Posterior Coronal Plating of Bicondylar Tibial Plateau Fractures Through Posteromedial and Anterolateral Approaches in a Healthy Floating Supine Position

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Abstract: Bicondylar tibial plateau fractures pose a significant challenge for treating surgeons. If the articular surface of the medial plateau has a second split component in the posterior coronal plane, it is difficult to get direct visualization and ensure plate fixation when the patient is in the supine position. Using a technique in which a single preparation and draping of both legs is needed, patients were operated on using a healthy floating supine position maneuver through dual posteromedial and anterolateral incisions and triple plate fixations. By flexing and adducting the contralateral healthy hip over the injured leg, more lateral rotation of the fractured knee can be achieved, providing better access and visualization of the posterior medial plateau using a posteromedial gastrocnemius approach.

Bicondylar tibial plateau fractures (Schatzker type V and VI and AO/OTA type 41C) are caused by high-energy trauma and are currently treated operatively using dual-incision approaches with plate and screw fixation. The patient is usually placed in the supine position intraoperatively. Generally, a posteromedial incision is used for the medial condyle split fragment manipulation and fixation, and an anterolateral incision is used for the comminuted lateral condyle fractures, leaving a skin bridge at least 7 to 8 cm in width. Slight knee flexion of approximately 30° and external rotation of the ipsilateral hip make access to the posteromedial edge of the proximal tibial easier. However, if the articular surface of the medial plateau has a second split component in the posterior coronal plane, it is difficult to get direct visualization and achieve plate fixation because ipsilateral hip external rotation is restricted while patients are in the supine position. Usually, patients need to be in the prone position for the posteromedial plateau operation and then be maneuvered into the supine position for the anterolateral plateau operation. This article describes a modified positioning approach that provides access to the posteromedial and anterolateral aspects of the knee in a single supine preparation and drape.

Preoperative Planning

Bicondylar tibial plateau fractures are initially stabilized with a spanning external fixator or calcaneal traction in a Brown brace (Shanghai Medical Equipment Factory, Shanghai, China) for 1 to 3 weeks to allow soft tissue injuries to heal and swelling to subside. If a spanning fixator is used and future surgery is planned, physicians should avoid inserting pins in the areas where incisions will be made. Surgery is undertaken when adequate soft tissue healing is achieved. Plain radiographs and computed tomography scans with 3-dimensional reconstruction of the knee should be obtained for preoperative planning.

The tibial plateau can be classified into 4 quadrants: anteromedial, anterolateral, posteromedial, and posterolateral. Optimal skin incisions can be selected based on the quadrants that the fracture involves. If the medial plateau was split into a large shearing posteromedial fragment, slight knee flexion of approximately 30° and external rotation of the ipsilateral hip usually afford sufficient exposure for reduction and plate fixation. However, if the medial plateau was further...
split into 2 or 3 components, usually with 1 large posterior coronal fragment, the authors chose to prepare and drape both legs for intraoperative manipulation to add exposure.

The operative strategy includes dual incisions and triple plate fixation (Figure 1). Split medial condylar fractures are reduced and fixed separately, with a posterior plate (coronal fragment) and a medial plate (sagittal fragment) in antiglide mode, usually by small undercontoured reconstruction plates with short screws that grip only the proximal cortices. The lateral condyle is a comminuted split depression that needs articular elevation, a bone substitute graft, and a heavy buttress plate with long screws inserted to the medial cortex to protect the lateral plateau reduction, hold both condyles together, and connect the reconstructed metaphysis to the tibial shaft.

**Surgical Technique**

Under intratracheal general anesthesia, the patient is placed in the supine position. A high-thigh pneumatic tourniquet is applied to the injured extremity. The authors prepared and draped both legs (Figure 2) and prefer to start with the posteromedial approach to provide a stable medial column to which the lateral plateau can be reduced and stabilized. The contralateral hip is flexed and adducted and the pelvis rotated toward the injured side. This results in the patient’s pelvis and lower trunk in a semilateral position, and the injured leg is rotated laterally, allowing access to the posteromedial incision to expose the posterior coronal fragment.

**Figure 1:** Diagram showing the fixation strategies for complex bicondylar tibial plateau fractures. The split medial condyle fragment is repositioned anatomically. A small plate with short screws is applied over the fracture spike in antiglide mode. The depressed lateral condyle is elevated, grafted, and fixed with a heavy buttress plate and long screws inserted to the medial cortex to protect the lateral plateau reduction, hold both condyles together, and connect the reconstructed metaphysis to the shaft.

**Figure 2:** Photograph showing the patient placed in the supine position, with both legs prepared and draped.

**Figure 3:** Photograph showing the contralateral healthy hip flexed and adducted over the injured leg by an assistant. This results in lateral rotation of the injured limb, and a better access to the posteromedial incision to expose the posterior coronal fragment.

