CHAPTER **23**

FRACTURES OF THE LATERAL PROCESS OF THE TALUS: Snowboarder's Fracture

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INTRODUCTION

Fractures of the lateral process of the talus are frequently missed at initial evaluation in the emergency room because the symptoms are similar to those seen in the ubiquitous inversion ankle sprain.[1-3] Mills and Horne reviewed 39 lateral process fractures in 5 different series and revealed that only 59% were correctly diagnosed.[3] For that reason, understanding the mechanism of the sustained injury is critical to identifying the fracture for appropriate treatment. Late diagnosis, as well as the articular nature of the injury, frequently lead to nonunion, osteonecrosis, impingement, traumatic arthritis, and disability. Therefore, it should be part of the differential diagnosis after an ankle injury for both acute and chronic pain.

This fracture has more recently been termed "snowboarder's fracture" or "snowboarder's ankle" because of the frequency with which it is seen in this sport.[4-7] Sudden impact into forced dorsiflexion after the foot is set in eversion is a common maneuver not only on snowboards but on skateboards as well. Other situations where this fracture occurs includes motor vehicle collisions (foot braced against the brake peddle or floorboards), stepping suddenly into a hole while in forward motion, falls from a height, or direct trauma.[1,2,7]

Since first reported in 1943[8,9] there has been some controversy regarding incidence, mechanism, and treatment. This fracture was reported to have an incidence of 0.86% (13 fractures) out of 1,500 ankle injuries[2] and subsequently to comprise 24% of all talar body fractures.[10] Hawkins described it as the second most common fracture of the talus,[1] with other reports of it comprising 33-41% of talar fractures overall.[2,9,11] Relative to overall ankle injuries sustained by snowboarders, Pigozzi[12] found that 8% involved lateral process fractures, while Bladin and McRory[5] as well as Kirkpatrick et al[7] reported 15%. It has also been noted to comprise 34% of ankle fractures in snowboarders.[7] Thus, this fracture has a 15-fold greater rate in snowboarders than in the general population.

ANATOMY

The lateral process is a triangle-shaped osseous protuberance that articulates superolaterally with the lateral malleolus. The inferior apex is directed at the calcaneal floor of the sinus tarsi while the posterior margin articulates with the edge of the posterior facet of the subtalar joint. Thus, the fracture is a dual intraarticular lesion is it involves both of these joint structures.[13]

The lateral process of the talus also provides local attachment for the cervical, bifurcate, anterior talofibular, and lateral talocalcaneal ligaments. Lying anterior and slightly superior to the calcaneofibular ligament, the lateral talocalcaneal ligament is actually a thickening of the lateral capsule of the subtalar joint that resists the separation of its articular surfaces. With all these ligament attachments, it is important to note that some injuries may be avulsion fractures.[2,9,14]

MECHANISM OF INJURY

Fracture of the lateral process of the talus is a high-impact injury involving a high degree of axial loading. However, other force factors are necessary to produce it. There are 2 principle mechanisms for producing the lateral talar process fracture. Prior to the development of snowboarding, the mechanism was thought to involve forced dorsiflexion on an already inverted ankle.[1,15] Mukherjee et al reported that in all the patients they studied, the fracture resulted from inversion and dorsiflexion of the ankle.[2] As the foot is locked in an inverted position, this results in the subtalar joint opening up with the talus shifting laterally (external rotation of the talus). The lateral process thus shifts upward on the posterior articular process of the calcaneus such that the joint surfaces are no longer congruous. Forced dorsiflexion then concentrates the forces at the lateral process of the talus to produce the fracture. Boon et al concluded that, in addition to the axial loading in inversion and dorsiflexion, external rotation (of the talus) is necessary to disrupt the talocalcaneal congruency and focus the stress on the lateral process.[16] This helps account for the often-observed articular damage to the posterior facet of the subtalar joint after this injury.

Inversion injuries may also result in avulsion fractures of the lateral process. As snowboarding emerged in popularity, other authors suggested that the injury results from severe dorsiflexion with eversion of the hindfoot, common occurrences after aerial maneuvers in soft-shelled boots.[4,6] In the controlled biomechanical study by Funk et al,[17] 0% of the specimens sustained lateral process talar fractures when subjected to inversion with associated dorsiflexion. However, 100% of the specimens subjected to eversion associated with dorsiflexsion force sustained fractures. They concluded that eversion of an axially loaded and dorsiflexed ankle is a likely mechanism unique to snowboarders that could explain the high incidence of lateral process talar fractures in this sport.

