Direct Posterior Approach for Treatment of Posteromedial Fractures of the Tibial Plateau

Abstract

Fractures of the tibial plateau that have an associated, displaced posteromedial fracture pattern are difficult to reduce and fix adequately through conventional surgical approaches. The direct posterior approach to posteromedial fractures of the tibial plateau, with the patient in a prone position, has been used to overcome limitations related to conventional posteromedial approaches. The posterior approach allows for fracture reduction by hyperextension of the knee through axial traction over a surgical bump. The technique allows the direct visualization of posteromedial fractures of the tibial plateau without the need for dissection of the neurovascular bundle, and for placement of an antiglide buttress plate at the apex of the posteromedial fracture fragment. Patients undergoing fracture repair through the posterior approach can typically be mobilized on the first day after their surgery with functional rehabilitation and restricted weight bearing for 8 to 10 weeks postoperatively.

Keywords: tibial plateau fracture, direct posterior approach, Lobenhoffer approach, Moore classification

Background

A multiplicity of modified anterior and posterior approaches to the tibial plateau has been recently described in the peer-reviewed literature.\(^1\)\(^2\)\(^3\)\(^4\)\(^5\)\(^6\)\(^7\)\(^8\)\(^9\) Displaced fragments of posteromedial fractures are highly prevalent in high-energy bicondylar fractures of the tibial plateau, and in Moore type I and type II fracture-dislocations of the plateau.\(^10\) Fractures with a posteromedial pattern are difficult to reduce and fix adequately through conventional surgical approaches.\(^11\) Displacement of the fracture is a major limitation in achieving the reduction of posteromedial condylar fractures with the patient in the supine position with a flexed-knee, figure-of-4 technique. Furthermore, from a biomechanical perspective, buttress plates should be applied posteriorly (eg, in antiglide technique), to achieve indirect reduction at the apex of the fracture of the tibial plateau.\(^12\) For these reasons, displaced posteromedial tibial plate fractures are not ideally managed through conventional surgical approaches in the supine position.\(^13\)

To overcome the limitations associated with conventional approaches and positioning techniques, the direct posterior approach to the repair of posteromedial fractures of the tibial plateau was described in 2003 in the German literature.\(^14\) This approach (Lobenhoffer) does not involve dissection or visualization of the neurovascular bundle in the popliteal fossa and allows the direct visualization of a posteromedial fracture of the plateau, its facilitated reduction by hyperextension of the knee, and direct posterior buttress plating with the patient in the prone position.\(^15\)

Indications

Indications for the posterior approach to the repair of a posteromedial fracture of the tibial plateau are:
1. Posteromedial fracture-dislocations (Moore type I or II) of the tibial plateau.
2. Bicondylar fracture-dislocations of the tibial plateau with a displaced posteromedial fragment (Moore type V).
3. Unicondylar medial fractures of the tibial plateau with posterior displacement and the apex of the fracture at the posterior tibial surface (selected Schatzker type IV patterns; AO/OTA 41-B1.2, B1.3, B3.2, B3.3).
4. Bicondylar fractures of the tibial plateau with a displaced posteromedial fragment and the apex of the fracture at the posterior tibial surface (selected Schatzker types V and VI patterns; AO/OTA 41-C1.3, C2.3, C3.2, C3.3).

Not all fragments of posteromedial fractures of the tibial plateau require buttressing through a direct posterior approach. The case presented in the instructional video accompanying this article shows a large posteromedial fragment, with its apex on the posterior aspect of the tibial plateau, which is suitable for direct posterior buttress plating. In contrast, many fractures with smaller posteromedial fragments with apices along the posteromedial ridge of the tibia may be adequately addressed through buttress plating on the posteromedial ridge of the tibia (eg, through a standard posteromedial approach with the patient in the supine position).

