In Brief

Fractures in Brief

Calcaneal Fractures

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Introduction

Calcaneal fractures are the most common tarsal fractures. Intraarticular calcaneus fractures frequently are caused by axial load, eg, from a fall or motor vehicle accident. Accordingly, these fractures can be bilateral and not infrequently are seen with other fractures (plafond, tibial plateau, hip, and spine) caused by proximal transmission of the same load.

Structure and Function

The calcaneus has two main functions: to transmit body weight and to act as a lever for the force generated by the calf muscles. Painless motion at its articulations with the talus and cuboid are essential for normal gait. The posterior aspect of the calcaneus is called the tuberosity. Medially, there is a horizontal eminence called the sustentaculum tali—a cantilevered ledge on which the medial talus rests; there is also a groove laterally under which the peroneus longus tendon passes. Superiorly, there are three facets, anterior, middle, and posterior, which articulate with the talus.

Two important angles reflect the anatomy as seen on lateral radiographs. The first is Böhler's angle (Fig. 1 [angle A]) which is subtended by a line drawn from the superior aspect of the anterior process to the superior

aspect of the posterior facet and a second line drawn from the superior aspect of the posterior facet tangential to the superior edge of the tuberosity [1]. A normal Böhler's angle is approximately 25° to 40°. Values below normal signify an intraarticular fracture with loss of sagittal bony alignment and calcaneal height. The second angle is the angle of Gissane (Fig. 1 [angle B]) [3]. This angle is the intersection of the lines along the downslope of the posterior facet and the upslope of the anterior process.

Injury Considerations

Patients with intraarticular calcaneal fractures often have sustained high-energy injuries. Because of axial transmission of force, these patients must be examined for additional injuries (eg, spinal, visceral injuries, contralateral foot injuries) which can be present 10% to 15% of the time [4]. Smoking and diabetes are noteworthy on history, as their presence increases the risk of operative complications.

Axial load of the talus into the calcaneus produces a so-called primary fracture line extending from the angle of Gissane in a posteromedial direction. This yields a posterolateral tuberosity fragment and an anteromedial sustentacular fragment. Additional transfer of energy causes further fragmentation and additional fracture lines.

Soft tissue injury with substantial swelling almost invariably is present and must be carefully assessed, monitored, and addressed.

Diagnosis and Classification

Radiographs should be obtained for all patients with signs and symptoms of heel pain after a plausible mechanism of

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Fig. 1 A lateral radiograph of the calcaneus shows Bohler's angle (angle A) and the critical angle of Gissane (angle B).

injury. If the radiographs show an intraarticular fracture, a thin-cut CT should be obtained with image reconstruction of the posterior facet. This detailed imaging of the major subtalar articular surface aids in planning the reduction, approach, and choosing fixation options. In addition, if the joint is sufficiently damaged (unreconstructable), a subtalar fusion may be chosen instead of or to supplement internal fixation. It at times is helpful to image the contralateral foot, to exclude bilateral injury and for comparison. A specific calcaneal axial radiograph (Harris view) can be informative but difficult to obtain because of patient discomfort.

As reported by Sanders, the classification of Essex-Lopresti divides intraarticular fractures into two types: tongue type (tuberosity fragment attached to the articular fragment) or joint-depression (when it is not) [4]. Also as reported by Sanders, Crosby and Fitzgibbons classified fractures as nondisplaced, displaced or comminuted; Sanders further classified fractures according to the number and location of posterior facet articular fragments on CT [4]. There is little evidence that these classification systems can be applied reliably [5], let alone point to biologically distinct entities, although there is evidence that with the Sanders' classification, higher types correlate with worse prognosis.

Treatment

Extraarticular fractures can be treated nonoperatively, unless the fragments are substantially displaced or impede soft tissue function, as is the case of the calcaneal tuberosity fracture still attached to the Achilles insertion.

Intraarticular fractures can be treated with varying treatments ranging from immobilization to limited and fully open approaches, or even primary fusion. The primary goals of surgery are to restore bony geometry (ie, height and width) and joint congruity.

Most patients are not taken to the operating room acutely. Surgery is timed optimally for the period when postinjury edema has resolved, yet the fracture fragments remain mobile.

Subtalar and triple arthrodesis are salvage operations, yet primary arthrodesis may be reasonable in cases of highly comminuted intraarticular fractures. Even then, some attempt to restore the gross contours of the bone should be made.

Outcomes

In a large trial, the mean SF-36 score considering all patients in all groups was approximately 65 of 100 [2]. In this prospective, randomized, controlled multicenter trial studying the effect of operative compared with nonoperative treatment of displaced intraarticular calcaneal fractures, approximately equivalent outcomes were seen in the surgical and nonsurgical groups. On a post hoc analysis (of perhaps dubious provenance), some patients did better with surgery; specifically, younger, female patients not receiving Workers' Compensation, having a light workload involving the foot, and having a high Böhler's angle. Of note, there was a 16% wound complication rate in the operative group.

Complications to consider beyond wound healing delay include compartment syndromes, complex regional pain syndromes, iatrogenic neurovascular injury, and malunions with widening of the heel or loss of height. There may be entrapment of the peroneal tendons. Subtalar arthritis may form, along with the possibility of calcaneal cuboid arthritis. Nonunions are rare.

Five Pearls

1. **Note the presence of diabetes, smoking, or any other medical condition that implies higher risk for complications after open treatment.**
2. **Even if you plan a primary arthrodesis, consider some fixation to restore bony geometry (so the heel fits in a shoe).**
3. **Delay treatment until the skin wrinkles but not so long that the fracture is sticky.**
4. **Set realistic expectations: in one study, the mean SF-36 score after treatment by experienced surgeons was only 65.**

5. Diagnoses not to miss: a foot compartment syndrome, entrapped peroneal tendons, or sustentaculum fracture (masquerading as an atypical sprain).

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