CLASSIFICATION

Classification of lateral process talar fractures continues to evolve. Hawkins originally designed a rather simple pattern classification, distinct from his classification of talar neck fractures.[1] (Table 1) Type I is a simple 2-part fracture extending from the talofibular articular surface down to the posterior facet of the subtalar joint that may or may not be displaced. Type II is a comminuted fracture involving both the fibular and posterior calcaneal articular surfaces of the talus and the entire lateral process. Type III is a chip fracture off the anteroinferior portion of the posterior articular process of the talus; it does not extend into the talofibular articulation.

Subsequent authors McCrory and Bladin[5,6,16] re-ordered Hawkins classification from simple to increasing severity of the fractures. Thus, Type I is a simple avulsion fracture of the tip of the lateral process, Type II is a larger fragment of the lateral process and Type III is a similar to Type II but with significant comminution. (Figure 1) This classification is widely used clinically and is often mistakenly referred to as the "Hawkins Classification." Funk et al[17] proposed a more detailed classification that was intended for more of a research tool but has not been adopted to date.

Table 1

HAWKINS ORIGINAL CLASSIFICATION OF LATERAL PROCESS TALAR FRACTURES

Type I:	Simple two-part fracture
Type II:	Comminuted fracture
Type III:	Chip fracture of the anteroinferior lateral process

CASE HISTORY

A 27-year-old male presented with intractable swelling and pain in his lateral left ankle 3 days after a snowboarding tumble. At the time of the injury he was able to resume snowboarding and noticed sharp ankle pain with various maneuvers. He was able to snowboard back down to his car at which time he stopped activity for the day. That night the ankle swelled and became intolerably painful prompting him to go to the emergency room the next morning. Radiographs were taken and read as negative with the resulting diagnosis of a severe sprain. He was given an analgesic prescription, his ankle was wrapped in an ace bandage, and he was advised to treat it with RICE. Referral was made for specialist consultation.

Upon examination in the office, the ankle was noted to be markedly swollen with ecchymosis on both the medial and lateral heel, more so laterally. It was very tender anterior and inferior to the fibular malleolus as well as at the anterior margin of the deltoid ligament. Movement was difficult due to splinting of the muscles.

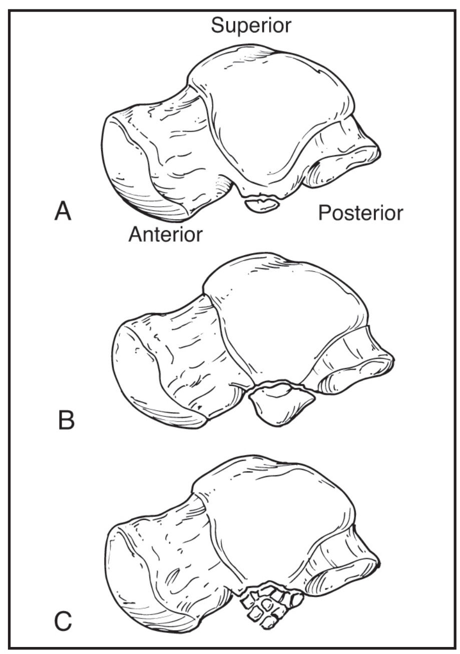

Figure 1. McCrory and Bladin Re-Ordered Classification of Lateral Process Talar Fractures (Re-drawn from Boon et al [16]) A = Type I – chip fracture; B = Type II – simple large fragment fracture; C = Type III- comminuted fracture. Although not identified in the classification, displacement is an important consideration, especially for treatment.

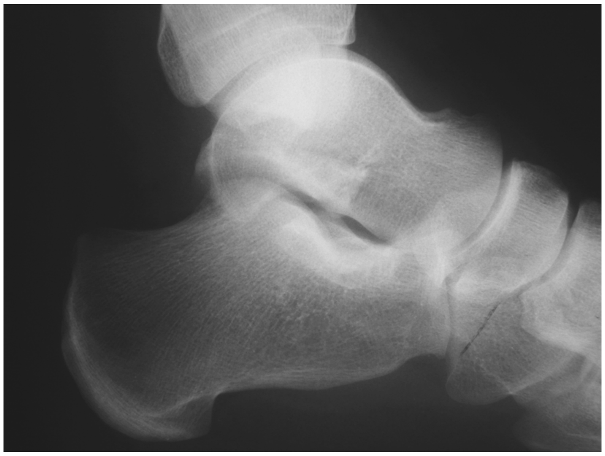

Figure 2. Lateral radiograph showing transverse fracture through lateral process.

