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Operative Techniques in
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Surgical Treatment of Posterior Tibial Plateau Fractures

Julius Bishop, MD, and Michael Githens, MD

Posterior tibial plateau fractures are not uncommon injuries and often necessitate surgical treatment. They are frequently unstable with knee flexion even in the absence of an axial load. As with other tibial plateau fractures, knee instability and articular incongruity are indications for surgery. Optimal reduction and fixation usually requires a direct surgical approach, which is dictated by the fracture location and morphology. Common fracture morphologies include a posteromedial fragment that may or may not be associated with a bicondylar tibial plateau fracture, a posterior shearing pattern that involve the posteromedial and posterolateral plateaus, and a fracture that is with posterolateral articular impaction. This article provides an overview of current concepts in the surgical treatment of posterior tibial plateau fractures with discussion on relevant surgical approaches and fixation strategies. Although the overall incidence of these injuries is relatively low, it is important for surgeons to recognize these injury patterns and treat them appropriately to optimize patient outcome.
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Introduction

Coronal plane fractures involving the posterior tibial plateau are increasingly recognized as injuries that require unique treatment strategies. Care must be given to the diagnosis and management of these injuries as they are easily overlooked, yet unstable patterns that necessitate fracture-specific surgical approaches and fixation strategies.

Posterior fractures are rarely found in isolation. They are typically a result of a high-energy injury and are found in combination with additional fractures through the tibial plateau.[1] Although the Schatzker and Moore classification schemes are frequently used to describe tibial plateau fractures, they do not specifically address posterior coronal plane patterns. Increased recent attention to these injury patterns has generated modifications of these classification systems as well as alternative classifications.[2-6] Careful scrutiny of reformatted computed tomography scans and their 3-dimensional renderings is important in understanding these patters, as the fracture location and pattern would dictate the surgical approach and fixation strategy. Although indications for posterior fixation are controversial, there is a growing body of evidence to support direct anatomical reduction and fragment-specific fixation.

Clinical Relevance

Posterior tibial plateau fractures are not uncommon. A clinically significant posteromedial fragment has been observed in 30%-59% of bicondylar patterns.[7,8] These fragments involve approximately a quarter of the total tibial plateau surface and are significantly displaced in half of the cases.[7,8] Posteromedial articular depression has also been observed in 50% of medial tibial plateau fractures (Schatzker IV patterns).[9] Posterolateral fragments are the least common but still occur in up to 44% of fractures. These fragments tend to be smaller, involving an average of 15% of the surface area of the plateau.[10,11]

Cadaveric models confirm the unstable nature of these patterns. Displacement of the posteromedial fragment occurs during knee flexion at low angles without axial loading.[12] Fracture fragment size is inversely correlated with the degree of loading during flexion, implying that a larger fragment is

Department of Orthopaedic Surgery, Stanford University Medical Center, Redwood City, CA.
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*Address reprint requests to Julius Bishop, MD, Department of Orthopaedic Surgery, Stanford University Medical Center, 450 Broadway St, MC 6342, Redwood City, CA 94063. E-mail: jabishop@stanford.edu

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subject to displacement at lower flexion angles.[13] These data suggest that even nondisplaced posteromedial fragments are at risk for displacement with early postoperative range of motion and supports the argument for stable fixation.

Clinical and radiographic outcomes after treatment of posterior patterns are limited to small observational studies.[6,14–30] In the largest series to date, satisfactory articular reduction (<2 mm step or gap) was achieved in 55% of patients with bicondylar tibial plateau fractures treated with combined anterolateral and posteromedial plating. Coronal plane alignment was satisfactory in 90% and sagittal plane alignment was restored accurately in 68% of cases. All patients demonstrated a significant residual dysfunction. Better functional outcomes were significantly correlated with high-quality reduction. Poor functional outcome was strongly correlated to increased fracture severity. Fracture severity was not correlated with reduction quality.[14] Sun et al[31] successfully combined anterolateral and direct posterior approach and dual plating for posterolateral fractures, reporting no fragment subsidence, no change in limb mechanical axis from immediate-to-final follow-up, no reoperations, and good functional outcomes in a cohort of 41 patients. Additional small series report a broad range of radiographic and functional outcomes after a variety of surgical approaches and fixation strategies. Common complications reported broadly across these series include saphenous nerve injury and superficial wound problems. Loss of reduction, deep infection, and major nerve or vessel injury are reported less frequently.