Surgical Technique

Patient Positioning and Surgical Approach

Patients undergoing surgical repair of a posteromedial fracture of the tibial plateau through the direct posterior approach are placed in the prone position on a regular table, with the ipsilateral leg extended on a leg prep holder or similar device (Figure 1). After a surgical “time-out” for communication among the members of the surgical team and completion of the items on a surgical safety checklist,16,17 including the preoperative application of an antibiotic (ie, a first-generation cephalosporin), the leg is exsanguinated and a tourniquet is inflated around the thigh.

The Direct Posterior Lobenhoffer Approach for Posteromedial Tibial Plateau Fractures

Surgical landmarks at the treatment site in the posterior approach to a posteromedial fracture of the tibial plateau consist of the medial head of the gastrocnemius muscle and the hamstrings, which are palpated on the medial border of the popliteal fossa. An incision of about 10 to 15 cm in length (depending on the distal fracture extension and length of the required buttress plate) is made vertically in the skin along the border of the medial head of the gastrocnemius muscle, to avoid crossing the popliteal fossa proximally (Figure 2). The subcutaneous tissue and popliteal fascia are dissected sharply with a No. 10 blade knife. Because the dissection is done entirely medial to the medial head of the gastrocnemius, the small saphenous vein (in the sulcus between the two heads of the gastrocnemius) and the medial sural cutaneous nerve (a branch of the tibial nerve in the popliteal fossa) are usually not encountered (Figure 3). Throughout the procedure, all neurovascular structures are retracted laterally under protection of the medial head of the gastrocnemius. There is no “true” interneural plane during the surgical dissection. The medial border of the medial gastrocnemius is identified by blunt dissection in a distal-to-proximal direction and is retracted laterally through the careful subperiosteal placement of a Hohmann retractor at the level of the lateral cortex of the proximal tibia. Specifically, the periosteum is incised on the lateral border of the proximal tibial metaphysis, either through Bovie cautery or with a No. 10 scalpel blade, and is carefully elevated across the lateral cortex of the proximal tibia on the lateral side (Figure 4). The Hohmann retractor is then positioned in the subperiosteal...
plane behind the lateral cortex of the tibia. This maneuver must be performed carefully to avoid indirect shearing injuries to the neurovascular bundle of the popliteal fossa. The insertion of the hamstring is then retracted medially with a Langenbeck retractor and the popliteus is identified and dissected through Bovie cautery with a vertical incision along its medial border and is detached subperiosteally with a Cobb elevator (Figure 5). The posteromedial fracture fragment is then visualized. Rarely, if needed for better medial visualization, the tibial insertion of the hamstrings is partly incised and released.

Fracture Reduction and Fixation
When the fragment of a posteromedial fracture of the tibial plateau is visualized, it can be indirectly reduced through the following maneuver(s): (1) hyperextension of the knee with axial traction over a bump placed under the thigh, proximal to the knee (Figure 6); (2) direct axial compression of the posteriorly displaced fragment through the use of a ball spike pusher; and (3) application of a T-shaped posteromedial buttress plate, with the first screw inserted through the plate and into an oblong hole at the apex of the fracture, allowing indirect reduction of the fracture by approximation of the plate to the bone with a nonlocking cortical screw.

After application of the T-plate, its proximal section is temporarily held in place with one or two 1.6-mm Kirschner wires through the designated holes in the plate. This will avoid accidental rotation of the plate by torque from the first screw applied through the shaft of the plate (“helicopter effect”) and, under fluoroscopic guidance in the lateral plane, will ensure perfect cephalad placement of the plate (Figure 7).

The plate recommended for fixation of the fracture fragment is a bulky T-plate that accommodates a large fragment. Although we previously advocated the use of small-fragment plates, in an early, pilot case series published in 2007,15 our current experience with more than 50 cases of posteromedial fractures of the tibial plateau...
revealed that 3.5-mm plates are prone to failure through bending and/or screw cutout and breakage. For this reason, we currently use only bulky, large-fragment plates of either conventional non-locking (4.5-mm) or combination locking (4.5-mm/5.0-mm) design. The length of the plate should be such as to accommodate at least three or four plate holes distal to the apex of the fracture. Therefore, the length of the surgical incision made for reduction of the fracture depends on the length of the selected plate.

