Fractures of the Talus: Current Concepts

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Abstract

Talus fractures continue to represent a challenging and commonly encountered group of injuries. Its near-complete articular cartilage surface, and its role in force transmission between the leg and foot, makes successful treatment of such injuries a mandatory prerequisite to regained function. Familiarity with the complex bony, vascular, and neurologic anatomy is crucial for understanding diagnostic findings, treatment indications, and surgical techniques to maximize the likelihood of anatomic bony union. This review details the structure and function of the talus, a proper diagnostic workup, the treatment algorithm, and post-treatment course in the management of talus fractures.
Level of Evidence: Level V, expert opinion.

Keywords: talus fractures, hindfoot trauma, avascular necrosis, AVN, post-traumatic arthritis

Introduction

Talus injuries present a diverse, unique set of challenges in management with a profound impact on the short- and long-term functional outcomes for the patient. The talus is 60% to 70% covered in articular cartilage,[27] but has no muscular attachments, and articulates with adjacent bony structures via capsuloligamentous restraints. It is anatomically divided into 3 main structures: the body, the neck, and the head, as well as the lateral and posterior (along which runs the flexor hallucis longus tendon) processes.[32] Structurally, it transfers loads from the tibia to the remainder of the foot.[10] The body is trapezoidal, bordered superiorly by the convex talar dome. The cartilaginous medial and lateral walls are irregular, and the subtalar concave surface makes up the floor. Anterior to the body, the neck does not possess any articular cartilage, and has varus and plantarflexed neck-body angles of 10 to 44 degrees and 5 to 50 degrees, respectively.[20] The talar head is convex, fully coated in articular cartilage, and articulates with the navicular bone. It is supported by the calcaneonavicular ("spring") ligament that maintains the plantar arch.

The blood supply (Figure 1) also follows a unique and delicate pattern, with several vessels contributing; the predominantly cartilaginous surface greatly limits the available regions for perforating perfusion. The extraosseous blood supply of the talus is an amalgam of contributions from the anterior tibial artery, posterior tibial artery, and perforating peroneal artery, though the posterior tibial artery is the largest contributor through its branch to the tarsal canal.[9] The

talar head also gets contributions from the dorsalis pedis and the artery of the tarsal sinus.[9] The talar body and dome are predominantly perfused by the posterior tibial artery with secondary contributions from the peroneal artery that anastamose in the subtalar joint through the tarsal canal (posterior tibial artery) and tarsal sinus (branch of the peroneal artery).[10] Blood flow has classically thought to be retrograde, originating at the neck,[24] although this has been called into question in studies that use newer imaging modalities.[37]

A number of studies have described the various injury mechanisms for talus fractures, which are generally high-energy incidents. In multiple retrospective reviews of talar neck and body fractures, motor vehicle collision (MVC) was the most common presenting injury mechanism.[1,19,21,51,60] Secondary etiologies in descending incidence include motorcycle collision, fall from height, pedestrian struck by automobile, crush injuries, and athletic injuries.[1,21,51,52,60]

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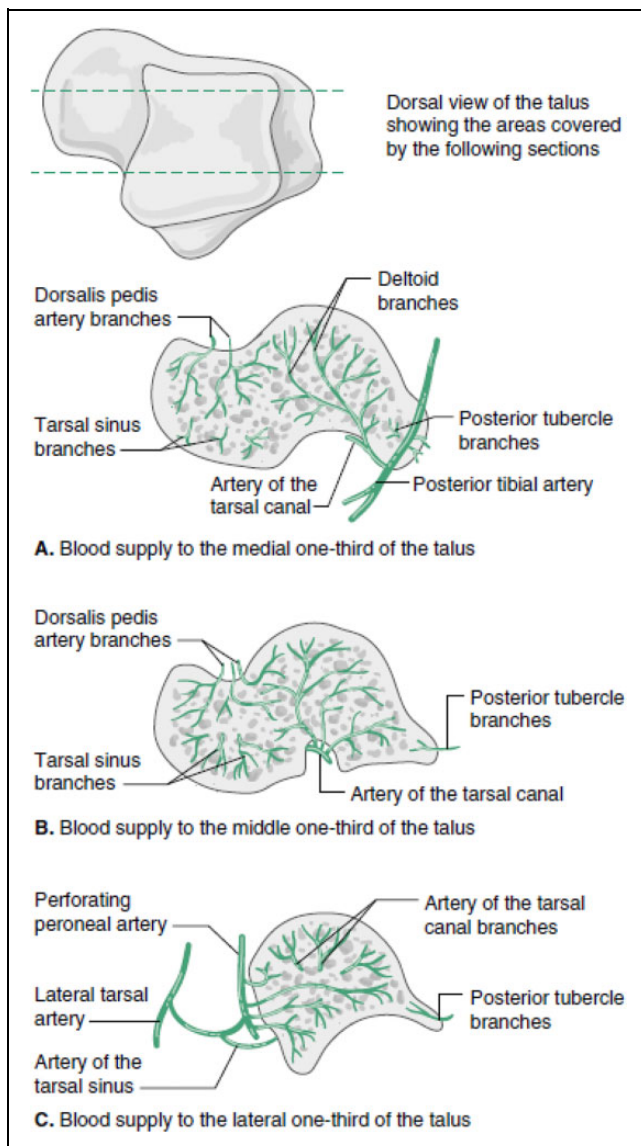Email: amschw3@emory.edu

