantalar dislocation to facilitate exposure

structures that could be addressed through the anterolateral approach (Fig. 6.10).

Capsule and fascia were closed using absorbable monofilament sutures and the skin closed with nonabsorbable nylon sutures. A gastrocnemius recession was performed at 6 weeks when the patient returned to have the external fixator removed, as gastrocnemius equinus contributes to this injury in the author's opinion. The patient was non-weight-bearing for a total of 12 weeks after the injury (Figs. 6.11 and 6.12). At 11 months, the patient is asymptomatic with good ankle, hindfoot, and midfoot motion and full return to activity including running (Fig. 6.13).

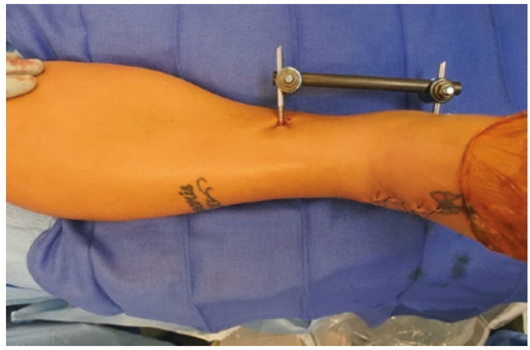

Fig. 6.10 A medial frame was placed given the persistent instability of the tibiotalar and subtalar joints after fixation of the talar head and reduction of the talus

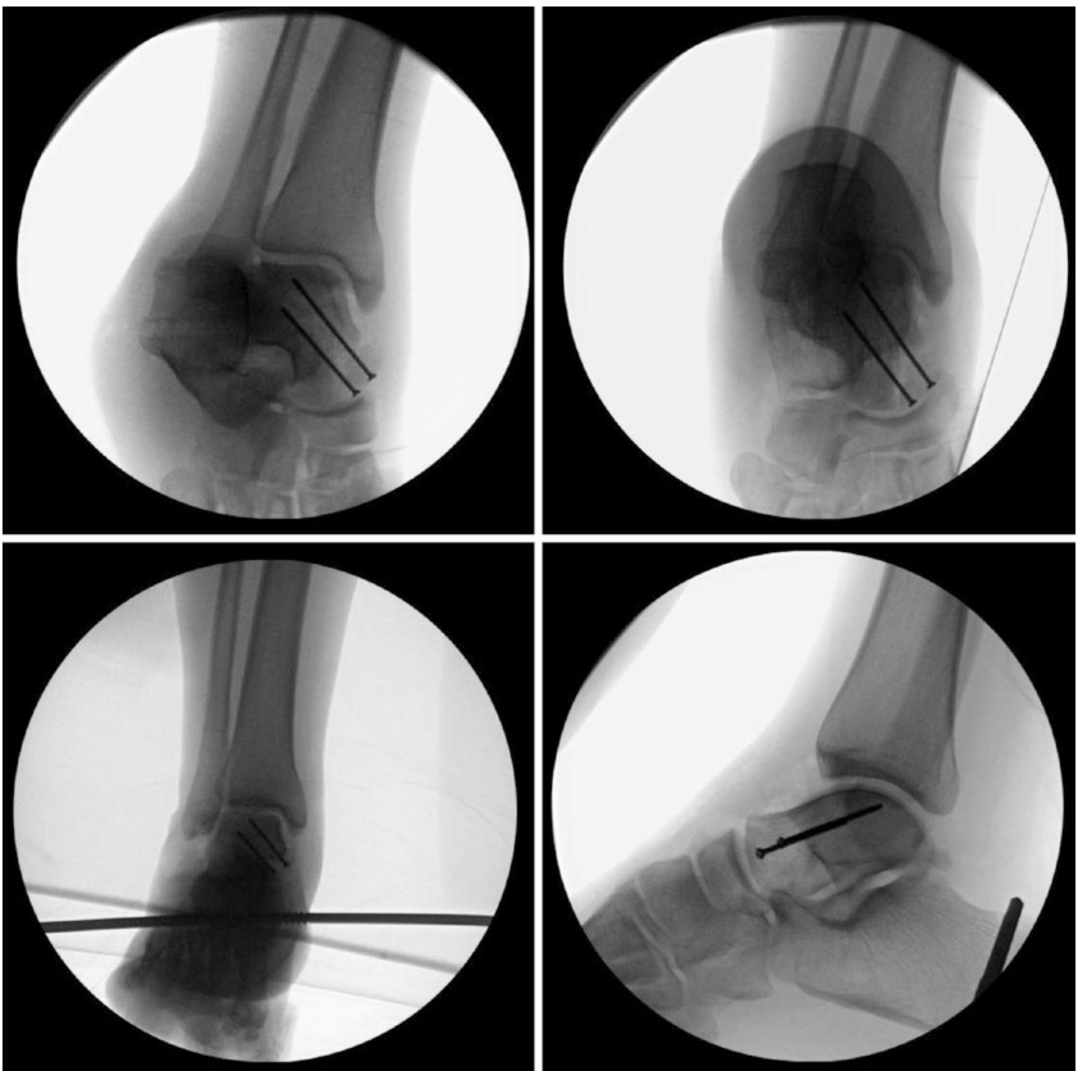

Fig. 6.11 Select Broden's views, AP and lateral intraoperative images show reduction of the talar body, reduction of the talar head fracture and placement of fixation

Fig. 6.12 Postoperative AP, oblique and lateral radiographs of the ankle and foot, respectively, showing reduction of the talus and fracture, along with hardware position

Fig. 6.13 AP, oblique, and lateral images of the ankle and foot at 6 months

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