Tibial Plafond Fractures

OVERVIEW

Fractures of the distal tibial weight-bearing surface, or the tibial plafond, are among the most difficult injuries the orthopaedic surgeon will treat. Fortunately, they are relatively rare, accounting for less than 10% of lower extremity fractures. They tend to occur in young (35-40 year-old) men, and cause significant morbidity. These injuries are often the result of a violent mechanism, such as motor vehicle collisions (MVCs), or falls from height. As a result, there is often a significant soft tissue injury, open fracture, or associated injury. There is no consensus on the optimal treatment, however, the protection of the soft tissue envelope surrounding the fracture frequently takes precedence over the fracture fixation itself. As such, for many tibial plafond fractures, this may require staged procedures to optimize the final outcome.

ANATOMY

The ankle mortise is made up of the articulations of the talus, the distal tibia, and the distal fibula. The tibial plafond (French for “ceiling”) forms the superior surface of the joint. The articular surfaces of the tibial plafond and talar body are covered with a layer of hyaline cartilage, which is thinner than the cartilage in either the knee or the hip. The bony and cartilaginous injury that can occur with tibial plafond fractures ultimately dictate the future function of the joint. The soft tissue envelope surrounding the tibial plafond and ankle joint is relatively thin, particularly over the medial surface of the distal tibia. As a result, tibial plafond fractures are often open injuries with full-thickness defects through the medial soft tissues. The distal neurovascular structures and tendons course very close to the surface of the distal tibial, and can also be at risk with tibial plafond fractures.

BIOMECHANICS

The concentric alignment of talus, distal tibia, and distal fibula surfaces is integral in the normal stability, function, and sagittal motion of the ankle. Disruptions of the articular surfaces can lead to post-traumatic arthropathy, instability, or stiffness at the ankle. The collateral and syndesmotic ligaments also help to stabilize the ankle joint, and may be injured when the tibial plafond fracture occurs.

Mechanism of Injury

Fractures to the weight-bearing surface of the distal tibia may occur as a result of rotational or torsional forces, but frequently occur from axial load injuries. In the typical high-energy mechanism the dome of the talus is driven proximally into the surface of the tibial plafond resulting in complex fracture patterns that often have several osteoarticular fragments displaced radially and impacted cephalad into the metaphyseal segment of the distal tibia. The common major fragments are the anterolateral (Chaput) fragment, the posterolateral (Volkmann) fragment, and the medial malleolus. There is frequently shearing or delamination of the cartilage surface from the subchondral bone of the tibial plafond or talar dome. As the distal tibia is impacted proximally there is typically shortening of the limb, particularly if there is an associated fibular fracture, as occurs in approximately 75% of plafond fractures. The shortening of the limb and the radial displacement of fracture fragments during this violent mechanism causes injury to the surrounding soft tissues. There may be full thickness injury, typically through the medial soft tissues, resulting in an open fracture, tearing of the neurovascular structures, or rupture or incarceration of the proximate tendons (frequently the flexor halluces longus or posterior tibial tendons). The shear force on the dermal layers may cause fracture blisters to occur, and trauma to the muscles may result in compartment syndrome.

CLINICAL PRESENTATION

Patients typical present to the emergency department after significant trauma, such and motor vehicle collisions, industrial accidents, or falls from height. The patient is typically in his 30’s or 40’s and may be in significant distress. They may complain of other musculoskeletal pain, and there may be other serious abdominal, thoracic or head injury. Other patients may present with a lower energy mechanism, such as a skiing accident, football or soccer injury, or bicycle crash.

EXAMINATION

As these injuries frequently occur as the result of a high-energy mechanism, such as MVC, patients should be evaluated following advanced trauma life support protocol. Associated injuries often occur, and there should be a high index of suspicion while evaluating the entire patient, including the lumbar spine. The examination of the involved limb starts with a neurovascular exam, which may require evaluation of the ankle brachial index, or ABIs. Impending compartment syndrome and tendon injuries should be evaluated. Soft tissue defects, including open fractures and fracture blisters, must be noted, taking note of exact location for future surgical planning. Local soft tissue care and splinting of the limb should occur once possible.

CLASSIFICATION

The classification systems for tibial plafond fractures typically used include the Ruedi and Allgower, and AO systems. Ruedi and Allgower described three types of injury: type 1 fractures that are non-displaced, type 2 fractures with articular displacement, and type 3 fractures that have articular comminution and impaction. The AO system is much more detailed, but basically has A-type fractures that are extra-articular, B-type fractures that have partial articular involvement, and C-type fracture that have complete articular involvement.

IMAGING STUDIES

The radiographic examination of tibial plafond fractures should begin with standard 3-view radiographs of the ankle should be obtained (Figure 1). Consideration should also be given for tibia-fibula and 3-view radiographs of the foot. For preoperative planning all tibial plafond injuries should be evaluated with CT imaging before definitive fixation. However, if a staged procedure is considered, the CT should be obtained after spanning external fixator placement. Contralateral limb radiographs can also be helpful for preoperative planning purposes.

TREATMENT

In the initial treatment of tibial plafond fractures care of the soft tissue envelope frequently takes precedence over the bony injury. Open fractures should be debrided urgently and patients should be given IV antibiotics and tetanus boosters (as indicated) immediately. High-energy injuries with significant displacement and shortening tend to have rapid swelling, and possible development of fracture blisters. Emergent fasciotomies must be performed on any patient with impending compartment syndrome. Patients with truly non-displaced fractures, or patients with absolute contraindications for surgical treatment may be treated with immobilization and progressive mobilization and weight bearing as healing occurs.

The majority of patients with tibial plafond fractures will be best treated with surgical fixation. There is some debate regarding the optimal treatment protocols, including timing of surgery, and internal or external fixation. Some surgeons advocate definitive external fixation for some fractures. However, in general, internal fixation has the advantage of correction of the deformity and stabilization to allow for early range of motion. Fractures with severe soft tissue injury will typically best be treated with temporary spanning external fixator placement across the ankle to allow for restoration of the limb length, gross alignment, and stability. If performed appropriately the soft tissue envelope should heal and tolerate definitive open reduction and internal fixation by two to three weeks. The tenets of treatment of these fractures advocated by Ruedi and Allgower suggest a four-part approach. This starts with restoration of the appropriate fibular length, reconstruction of the articular surface of the plafond, bone grafting metaphyseal defects, and stable internal fixation. The fracture pattern and the associated soft tissue injury will tend to dictate the timing of surgery, surgical approach, and type of internal fixation. Typical approaches for fixation include anterolateral, anteromedial, posterolateral, and posteromedial. Some advocate direct anterior for some fracture patterns. Direct medial incisions should be used with great caution in treating these fractures due to the very thin soft tissue envelope overlying this area of the distal tibia. Post-operative care will usually require a brief period of splint the ankle until soft tissues have healed sufficiently to allow for early motion at the ankle and subtalar joints. Weight bearing is typically restricted to non-weight bearing for 12 weeks post-operative depending on the amount of articular involvement, and a removable splint or boot should be used to prevent equinus contracture.

CONCLUSION

Tibial plafond fractures typical occur with high-energy mechanisms, in young patients and results in significant morbidity. Associated injuries or trauma to the soft tissues around the fracture tend to dictate the timing and approach of treatment in these fractures. Early treatment of soft tissue injuries, and temporary stabilization with spanning external fixators may be necessary to optimize results for these challenging injuries.

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