Figure 1. Blood supply to the talus. (Source: *Core Knowledge in Orthopaedics: Foot & Ankle*, Elsevier.)

The incidence of delayed presentation and/or undiagnosed injuries to the talar neck/body was found to be 6.9% in a review of 102 patients and most commonly occurred in lower-energy scenarios such as falls from 1 m, rotational injuries during the loading phase of rock climbing ascent, and rotational injuries during community ambulation.[61] Acute subtalar instability follows a similar pattern of injury mechanism for talar neck fractures, as it requires high energy to dislocate the inherently stable subtalar joint.[5] Talar head fractures, though rare, also represent a sequela of high-energy trauma, such as an MVC.[3] A retrospective study of the lateral talar process fractures shows a strong association (88%) with snowboarding, hence its eponym "snowboarder's fracture."[55] Talus injuries represent a heterogeneous set of injuries that are complicated by the predominantly articular nature of the bone, its prominent role in the weightbearing process, and the tenuous blood supply network that perfuses it.

Epidemiology

Talus fractures are relatively rare injuries (Table 1); they are estimated to account for 0.1% to 2.5% of all fractures, and 3% to 5% of foot and ankle fractures.[9,21,55] The true incidence of talar fractures may be underestimated because of a sensitivity of just 74% for plain radiographs,[14] and resultant prevalence of missed diagnosis.[9,61] Talar fractures are more common in men than women, and the average patient age early to mid-30s, with a broad range.[11,19,25,39,45,54]

Fractures of the talar neck are the most common anatomic site for injury and account for 45% to 50% of all fractures of the talus.[1,9,47] Talar neck fractures are most commonly characterized by the Hawkins classification, which also predicts likelihood of avascular necrosis[26] (Table 2). Given the predisposing high-energy injury, the rates of associated fractures are as high as 64%.[47,48,50] Similarly, 18% to 25% of talar neck fractures are open.[47,48,50] Subtalar dislocations occur in 15% of talar injuries, with 80% and 15% incidences of medial and lateral instability, respectively.[5] Given the inherently high energy required for dislocation, 10% to 40% are open injuries.[5] Fractures of the talar body are more rare than neck injuries, making up 13% to 23% of talus fractures, and commonly occur as a result of direct axial load to the calcaneus resulting in compression between the calcaneus and the tibial plafond.[49,62] Fractures of the talar head, including osteochondral fractures, account for 3% to 10% of all talus fractures, and seem to have a higher incidence in concomitant talar dislocations.[13,20,40] Finally, lateral process fractures often present in delayed fashion, and incidence is difficult to assess, though one study demonstrated occurrence in 0.86% of any injury about the ankle.[41]

Diagnostic Imaging

Although plain radiographs serve as the gold standard for initial screening for bony injuries about the foot and ankle, the sensitivity for any talar injury is only 74%, with displacement being the largest driver of radiographic sensitivity.[14] In particular, talar dome osteochondral fracture, lateral process fracture, and posterior process fracture are the most frequently missed fracture sites.[14] Given these findings, computed tomography (CT) is the gold standard for diagnosis, though only 91% of fractures were properly evaluated with a CT scan at a level 1 trauma center.[14] CT should be part of routine surveillance of ankle injuries that have swelling and pain disproportionate to radiographic findings, as 6.9% of talus fractures were undiagnosed at the time of presentation.[61]

Some authors suggest that a CT scan is a requisite for surgical fixation of a talus fracture and should be performed after a closed reduction is achieved. Even when x-ray demonstrates the fracture pattern, CT provides additional

Table 1. Review of Reported Sex, Age, and Open Fracture Rates.