**Figure 4:** Schematic drawing showing the posteromedial skin incision.
The surgeon stands on the opposite side of the operated limb. An inverted L-shaped incision is made, centering the horizontal limb at the popliteal crease. The medial arm of the incision is made just posterior to the medial edge of the tibia (Figure 4). The medial condyle is exposed through a posteromedial gastrocnemius approach, which is similar to those described by Lobenhoffer et al.,7,8 Galla and Lobenhoffer,7 and Carlson.12,13 Sharp dissection is carried deep, and the posterior fascia is incised between the medial gastrocnemius (posterior border of the dissection) and the pes anserinus anteriorly. The medial collateral ligament remains intact anteriorly and deep to the pes anserinus. The pes tendons are mobilized posteriorly and proximally, keeping their insertion intact. A Penrose drain can be used for their retraction.

The medial gastrocnemius is then elevated posteriorly and laterally, exposing the posterior tibia (Figure 5). No gastrocnemius tendon release is attempted. The popliteal neurovascular structures are safely protected deep to the gastrocnemius muscle, but overzealous retraction is avoided to prevent traction injury to the tibial nerve. The soleus and popliteus muscles are then elevated from the medial edge of the tibia by sharp dissection, exposing the fracture site.

The joint is then entered posteriorly while carefully protecting the capsular and ligament insertions. The coronal split posterior fragment is reduced anatomically under direct visualization, and a small undercontoured reconstructive plate is placed onto the spike and fixed in antiglide fashion, usually with four 3.5-mm cortical screws, 2 on each side of the spike.

The contralateral leg is put back to its normal position, and the fracture is checked by fluoroscopy. The sagittal split medial fragment is then reduced and fixed with another reconstructive plate, and the entire medial condyle is put onto the tibia shaft. Short screws only grasping the proximal cortices are used to avoid interfering with lateral plateau reduction later.

The healthy leg is put back, and the support on the patient’s back is removed; this returns the patient to a true supine position for a lateral plateau operation. A bump added under the ipsilateral hip further internally rotates the lower limb. The lateral tibial plateau is exposed through a conventional anterolateral approach. After submeniscus arthrotomy, the comminuted lateral plateau is visualized. The depressed articular fragments are elevated with a large amount of cancellous and subchondral bone. A bone grafting substitute is placed to support the elevated fragments. Another T- or L-shaped heavy plate with long screws is used to buttress the reduced lateral plateau fracture, hold the tibial condyles together, and connect them to the tibial shaft. Locking plates are preferred in lateral fixation. Both incisions are closed using absorbable sutures in routine fashion over suction drains. No external splints are used.

After the incision has stopped bleeding and swelling, usually 3 to 4 days postoperatively, continuous passive motion using a machine is allowed to less than 45° of flexion in the first week, and increased gradually to 90° in the second week. Patients are encouraged to regain full range of motion in 4 weeks. Weight bearing is restricted to toe-touch (5-10 kg) during the first 2 months and increased progressively in the third month. Full weight bearing is not permitted before 3 months.

**PATIENT SERIES**

Between January 2006 and December 2008, twelve patients with bycondylar tibial plateau fractures were prospectively treated using this maneuver through dual posteromedial and anterolateral incisions with triple plate fixations. Eight men and 4 women with a mean age of 48 years (range, 39-60 years) were included. Seven patients were injured in traffic accidents, and 5 were injured in falls from a height. All fractures were Schatzker type VI (AO/OTA types 41C2 and 41C3). Ten cases involved 4 plateau quadrants and 2 cases involved 3 quadrants. Mean time from injury to operation was 9.5 days (range, 7-12 days).

No cases of infection were observed. One patient had a superficial dehiscence postoperatively that healed without further treatment. The time of bony consolidation and full weight bearing averaged 21.7 weeks (range, 16-26 weeks). Patients were followed up for at least 24 months (range, 24-48 months). At 1 year postoperatively, no loss in reduction or alignment was observed. Mean
Hospital for Special Surgery knee score was 87.3 (range, 78-95). Patients were satisfied with their treatment outcomes.

An illustrative case of comminuted biconcylar tibial plateau fracture, operated on with posteromedial and anterolateral approaches in the healthy floating supine position and triple plate fixation, is presented in Figure 6.