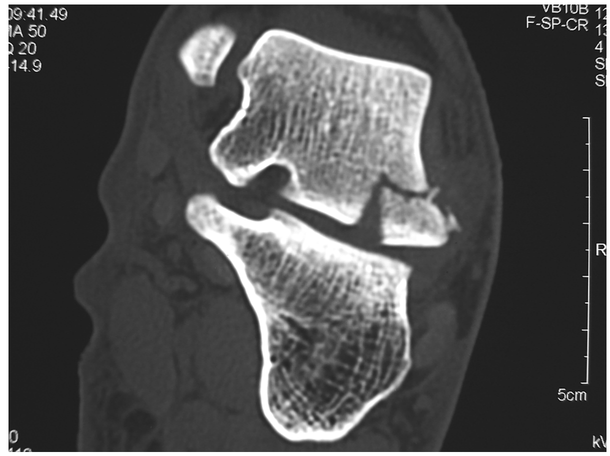

Figure 3. Coronal computed tomography image of intra-articular fracture of lateral process.

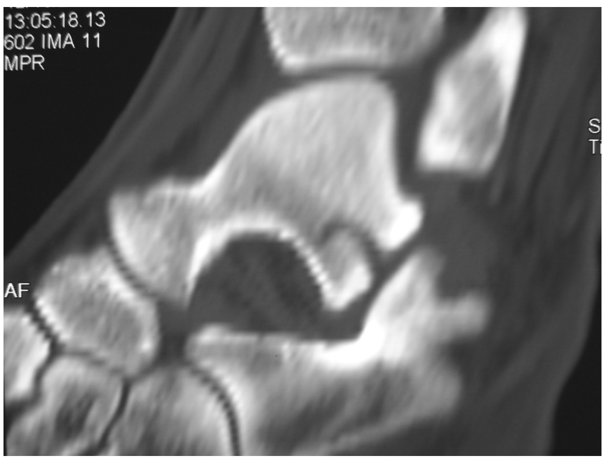

Figure 4. Sagittal reconstruction computed tomography image of Type II lateral process fracture.

Figure 5. Ankle mortise radiograph of fracture reduction and fixation repair.

Figure 6. Lateral radiograph of fixation repair of fracture.

The radiographs taken at the hospital were reviewed, and fracture line was noted on the mortise or oblique view just below the lateral malleolus. Boney overlap on the lateral radiograph allowed visualization of a vague fracture line through the lateral process (Figure 2). His foot and ankle were placed in a modified Jones below knee compression cast to reduce the swelling and prevent the formation of fracture blisters. A computed tomography scan was ordered. It showed very clearly, a moderately displaced large fragment fracture of the lateral process that extended intraarticular into the subtalar joint (Figures 3,4).

The fracture was treated by open reduction internal fixation 10 days after injury with a single 3.0-mm cannulated interfragmentary screw (Figures 5,6). He was placed in a nonweightbearing cast for 4 weeks and transitioned into a protective walking cast for 2 weeks of progressive weight-bearing at which time he was allowed to return to his work as a flooring contractor. At 6 weeks, follow-up he presented to the office in running shoes because he found the walking cast uncomfortable. Subsequent healing was uneventful. He resumed full time work and actively skateboarded. After interviewing by phone he was noted to be pain-free at 2 years postoperative.

Diagnosis

As already noted lateral process fractures are often missed on initial evaluation since the symptoms are almost identical to inversion ankle sprains with injury to the anterior talofibular ligament.[9,18,19] The patients may relate that they stepped in a hole or, while snowboarding, experienced a hard landing or fall and subsequent pain. Tenderness to palpation is noted at the lateral process, tip of the fibula, anterior talofibular ligament and sinus tarsi.

Although they can be easily missed in the initial radiographs, they are best seen in the ankle mortise view, especially with the foot in slight plantarflexion. Comminuted and avulsion fractures can be seen in lateral view.[20,21]

Diagnosis, then, requires a high degree of suspicion, in addition to a careful understanding of the mechanism of injury. A posterior subtalar effusion observed on a lateral radiograph is highly suggestive of a lateral process fracture.[20] More specifically, it has been demonstrated the sum of effusion distensions in the anterior and posterior recesses of the posttraumatic ankle of 13-mm or greater has an 82% sensitivity and a 91% specificity for an intraarticular occult ankle fracture.[21,22] This is indication for further diagnostic studies.