Study	Subject Selection	Male, n (%)	Female, n (%)	Average Age, y	Open Fractures, n (%)
Vallier et al (2004)[9]	Consecutive patients with talar neck fractures managed operatively	60 (60)	40 (40)	32.6	24 (24)
Vallier et al (2004)[13]	Consecutive patients with talar body fractures managed operatively	39 (70)	17 (30)	34.1	11 (20)
Fournier et al (2011)[10]	Patients with neck, body, and neck and body fractures treated by internal fixation with >5 years of follow-up	75 (68)	36 (32)	34	22 (20)
Vints et al (2018)[22]	Consecutive adult patients (>18) with acute talar fractures	65 (77)	19 (23)	36.9	16 (19)
Ohl et al (2009)[21]	Patients with displaced neck or body fractures managed operatively with >2 years of follow-up	12 (60)	8 (40)	38.8	6 (30)
Canale et al (1978)[23]	Patients with talar neck fractures			30	17 (24)

Table 2. The Hawkins Classification of Talar Neck Fractures.

Classification	Reported Ranges of Risks of Avascular Necrosis, %	Description
Hawkins type I	0-13	No displacement
Hawkins type II	20-50	Subtalar joint dislocation
Hawkins type III	20-100	Subtalar and tibiotalar joint dislocations
Hawkins type IV	70-100	Subtalar, tibiotalar, talonavicular joint dislocations

information on degree of comminution, articular involvement, and surgical planning.[36,47,52,58] Given the sensitivity of CT in diagnosis, further imaging is not typically indicated; however, magnetic resonance imaging has proven useful for persistent pain after trauma to aid in diagnosis of peritalar soft tissue injuries and osteochondral injuries such as those in the talar head or dome (Figure 2).[22]

Surgical Indications and Timing of Fixation

Given the predominantly articular nature of talus fractures, maintenance of a reduced joint line and stable articulation are key to short-term functional status and long-term mitigation of post-traumatic arthritis risk. As such, patients with nondisplaced neck and body fractures, some nonambulatory patients, and patients medically unable to tolerate surgery are the only patients in whom nonoperative treatment should be considered.[50] Even displacement magnitudes just over 1 mm in body fractures are an indication for surgical reduction and fixation.[52] Talar neck fractures with no articular surface displacement can undergo a nonoperative trial of rigid immobilization and strict nonweightbearing, but must be monitored closely for fragment shift.[9,47] Patients whose polytraumatized status precludes them from adherence to

weightbearing status should undergo in situ surgical stabilization of the talus fracture to avoid incidental fracture displacement.[52]

As these injuries often accompany high-energy trauma, the soft tissues about the foot and ankle must dictate the tolerance for early fixation. Severe soft tissue swelling or fracture blisters, extensive open fracture wounds that limit access to the fracture, and severely comminuted open fracture wounds with gross contamination are relative contraindications to early open treatment.[52] For these patients, early multiplantar external fixation (EF) should be applied, with concomitant and subsequent repeat debridements, to allow for demarcation of the zone of injury and soft tissue rest with underlying indirect reduction of fracture fragments. Soft tissue healing precludes conversion of EF to an open articular and bony reduction and internal fixation (ORIF). However, for patients with minimal to no gross contamination, consideration of concomitant temporizing or definitive internal fixation with the index irrigation and debridement may be considered in lieu of furthering soft tissue compromise with reopening and extension of traumatic wounds.

Superficial soft tissue infections, advanced peripheral vascular disease, chronic venous insufficiency (with skin ulceration), systemic immunodeficiency, and noncompliant patients are relative contraindications for ORIF and may be indications for definitive treatment in EF.[43] However, a low threshold for operative treatment should be employed, even in high-risk patients, because unsuccessful closed reduction attempts will lead to further decompensation to compromised soft tissues.[43]

