Complications and outcomes of the transfibular approach for posterolateral fractures of the tibial plateau

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ABSTRACT

Objective: Evaluate complication rates and functional outcomes of fibular neck osteotomy for posterolateral tibial plateau fractures.

Design: Retrospective case series.

Setting: University hospital.

Patients: From January 2013 to October 2014, 11 patients underwent transfibular approach for posterolateral fractures of the tibial plateau and were enrolled in the study. All patients who underwent transfibular approach were invited the return to the hospital for another clinical and imaging evaluation.

Intervention: Transfibular approach (fibular neck osteotomy) with open reduction and internal fixation for posterolateral fractures of the tibial plateau.

Main outcome measurements: Complications exclusively related to the transfibular approach: peroneal nerve palsy; knee instability; loss of reduction; nonunion and malunion of fibular osteotomy; and functional outcomes related to knee function.

Results: Two patients failed to follow-up and were excluded from the study. Of the 9 patients included in the study, no patients demonstrated evidence of a peroneal nerve palsy. One patient presented loss of fracture reduction and fixation of the fibular neck osteotomy, requiring revision screw fixation. There were no malunions of the fibular osteotomy. None of the patients demonstrated clinically detectable posterolateral instability of the knee following surgery. American Knee Society Score was good in 7 patients (77.8%), fair in 1 (11.1%), and poor in 1 (11.1%). American Knee Society Score/Function showed 80 points average (60–100, S.D:11).

Conclusion: The transfibular approach for posterolateral fractures is safe and useful for visualizing posterolateral articular injury. The surgeon must gently protect the peroneal nerve during the entire procedure and fix the osteotomy with long screws to prevent loss of reduction.

Level of evidence: Therapeutic level IV.

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Introduction

Posterior fractures of the tibial plateau are increasingly common, and the orthopaedic surgeon is becoming familiar with this demanding treatment. The injury mechanism is an axial force with the knee in flexion. The knee position (varus, valgus, or neutral) determines the fracture location in the posterior column of the tibial plateau (medial, lateral, or both, respectively) [1].

Treatment for posterior column fractures has changed significantly during the last decade. Since the first posterior approach descriptions by Galla [2], Lohenhofer and Tscherner [3], and more recently with the application of the three column concept [4], surgeons have become more confident performing exposures and treatment of posterior fracture variants.

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Many surgeons are cautious about using the transfibular approach due to the concerns about iatrogenic injury to the peroneal nerve and complications related to the fibular neck osteotomy.

However, in some fracture patterns with posterolateral articular displacement, the transfibular approach can be the best option to achieve joint surface visualization and accurate fracture reduction, thereby diminishing posttraumatic arthritis risk.

The present study aims to evaluate complication rates related to the transfibular approach for posterolateral fractures of the tibial plateau. We evaluated peroneal nerve palsy, knee instability, nonunion, and malunion of the fibular osteotomy site.

Ethical approval was granted by the local ethics committee.

Patients and methods

From January 2013 to October 2014, 11 patients underwent transfibular approach for posterolateral fractures. All surgeries were performed in one university hospital by experienced fracture surgeons. Two patients did not return for regular follow-up and were excluded from the study.

All fractures were classified using both Schatzker and the three-column classification systems [5]. Age, average, gender, injury mechanism, Schatzker and Luo classifications are shown in Table 1.

All patients treated with transfibular approach were followed in outpatient clinic with regular clinical and x-ray evaluation. American Knee Society Score and American Knee Society Score/Function were used to verify treatment outcomes.

Follow-up average was 16 months (12–21 months, SD:3).

All patients had standard anteroposterior and lateral radiographs.

Fracture and osteotomy union were defined as bridged cortices on two radiographic planes and full weight bearing without pain.

Statistical analysis was conducted using SPSS with a confidence interval at 95%.

