

Calcaneal Fractures

ANATOMY

The calcaneus is the largest of the tarsal bones of the foot. It articulates with the talus through the posterior, middle, and anterior facets. The largest and most critical of these articulations is the posterior facet. The articulation between the talus and calcaneus also form the sinus tarsi. The calcaneus also articulates with cuboid forming calcaneal-cuboid joint. The Achilles tendon inserts on the calcaneal tuberosity along the posterior portion of calcaneus. The sustentaculum tali is a projection along medial aspect of calcaneus. It has numerous ligaments insertions and the Flexor Hallucis Longus tendon passes beneath it. Due to its strong ligament attachments it frequently does not displace during fracture and is commonly referred to as the “constant fragment”.

BIOMECHANICS

The calcaneus is critical to hindfoot function. It plays major role in hindfoot motion. It functions with the talus to provide inversion and eversion. The position of hindfoot is also thought to effect transverse tarsal locking mechanism with a varus position locking and stabilizing midfoot for propulsion. When the hindfoot is everted the transverse tarsal joints are supple and function to accommodate uneven ground. The calcaneus also provides lever arm for plantar flexion and is a strong foundation for bearing weight.

PATHOGENESIS

Calcaneal fractures typically present after significant axial load (fall from ladder) or after motor vehicle accident. The talus is impacted, specifically the by lateral process, into the calcaneus creating a impaction type fracture. This typically creates common pattern seen with primary fracture line extending from anterior lateral to posterior medial. Secondary fracture lines are also frequently seen extending out through the tuberosity. This frequently lead to articular incongruity, a widen heel with varus angulation, and loss of calcaneal height. Avulsion fractures of the tubersoity are also seen and frequently occur following eccentric load on the Achilles tendon.

CLINICAL PRESENTATION

These injuries commonly present after significant fall from height or high-energy motor vehicle accidents. Calcaneal fractures frequently demonstrate a significantly swollen widened heel with varus angulation. Patients may have severe pain with an inability to weight bear on the effected side. Attention should be paid to evaluation of posterior skin if tuberosity avulsion is noted.

EXAM

Prior to focusing on the heel, the examiner should perform full orthopedic exam to look for concomitant injuries. A specific focus on lumbar spine evaluation should be performed as calcaneal fractures can frequently occur concurrently. Skin should be evaluated for swelling, posterior skin should be examined especially in the setting of tuberosity avulsion fractures. Open fractures and compartment syndrome of foot can occur with more high-energy type injuries.

CLASSIFICATIONS

There are numerous classifications for calcaneal fractures. Essex-Lopresti classified as non-displaced, tongue type, and joint depression². This classification is simple and can be performed using plain radiographs. It also has to have prognostic value based on work by Buckley et al ³. A pre-operative computer tomography classification was developed by Sanders and is commonly used when classifying calcaneal fractures⁴. This classification specifically focuses on coronal CT assessment of posterior facet. It assists the surgeon with surgical planning and it is based on number and location of fracture lines involving the posterior facet. Type 1 are non-displaced fractures. Type 2 have one fracture line involving the posterior facet. Type 3 have two fracture line involving the posterior facet and type 4 have three or more posterior facet fracture lines. The fracture lines of type 2, 3, and 4 are further classified by location medial to lateral involving posterior facet with A being lateral, B being middle, and C being medial. This classification has also been shown to have prognostic value³.

IMAGING STUDIES

Plain films with full foot series with AP, lateral oblique, lateral, and axial harris views should be obtained. Important radiographic findings include amount of heel varus, Bohler's angle,

and angle of Gissane. Bohler's angle is the angle between line drawn from tip of anterior process to posterior aspect of posterior facet and line from posterior aspect of posterior facet to tip of calcaneal tuberosity. Normal is 20-40 and is frequently reduced in calcaneal fractures. Angle of Gissane is also measured on lateral xray and is angle between posterior facet and anterior process (normally about 130 degrees). Once suspicion for calcaneus fracture has been confirmed a computed tomography scan should be obtained. A special coronal series should be obtained to evaluate the posterior facet and classify fractures based on Sanders classification.

TREATMENT

Open fractures require surgical debridement. Fractures involving an avulsion of achilles insertion with pressure on posterior skin require immediate stabilization to prevent skin necrosis. Closed fracture treatment depends on a number of factors. Smoking, advanced age, and occupation as a laborer are all factors associated with poor outcomes following surgical stabilization₃. Patients with secondary gain related to their injury (workman's compensation) have been shown to have poor outcomes with both operative and non-operative treatment₃. When non-operative treatment is selected, patients are typically immobilized between 6 and 12 weeks depending on severity of fracture. After immobilization patients are returned to weight bearing slowly, advised to focus on range of motion exercises, and likely benefit from physical therapy, shoe modification, and custom orthosis.

Operative management of tongue type and tuberosity avulsion fractures can frequently be fixed with screws minimally invasive incisions. Displaced intra-articular fractures can be treated with open reduction internal fixation with extended lateral approach or minimally invasive sinus tarsi approach depending on fracture severity and surgeon comfort.

Occasionally in severe comminuted fractures reduction and primary arthrodesis may be indicated but to this date no difference in outcomes has been established₅. Operative management should not be performed until soft tissue swelling has resolved and skin wrinkles are noted.

CONCLUSION

Calcaneal Fractures are challenging injuries. A thorough understanding of anatomy, pathogenesis, and treatment options are keys to optimizing management. Patient education about implications of these injuries on long-term morbidity is critical. Future investigations

will be required to delineate which injuries should be managed surgically in what patient populations and what surgical approach is optimal for each cohort.

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