Historically, emergent treatment and fixation was recommended for talus fractures because of the known risk of osteonecrosis with talar neck fractures.[23] This paradigm has shifted somewhat recently. Open injuries, as with any other fracture, require emergent debridement and stabilization.[51] Closed injuries, however, are amenable to a more situational approach to surgical timing. Delayed fixation is protective of soft tissue complications (wound dehiscence, skin necrosis,
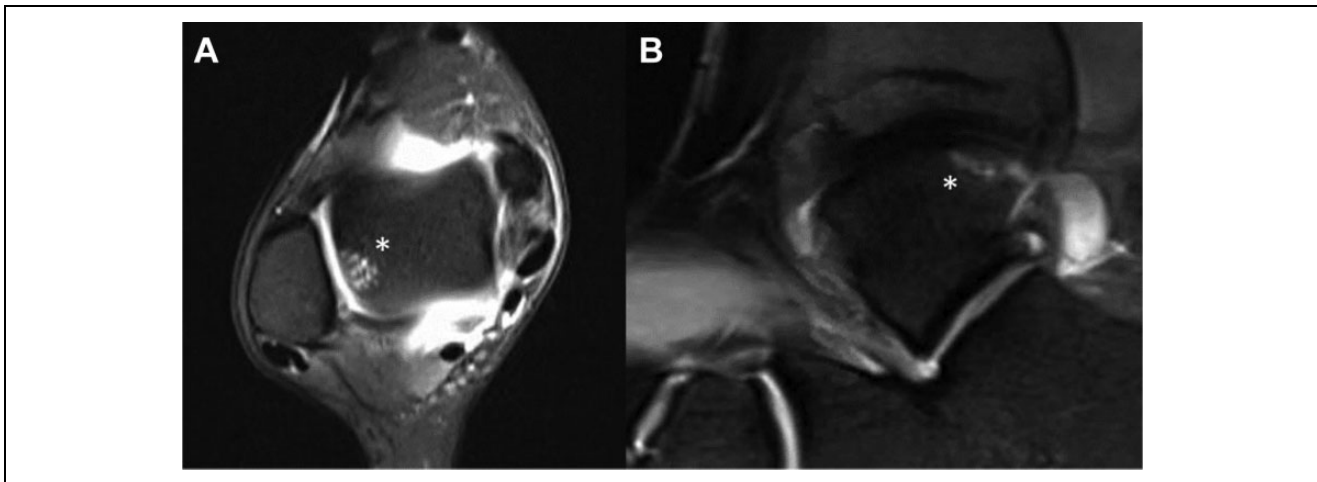
Figure 2. Osteochondral fracture noted on (A) axial and (B) sagittal magnetic resonance images. The osteochondral lesion is marked with an asterisk.

and infection) when comparing delayed vs immediate fixation (2%-10% vs 77%).[59] Further, there is no current evidence linking timing of fixation and development of posttraumatic osteonecrosis.[34,44,50,51] Rather, fracture displacement and concomitant soft tissue injury are predictive of talar necrosis.[53] There is some limited evidence that delayed fixation may provide better outcomes, which has been suggested to be due to increased soft tissue recovery and transfers of care to more experienced surgeons and the opportunity for surgical planning.[23]

Nonoperative Treatment

Nondisplaced fractures of the head and body can be treated by casting the foot and ankle in a neutral position for 6 weeks. Partial weightbearing is required for approximately 8 to 10 weeks until radiographic proof of union of the fracture is obtained.[50] However, even without imaging-evident displacement noted, the predominantly articular nature of the bone mandates stable fixation of fractures of the weight-bearing and load-transferring areas of the head and body of the talus. Further, a trial of cast immobilization of acute posterior or lateral talar process fractures of at least 6 weeks is useful, as articular congruity is typically maintained.[7] Finally, nondisplaced talar neck fractures are still typically treated with surgical fixation, though a trial of prolonged cast immobilization and nonweightbearing may be useful in nonambulatory patients or poor surgical candidates.[50] Ultimately, any residual displacement after a talar neck fracture can have a profound impact on subtalar joint contact pressures, and the amount of plantarflexion that is required to maximize anatomic alignment after a fracture is not commensurate with long-term hindfoot function.[20]

For all other fractures, closed reduction and immobilization is a temporizing measure to relieve the high soft tissue stress delivered by displaced fracture fragments, and typically requires substantial muscular relaxation.[50] To reduce

dislocated talar neck fractures, the forefoot is initially maximally dorsiflexed to re-create the initial deformity, followed by forced plantarflexion with concomitant distraction of the calcaneus, and gentle inversion/eversion.[43] Talar body fractures similarly require significant distraction of the subtalar joint and direct manipulation of the displaced fragment.[43] Inability to obtain anatomic reduction that threatens the soft tissues or neurovascular structures requires emergent operating room for closed, percutaneous, or open reduction.[33]