Surgical technique

Depending on concomitant anteromedial, anterolateral, or posteromedial fractures, the patient was placed either in a prone or a lateral decubitus position. Either a general or spinal anesthesia was utilized, and prophylactic antibiotics were administered. A tourniquet was used routinely. A ten centimeter posterolateral approach was performed using the fibular head as a landmark. The incision starts approximately 3 cm proximal to the fibular head and extended approximately 5–7 cm distally. The peroneal nerve was carefully identified and gently protected with a number 2 Penrose drain during the entire procedure.

After identifying and protecting the nerve, the fibular head was drilled with a 2.5 mm intramedullary drill, starting at the proximal tip of the fibular head and directed distally into the intramedullary canal, facilitating later screw fixation of the osteotomy. A 1.5 mm

<table>
<thead>
<tr>
<th>Patients</th>
<th>Gender</th>
<th>Age</th>
<th>Injury mechanism</th>
<th>Schatzker Classification</th>
<th>Luo Classification</th>
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<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>35</td>
<td>Motorcycle accident</td>
<td>II</td>
<td>Posterior + anterolateral columns (Flexion/Valgus)</td>
</tr>
<tr>
<td>2</td>
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<td>53</td>
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<td>II</td>
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</tr>
<tr>
<td>3</td>
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<td>22</td>
<td>Fall</td>
<td>V</td>
<td>Posterior + anterolateral + anteromedial columns (Flexion/Neutral)</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>49</td>
<td>Fall</td>
<td>V</td>
<td>Posterior + anterolateral + anteromedial columns (Flexion/Neutral)</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>24</td>
<td>Motorcycle accident</td>
<td>V</td>
<td>Posterior column (Flexion/Valgus)</td>
</tr>
<tr>
<td>6</td>
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<td>19</td>
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<td>Fall</td>
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</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>55</td>
<td>Fall</td>
<td>I</td>
<td>Posterior column (Flexion/Valgus)</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>45</td>
<td>Fall</td>
<td>I</td>
<td>Posterior column (Flexion/Valgus)</td>
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</tbody>
</table>
Kirschner wire was placed lateral at least 2 cm distal to the proximal tip of the fibula to mark the apex of the chevron osteotomy and protect the peroneal nerve crossing below. A small oscillating saw was used to cut the chevron osteotomy. Copious irrigation was utilized to avoid excessive heat generation. Small, thin osteotomes are used to complete the osteotomy without increasing bone removal at the level of the bone cut. The osteotomized fibular head is then retracted proximally.

A standard lateral arthrotomy was performed with submeniscal arthrotomy to allow articular surface visualization and reduction. Standard reduction techniques including bone grafting were used.

For posterolateral fixation, we routinely utilize a horizontal rafting technique, previously described by Bermúdez and Ziran [5] (Figs. 1 and 2). This treatment method is even particularly helpful for associated posterolateral and anterolateral fracture patterns [6].

If necessary, standard buttress plates in antiglide position can be added to achieve stable fixation. The fibular osteotomy is typically stabilized using an intramedullary 3.5 mm or 4.5 mm extra long screw with a washer. If necessary, suture of the tibiofibular proximal ligaments is performed.

The standard postoperative regimen included early range of motion and muscle strengthening immediately after surgical wound healing. Patients are not allowed to bear body weight for 10–12 weeks. Following this time, partial weight bearing is allowed and rapidly advanced to full weight bearing as tolerated by the patients.

Results

All fractures were healed at the final imaging. No patients at final follow up developed symptomatic nonunion or malunion of the fibular osteotomy. One patient lost reduction at the fibular osteotomy and required revision surgery (Figs. 3 and 4)

No leg-length discrepancies were noted. One patient presented knee with varus malalignment of 10° in the operated limb and had poor functional outcome. The American Knee Society Score was good in 7 patients (77.8%), fair in 1 (11.1%), and poor in 1 (11.1%; the varus malalignment patient). Average AKSS/Function was 80 points (60–100; SD:11).