Adequacy of the plate position and fracture reduction are confirmed fluoroscopically, after which additional screws are placed through the shaft of the plate. In order not to jeopardize adjunctive reduction and plating of the lateral tibial plateau if the latter measures are needed, the proximal screw holes in the horizontal section of the T-plate are filled with additional locking head screws only if the plate is used as a stand-alone device (Figure 8). When applied in this way, the posteromedial T-plate is left to serve a pure buttress function, with three or four screws in the shaft of the plate. Because it is typically 4 to 6 mm too long, owing to the initial approximation of the plate to the bone during the indirect reduction maneuver, the first or apex screw that is inserted through the plate must be replaced by a screw of shorter length before wound closure. If the longer, initially inserted screw remains in place, the protrusion of its tip across the far cortex of the tibia can seriously irritate the thin anteromedial soft-tissue envelope of the tibia. This complication may necessitate the removal of a posterior plate, which is ordinarily left in place after being attached.

**Wound Closure and Rehabilitation**

Closure of the surgical wound made for the posterior approach to a posteromedial fracture of the tibial plateau is simple and straightforward, because the approach is very biologic and the buttress plate used for fracture reduction is completely covered by the medial gastrocnemius muscle after removal of the retractors used in the surgical procedure. Placement of drains is not required. The popliteal fascia is closed with interrupted sutures, followed by closure of the subcutaneous tissue layer and the closure of the skin with staples. A sterile dressing is applied and the patient is turned over and placed in the supine position on the operating table for fluoroscopy in the AP and lateral views (Figure 9). If adjunctive fixation of the lateral tibial plateau is required, such as in the case of bicondylar fractures, the leg is prepared anew and draped as needed for a standard approach to fracture fixation through an anterolateral approach or with percutaneous lateral-to-medial lag screws.

The care following the direct posterior approach to reducing a posteromedial fracture of the tibial plateau consists of putting the patient's knee in a hinged brace and mobilizing the patient on postoperative day 1 with restricted weight bearing on the ipsilateral lower extremity (touch-down weight bearing of about 20 to 30 lb of weight) for 8 to 10 weeks postoperatively. Posterior staples are removed at 2 weeks postoperatively.

**Pearls, Pitfalls, and Complications**

The direct posterior approach represents a safe and efficient option for addressing displaced fragments of a posteromedial fracture of the tibial plateau through direct posterior buttress plating. Because the requisite dissection is done entirely medial to the medial head of the gastrocnemius muscle, the posterior approach does not involve visualization of the neurovascular bundle. With diligent surgical dissection technique and careful placement of lateral retractors, this avoids risk to neurovascular structures in the lower leg. Moreover, in our experience with more than 50 patients, postoperative complications of the direct posterior approach have been rare, without complications related to the surgical incision used in the procedure or neurovascular injuries. However, we observed three distinct patterns of perioperative complication in our learning curve with the direct posterior approach: (1) one patient with a postoperative surgical site infection required an unplanned return
to the operating room for débridement and washout of the surgical site; (2) three patients with excessively long posterior apex-reduction screws required early hardware removal after fracture healing because of irritation by the screw tips of the thin anteromedial soft-tissue envelope; (3) in one patient with osteoporotic bone, who had a displaced fracture at more than 3 weeks after its causative injury, the buttress plate was unable to overcome the forces causing the displacement, leading to cutout of the buttress plate screws from the patient’s poor-quality bone, with inability to reduce the medial condyle through the posterior approach.

A shortcoming of the posterior approach is the need for patient repositioning from the prone to the supine position in cases of bicondylar fractures of the tibial plateau requiring adjunctive lateral reduction and fixation, necessitating repreparation and draping for an anterolateral approach. In our experience, this is needed in about 80% of all cases of posterocondylar fractures of the tibial plateau. With the exception of selected anecdotal case reports, published data on patient outcomes with the direct posterior approach are currently lacking, and its validation is needed in prospective trials.

References


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