Operative Management

External Fixation

External fixation should be used to stabilize a reduced talus fracture and/or dislocation when soft tissue injury and/or patient medical status preclude safe open reduction and internal fixation. Multiple techniques are described for external fixation. When it is necessary to place pins into the talus itself, the medial safe zone is along the anteromedial neck, proximal to the talonavicular joint and superior to the tibialis posterior tendon. The safest zone on the lateral aspect of the talus is a small nonarticular portion of the neck, though this requires fluoroscopic localization due to difficulty with reliable palpation.[46] Another method, described for talar extrusion, involves an indirect distraction of the tibiotalar and subtalar joints with an external fixator apparatus, with concomitant Steinman pin transfixion through the calcaneus, talus, and tibial plafond.[31] Finally, classic delta-frame constructs can be used in stable reductions.

Internal Fixation

Anatomic reduction and rigid fixation of articular talus fractures remains the mainstay of treatment to avoid alteration of contact pressures between the ankle and hindfoot articulations and minimize the risk of osteonecrosis; malunion tolerances are less than 3 degrees.[15] Further surgical

considerations that dictate approach, implant use, and fixation mode include level of fracture comminution, concomitant bony and/or soft tissue injury, and fracture pattern.[35]

Combined anteromedial and anterolateral approaches facilitate maximal exposure.[59] The extensile anteromedial approach extends from the tip of the medial malleolus to the base of the first metatarsal with an intermuscular plane between the tibialis anterior and posterior, and exposes the medial talar neck and the anterior tibiotalar articulation. An adjunct oblique medial malleolus osteotomy offers additional exposure to the talar dome, if indicated.[59] The anterolateral incision extends from the tip of the lateral malleolus down the fourth ray, terminating at the talonavicular joint, to visualize the lateral talar dome and body, the lateral neck and lateral process, and talonavicular and subtalar articulations.[59] Use of a lateral malleolus osteotomy is rarely indicated, limited mostly to technique case reports in the literature.[42]

Limited incision approaches have also been described, with or without simultaneous use of extensile approaches.[35] The sinus tarsi approach is a selective lateral approach that extends from the tip of the lateral malleolus to the base of the fourth ray, exposing the subtalar joint.[35] Percutaneous screw fixation of nondisplaced, noncomminuted talar neck and body fractures can be considered, though strict care to cross the fracture perpendicularly in the anterior-posterior and superior-inferior planes is necessary to achieve maximal fragment compression.[2] This is typically accomplished with 2 screws to minimize rotational forces and can be done as an all-antegrade, all-retrograde, or combined antegrade-retrograde construct.[2,6]

Anatomic reduction is best obtained through dual approaches to directly visualize both the medial and lateral talar neck, recognizing that the dorsomedial talar neck is typically the most comminuted, and reduction reference points may be on the lateral neck. The goal of fixation methods include direct anatomic compression of fracture lines without comminution and maintenance of length and alignment where comminution precludes compressive forces.[4] Lag screw fixation confers maximal construct stability, though it sacrifices the alignment control of plate constructs with or without supplementary lag or interfragmentary fixation.[12] Currently, intraoperative contouring of minifragment plating on the lateral surface of the talus is recommended to avoid medial shortening and varus malunion, particularly in cases of neck shortening greater than 2 mm (Figure 3).[35] Medial plates have proven to be potentially symptomatic, so the use of screws (most commonly headless or countersunk) is often preferred to supplement lateral plate fixation (Figure 3).[30]

Role for Arthroscopy

Arthroscopy has been reported in some unique situations. Although not suitable as a sole method of fracture visualization and reduction for large, displaced fragments, it enables
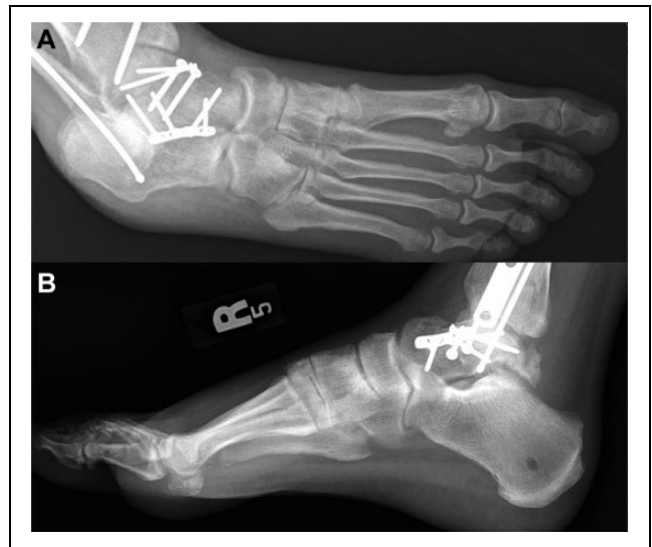