The computed tomography scan has become the "gold standard" for evaluating for lateral talar process fracture.[23-25] Axial and direct coronal images taken with a collimation thickness of 2-mm expose good study of the ankle and subtalar joints including the lateral process of the talus. With multislice equipment, axial 1-mm slices can be acquired and reconstructed in the coronal and sagittal planes for detailed images. Both techniques result in excellent visualization of the lateral process fracture to help assess fracture size, fragments, displacement and articular surface status. Magnetic resonance imaging is not recommended for routine evaluation of lateral process fractures, however, it may be helpful to assess for associated soft tissue damage.[25,26] When sophisticated imaging is not available, lateral tomography can be utilized.[27]

TREATMENT

Early recognition and treatment are highly recommended in order to avoid complications such as nonunion, malunion, bone impingement, avascular necrosis, and posttraumatic arthritis.[9,28,29] Fracture size and amount of displacement are critical factors for planning treatment.

Small cortical avulsion fragments can be treated symptomatically with short-term immobilization followed by joint mobilization and progressive return to weightbearing. If symptoms persist after 6 months, surgical excision and remodeling of the lateral process are indicated.[25,29] Nondisplaced fractures involving small chips or a single large fragment can be treated with non-weightbearing immobilization for 4-6 weeks followed by a weightbearing cast for an additional 2-3 weeks.

Displaced fractures are more problematic as they can lead to nonunion and painful outcomes if not repaired. Closed reduction may be attempted by manipulation of the fragments and casting, but it is not thought to have good outcomes.[9] Single large fragments >1 cm or fragments displaced more than 2-mm are recommended for surgical reduction and fixation with a surgical screw or Kirschner-wires for the smaller fragments. The headless Herbert screw and other similar devices can be used to fix lateral process fractures because it can be buried below the articular surface.[13,25,29,30]

Large comminuted fractures that defy open reduction internal fixation can be treated initially with immobilization, with subsequent fragment excision. However, some authors believe that initial excision of the small fragments produces better long-term results by preventing loose body formation and subtalar joint arthritis.[9,25]

Removal of large or multiple fragments as from a nonunion, can result in considerable instability of the subtalar joint and require subsequent arthrodesis. Similarly, posttraumatic arthritis can result from this injury and require fusion as it seems that the subtalar joint is more commonly disabled by posttraumatic arthritis than is the ankle joint.[25] Some authors suggest physical therapy for joint stiffness and orthotics for biomechanical control may be beneficial prior to delayed surgical intervention.[6] It is extremely rare with this injury that talofibular arthrosis necessitates ankle fusion.

RESULTS AND PROGNOSIS

Universally noted in the literature is the fact that delays in diagnosis and appropriate treatment result in painful and disabling long-term sequelae.[13,25] Lateral process talar fractures have been reported to result in generally poor outcomes when cast immobilization is the lone treatment.[1,2,5,11,31] However, Tucker et al[9] reported 2 cases of successful closed reduction treatment using the AOFAS Ankle-Hindfoot Rating Scale.

Valderrabano et al[32] published the results of a small cohort study of 20 snowboard-injury lateral process talar fractures and their treatment using the same AOFAS rating scale. The mean follow-up was 3.5 years (26-53 months). They concluded that McCrory Type II (large fragment) fractures repaired surgically resulted in better outcomes with reduced sequelae and allowed patients to gain same sports activity as before the injury. Fowble et al[30] reported completely pain-free results at 3-3.5 years following surgical repair of the same fracture type using the same AOFAS rating scale.

CONCLUSION

Fracture of the lateral process of the talus is the result of a high-impact injury that has an extremely high incidence in the sport of snowboarding. The fracture has been observed in children under 12 years of age.[33] Its early diagnosis is critical for the best outcomes so it requires a high degree of suspicion. If radiographs fail to visualize a fracture in the face of symptoms and a suspected mechanism, a computed tomography scan is highly recommended to better diagnose the injury. Conservative measures are instituted only for the nondisplaced or easily reducible fractures while early surgical intervention for displaced fracture fixation or fragment excision seem to lead to better long-term results. Failure to recognize and treat the injury early on has very disabling outcomes.

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