Treatment Strategies

The goals in treating articular fractures of the proximal tibia include restoring knee joint stability, limb mechanical axis, and articular congruity. These goals are achieved through direct anatomical reduction and fixation with interfragmentary compression to gain absolute stability.

Approaches

Posteromedial

The posteromedial approach affords access to the posterior medial and posterior portions of the medial condyle and is ideal for posteromedial shear and impaction injuries. It can be performed with the patient in the supine position and can be done in conjunction with a standard anterolateral approach for bicondylar patterns. It has also been described in combination with a posterolateral approach.[16,17,20,22,23,26,32,33]

A longitudinal incision is made 2 cm posterior to the posteromedial border of the tibia. Care must be taken to identify and preserve the saphenous nerve and its branches. The pes anserinus tendons are identified, mobilized, and retracted as necessary. If these tendons continue to obstruct reduction and fixation efforts, they can be tenotomized and repaired at the end of the procedure. The fascia over the medial head of the gastrocnemius is incised and the muscle is retracted laterally so the subperiosteal dissection can then be carried across the back of the tibia. A bump under the heel is helpful at this stage. A medial submeniscal arthrotomy can be performed as necessary for direct visualization of the articular surface.

Direct Posterior

Many iterations of the direct posterior approach have been published.[6,27,30,34-40] The patient is positioned prone and a straight incision is made along the border of the medial head of gastrocnemius ending at the level of the joint line. After incising the popliteal fascia, the small saphenous vein is identified in the sulcus between the gastrocnemius heads. The medial gastrocnemius is retracted laterally while the semimembranosus complex is retracted medially without detaching its insertion on the posteromedial tibia. Alternatively, if additional exposure is necessary, the tendon of the medial head of the gastrocnemius can be divided sharply, proximal to the muscle's blood supply, leaving a cuff for repair. The medial gastrocnemius is then retracted laterally, protecting the neurovascular bundle.[30] The upper border of the popliteus muscle is detatched and dissected subperiostally, exposing the fracture. The tibial insertion of the semimembranosus complex can be incised in a subperiosteal fashion, if additional exposure is needed. If further distal exposure is needed, the soleus origin may be partially elevated.

Posterolateral

Several variations of a posterolateral approach have been published.[19,25,32,41,42] Carlsonet al provides an early description of the posterolateral approach without fibular osteotomy done in concert with a posteromedial approach to address bicondylar fractures with posterolateral and posteromedial shear fragments. After making an s-shaped curvilinear incision over the border of the biceps femoris, the common peroneal nerve is identified and mobilized to allow gentle lateral retraction. The lateral head of the gastrocnemius is retracted medially to expose the underlying soleus. The soleus is elevated from the proximal tibiofibular joint distally and medially, exposing the posterior lateral tibial plateau.[32] Although this approach provides an excellent posterior exposure of the lateral plateau, the fibular head limits further lateral exposure and may impede fracture reduction. Solomon et al describe a posterolateral approach utilizing a proximal fibular osteotomy, allowing exposure of the lateral and posterior aspects of the lateral tibial plateau. The skin incision is made along the anterior border of the biceps femoris and carried down the leg. After mobilization of the common peroneal nerve, the fibular head is exposed and an osteotomy is made just distal to the biceps insertion. With retraction of the fibular head proximally, the lateral plateau and joint capsule are clearly exposed.[19] Frosch et al developed a surgical approach to the posterolateral tibial fracture, which both protects the soft tissue and allows for good visual control of fracture reduction. The approach involves a lateral arthrotomy for visualizing the joint surface and a posterolateral approach for the fracture reduction and plate fixation, both of which are achieved through a posterolateral skin incision.[25] Chen et al have similarly popularized a