Figure 3. Fixation of talar neck fracture with lateral mini-fragment plating and medial countersunk screws on (A) oblique radiograph and (B) lateral radiograph of the foot.

direct visualization of smaller articular fractures that are difficult to visualize through an open approach and avoids the soft tissue stripping of an extensile dissection. Monllau et al[38] had good short-term results in the arthroscopic reduction and fixation of a coronal talar body fracture that occurred in conjunction with an osteochondral fracture of the talar dome. This approach to treatment also facilitated earlier rehabilitation, beginning at 15 days postoperatively. Jorgensen et al[29] described arthroscopic reduction and internal fixation for 2 special cases: a comminuted fracture of the posterolateral talar body with extension into the tibiotalar joint and a lateral talar body fracture involving the articular surface with displacement and multiple loose bodies. Dodd et al[18] described arthroscopic assisted transfibular fixation of an articular talar dome fracture, and reported satisfactory clinical outcome at 1-year follow-up.

Arthroscopy can also be used as an adjunct method of fracture visualization to assist with an open reduction for percutaneous screw fixation. In a series of 7 consecutive patients treated for closed Hawkins type II talar neck fractures with arthroscopically assisted reduction and percutaneous screw fixation, 6 of 7 patients were pain free at their time of final follow-up.[56] There is a single-patient report of treating a Hawkins III talar neck fracture with an entirely arthroscopic technique, with no reported complications and a return to activities in short-term follow-up, though long-term outcomes are unclear.[57]

Outcomes

Outcome measures are difficult to quantify given the variability of the fracture's anatomic location, displacement severity, associated soft-tissue injuries, surgical approach, and associated orthopedic and nonorthopedic injuries.
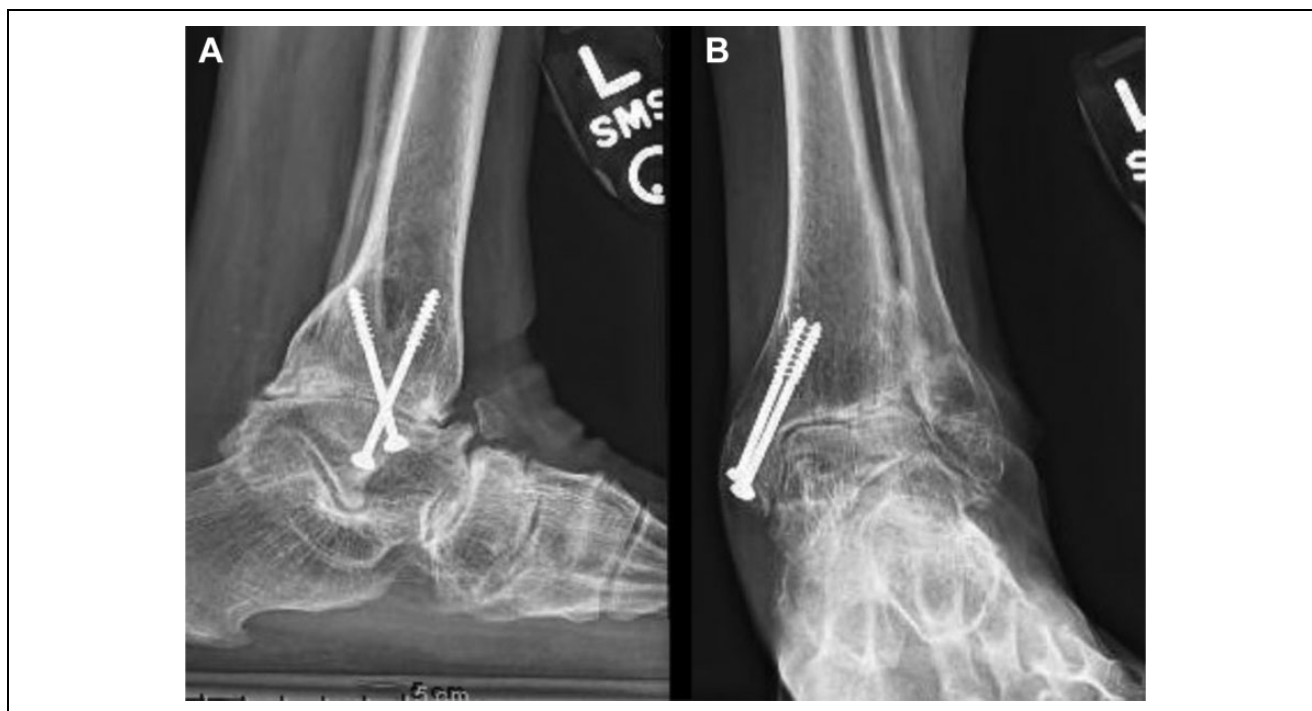
Figure 4. Post-traumatic subtalar and tibiotalar arthrosis after remote nonoperatively treated talus fracture on (A) lateral radiograph and (B) anteroposterior radiograph of the ankle.