**DISCUSSION**

Bicondylar tibial plateau fractures result from high-energy injuries and are often...
combined with marked trauma to the surrounding soft tissues. Management is challenging, requiring a combination of accurate bone reduction and fixation and minimal soft tissue invasion. Currently, the treatment protocols can be classified into 3 categories: open reduction and internal fixation, limited open reduction with percutaneous screw fixation and hybrid fixator stabilization, and indirect reduction and application of fine-wire circular external fixator. Each method has advantages and disadvantages. The authors reserve the use of external fixation devices in the treatment of complex bicondylar tibial plateau fractures to span the fracture site until the patient is amenable to definitive fixation with open reduction and plate fixation. This treatment principle is in accordance with those of Krupp et al.

The characteristics of the most complex bicondylar fractures follow a regular pattern. The concave medial plateau is split in a mediolateral direction with a major posteromedial fragment, whereas the convex lateral plateau is depressed into various amounts of multifragments with broadening of the lateral compartment. In the authors’ practice, bicondylar tibial plateau fractures are usually treated through posteromedial and anterolateral incisions with 2 plate fixations. The main purpose of the posteromedial approach is to achieve an exact anatomic fracture reduction and fix the split fragment over the spike in antiglide fashion with small implants to create a stable strut that facilitates lateral fixation. The main purposes of an anterolateral approach are (1) to elevate the comminuted articular depression with bone substitute grafting to fill the gap and (2) to fix the medial cortex with a heavy buttress plate and long screws, thus protecting the lateral plateau reduction and holding both condyles together, securing their contact with the tibial shaft (Figure 1). Recently, lateral locking plates have become more popular.

Generally speaking, the surgical approach and patient position depend on fracture location and displacement. Weil et al. reported that, with the ipsilateral knee in slight flexion and the hip in external rotation, the medial plateau is accessed easily in a posteromedial supine approach. However, when the articular surface of the medial plateau has a second posterior split component in the coronal plane, it is recommended that management is performed through a posterior approach for direct visualization and manipulation with the patient in the prone position and, preferably, with 2 antiglide buttress plates. However, in some clinical instances it may be desirable to place the patient in a supine instead of a prone position. The position of a patient on the operating table should afford maximum safety to the patient and convenience for the surgeon. However, prone positions are limited in some instances, such as in patients with associated chest trauma. Furthermore, intraoperative repositioning of the patient means a second skin preparation and draping, which is time consuming. In patients with bicondylar fractures, it also means that the first operation, usually to the medial plateau, is finished and the skin is closed. It leaves no opportunity for secondary adjustment or revision of the first procedure.

Compared with changing patients’ positions intraoperatively, the advantages of the current maneuver are a single skin preparation and draping, reduction in operative time, and the opportunity for technical adjustment through the first incision, if needed. The main disadvantage is that an additional scrubbed assistant is needed to keep the healthy leg in position.

The indications for this healthy floating supine position are bicondylar tibial plateau fractures with a posterior coronal fragment that requires a separate plate fixation. It is possible to operate on 3 (anteromedial and posteromedial) or 3 (plus posterolateral) quadrants of bicondylar tibial plateau fractures from the posteromedial gastrocnemius approach while the patient is in the supine position. However, this maneuver is not allowed for patients with associated spine fractures, contralateral leg fractures, and pelvic fractures and for patients who are obese. For those contraindications, spine and pelvic fractures should be treated first. It is the authors’ practice to change the patient’s position during traditional open reduction and plate fixation or to use a limited open reduction technique with external fixator protection.

In 2010, Luo et al. introduced a floating position using 1 preparation and drape for posteromedial and anterolateral approaches. The patient was placed in the lateral decubitus position with the injured leg up. The lower leg and pelvis were first rotated to a prone position to perform posteromedial approach to fix the posterior and medial tibial plateau fractures with an inverted L-shaped incision. Then, the lower leg and pelvis were rotated back to the lateral position to perform an anterolateral approach to fix the lateral tibial plateau.

In contrast with the injured-side rotation method presented by Luo et al., the current approach used rotation of the healthy lower leg and pelvis. By preparing and draping both legs, the contralateral healthy hip is flexed and adducted over the injured leg. This maneuver makes the patient’s lower trunk rotate and results in the injured limb rotated laterally, providing better access and visualization of the posterior coronal fragment in the medial plateau. This floating supine position allows for a healthy-side maneuver, which is safer than the injured-side manipulation.

Furthermore, in the authors’ opinion, intraoperative fluoroscopic examinations of the knee in standard anteroposterior and lateral views are easier to achieve in the supine position.
position. This positioning maneuver also can be used with interoperative fixators or large distractors that are applied to facilitate tibial fracture reduction. The potential pitfalls lie in the extensive soft tissue dissection, which is dangerous for infection and wound healing.23

CONCLUSION
With single preparation and draping of both legs in the supine position and the contralateral healthy hip flexed and adducted over the injured leg, more lateral rotation of the fractured knee can be achieved, providing better access and visualization of the posterior medial plateau.

REFERENCES