A systematic review of talar neck fractures determined an average American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot score of 76.5 following ORIF of an aggregate of all Hawkins classified fractures. Type I fractures were observed to have an average AOFAS score of 77.0, Type II had 86.1, Type III had 68.3, and Type IV had 68.3.[28] A similar fracture severity-dependent effect on functional outcomes was repeated by Halvorson et al.[25] Predictably, avascular necrosis shows an average AOFAS score detriment of more than 22 points.[34] Post-traumatic subtalar osteoarthritis had an average decreased AOFAS score of approximately 9 points; combined subtalar and tibiotalar osteoarthritis resulted in a 12-point decline.[34] There was no significant difference in outcomes between talar body and talar neck fractures. Lateral process fractures showed the best functional outcomes after surgery, when compared with fractures of any other portion of the talus.[19] Ultimately, anatomic union of talar neck and body fractures, without post-traumatic arthritis or osteonecrosis, yields a satisfactory functional outcome. Postsurgical complications are poorly tolerated by most patients.

Complications

Post-traumatic Arthritis

Although there is a wide variety in reported incidence of complications, post-traumatic arthritis is thought to be the most common. A systematic review evaluated subtalar joint degeneration following a talar neck fracture and found a reported range of 4% to 100% incidence rate with a mean of 49%. This large variation is likely associated with follow-up time used in the study; studies with longer follow-up times generally had a higher incidence rate than those with short follow-up times. Studies with a minimum 2-year follow-up time had an overall subtalar arthritis rate of 81%.[17] Similarly, arthritis of the ankle joint and/or subtalar joint was observed in 21 of 39 patients (54%) with talar neck fractures treated by ORIF.[51] In a larger study, the overall rate of post-traumatic arthrosis in talar neck fractures was reported to be 68% by a systematic review article that included 635 patients.[25] Subtalar arthrosis was most common in 42% of the cohort (265 of 635 patients) (Figure 4); isolated tibiotalar arthrosis was the second most common, representing 18% of the study population (115 of 635).[25]

Treatment of post-traumatic arthritis can be accomplished through arthrodesis of the affected joints. For example, isolated subtalar arthritis may be treated with instrumented fusion of the subtalar joint; combined subtalar and tibiotalar arthritis should be managed with tibiotalocalcaneal fusion (Figure 5). However, it may be preferable to fuse the entire hindfoot, as there is a high risk of adjacent tibiotalar joint disease after subtalar fusion.

Avascular Necrosis

Avascular necrosis (AVN) of the talus is another common concern, accounting for the second most common postsurgical complication (Figure 6).[10] For talar neck fractures, the

Figure 5. Treatment of post-traumatic arthrosis with tibiotalocalcaneal intramedullary nail on (A) lateral radiograph and (B) antero-posterior radiograph of the ankle.

rate of osteonecrosis increases with fracture grade (Table 2). In Hawkins's original description, he reported overall osteonecrosis rates of 0%, 42%, and 91% for Hawkins types I, II, and III, respectively.[26] Similarly, osteonecrosis was observed in 19 of 39 patients (49%) with talar neck fractures treated by ORIF; severity-specific rates were 39% for type 2 and 64% for type 3. However, 7 of the 19 patients experienced revascularization without collapse.[51] More recent studies have shown decreased rate of post-traumatic AVN, which is hypothesized to reflect either a latency bias of insufficient follow-up, or an improvement in the expeditious and soft tissue–friendly treatment algorithm. A 2013 review of 19 studies that reported AVN in talus fractures determined an all-comer AVN incidence rate of 33%, with AVN occurring in 282 of 848 talar fractures. An incidence of 24% (174

of 735) was observed in talar neck fractures. AVN was observed in 6% of type 1, 18% of type 2, and 45% of type 3.[25] Similarly, an analysis of 26 studies that reported osteonecrosis following talar neck fracture found an overall incidence rate of osteonecrosis of 31% and an incidence rate of 25% in studies published after 2000.[17] In a study of 31 patients, the rate of osteonecrosis was higher in open fractures (9/13 patients) than closed fractures (9/18 patients).[51] When comparing talar body and neck fractures, another study found more than twice the rate of AVN in neck fractures (55%) than body fractures (27%).[52] Similar to post-traumatic arthritis, post-traumatic talus AVN is classically managed with a hindfoot intramedullary fusion nail (Figure 5).[16] However, newer therapies have emerged, such as vascularized bone grafting and total talus replacement.[16]

Figure 6. Post-traumatic avascular necrosis of the talar dome after talar neck fracture, as indicated by focal area of sclerosis. The asterisk indicates the region of avascular necrosis.

Infection

Infection after surgical treatment of a talus fracture is a significant concern given the high rate of (at least) short-term local devascularization. Open fractures, subject to the greatest deal of soft tissue stripping and contamination, were found to have a deep infection rate of 25% in a small case series of open injuries.[8] For closed fractures, the rate of infection is not well reported in the literature, though a large systematic review did note an overall deep infection rate of 21%.[25] Alternatively, in a series of 77 patients, only 1 developed a postoperative infection.[53] To minimize the infection rate, open fractures and dislocations should undergo serial debridement until contamination and soft tissue necrosis has been eradicated. Closed fractures should be managed when soft tissue swelling has diminished to avoid high stress and malperfusion of incisional skin flaps.

Malunion and Nonunion

Malunion is poorly tolerated by talus fractures, given the bone's multiple joint articulations, and its role as the cornerstone of weight transfer between the tibial and foot. As such, anatomic union is the foundation of a satisfactory clinical outcome, and persistent pain in the absence of infection, arthritis, or necrosis raises the suspicion of a deviation from a well-aligned talus. In a systematic review of talar neck fractures, an overall rate of nonunion at 5% (21 of 423 fractures) and malunion at 17% (81 of 466 fractures) was found.[25] Like other complications, the rate of nonunion is highly variable, with rates ranging from 3% to 20%.[28,39,51] The most common malunion is varus through the talar neck, which can be treated with a medial-based opening wedge osteotomy of the talar neck.

Additional Procedures

Repeat surgical intervention after an index treatment of a talus fracture can stem from treatment of infection, reconstruction of a malunion, revision fixation of a nonunion, or fusion/joint reconstruction of post-traumatic arthritis. In a review of 18 studies, secondary surgery was needed in 19% for 715 fractures.[25] However, when looking at displaced fractures, 37% of fractures in a single series needed a secondary reconstructive surgery.[44] The incidence of secondary surgery rose from 24% at 1 year after the injury to 48% after 10 years.[44] Similar rates are reported by Vallier et al[51]: of 60 talar neck fractures treated by ORIF with follow-up data, 28% underwent secondary procedures.

Other Complications

Other complications that have been documented in the literature include complex regional pain syndrome and venous thromboembolic event, which are rare occurrences described sparingly in a small series of 20 patients.[39]

Summary

Talus fractures represent a challenging and heterogeneous group of injuries. Identification and characterization of talus fractures can be difficult with plain radiography, and 3-dimensional imaging is often necessary. Because the talus serves as the pan-articulating keystone between the leg and foot, anatomic reduction and stable fixation are crucial to preserving lower extremity function. Open fractures may be treated with external fixation or early fixation with surgical debridement, depending on soft tissue contamination and the location of traumatic wounds. Fixation methods range from extensile open plate fixation to limited, percutaneous, and/or arthroscopy-assisted screw fixation depending on fracture pattern and displacement. The talus has a tenuous blood supply and has a displacement-dependent risk of avascular necrosis and/or articulation osteoarthrosis, particularly after talar neck fractures. Complications can result in a significant decline in functional status, and understanding of the bony and vascular anatomy and respect for soft tissues is crucial to maximizing the likelihood of a successful outcome.

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