No patients had symptomatic knee instability, and there were no peroneal nerve palsies. No patients developed superficial or deep infections.

There was no association between Schatzker Classification and AKSS (P = 0.480) and Schatzker Classification and AKSS/Function (P = 0.076).

In addition, there was no association between Luo Classification with AKSS and with AKSS/Function. (P = 0.323 and P = 0.526, respectively).

Finally, there was no association neither between age with AKSS nor with AKSS/Function (P = 0.200 and P = 0.312, respectively). However, in light of the small sample size, these statistical findings must be interpreted with caution.
Discussion

Approaches to the surgical exposure of tibial plateau fractures have evolved from anterior extensile exposure to more soft tissue friendly fragment specific approaches. These approaches provide more direct visualization of fracture reduction and more precise buttress application. Posterior approaches have become an important part of complex plateau fracture management involving the posterior column of the articular surface [4]. Lobenhoffer [7] developed a posteromedial approach for posteromedial condylar fracture dislocations. This approach is simple and safe and allows direct fracture reduction and simple application of a precise buttress plate.

Similarly, Carlson [8] described posterolateral and posteromedial approaches with the patient in prone position for posterior column fractures. For posterior bicondylar patterns, Bhattacharyya et al. [9] described a single posterior approach.

Although some authors have proposed assessing the posteromedial and posterolateral elements through a single posteromedial approach [9], this procedure is technically demanding and carries risk of iatrogenic vascular injury due to necessary traction for visualization.

While these posterior approaches have significantly simplified exposure for specific posteromedial and posterolateral fracture patterns, some posterior patterns, particularly in the posterolateral part of the joint, are still challenging.

Addressing the complicated posterolateral patterns, Frosch et al. [10] described the anterolateral and posterolateral arthroscopy approach without fibular osteotomy.

With the patient laterally positioned, a single laterally based incision allows for fracture reduction and fixation.

In contrast, Solomon et al. [11] presented their lateral exposure using fibular osteotomy. This approach enables treating complex anterolateral and posterolateral fractures using double anti-glide plates. Potential complications related to this technique include peroneal nerve palsy and fibular nonunion which were not reported in their series.

An additional and potentially less morbid method for posterolateral exposure was described by Yu et al. [12] and requires partial fibular head osteotomy, preserving lateral collateral ligament to prevent knee instability. The resected fibular head bone can subsequently be used as bone graft to support depressed articular fragments.

Despite the variety of options available for posterolateral exposure, there are still fracture patterns, particularly fracture patterns involving the posterolateral articular surface adjacent to the proximal fibular articulation that are best visualized using a transfibular osteotomy. Still, surgeons remain wary of transfibular approaches and the possibility for problematic complications like peroneal nerve palsy and fibular nonunion.

There are no reports in the literature specifically focused on complications of the transfibular approach. In the present case...
series, only one patient lost osteotomy fixation. In this case, simple revision was successfully performed by placement of a longer screw. No peroneal nerve palsies, malunions, nonunions at the osteotomy site, or symptomatic posterolateral instability were seen in this series.

Based on our experience with the transfibular approach, we recommend:

1 Making a long incision with low threshold for proximal extension to facilitate location and dissection of the peroneal nerve proximally and to limit excessive traction.
2 Pre-drilling the fibula prior to osteotomy, facilitating screw placement for osteotomy fixation.
3 Placing Kirschner wire marking the inferior limit of the fibular osteotomy to prevent nerve damage during the osteotomy and serve as a reference point for the chevron osteotomy.
4 Utilizing a chevron osteotomy technique for better bone contact, compression, and stability.
5 Stabilizing the fibular osteotomy with an extra long 3.5 mm or 4.5 mm cortex screw (based on intramedullary canal diameter) with a washer. Screws shorter than 80 mm must be avoided due to risk of reduction loss. Larger diameter screw designs can cause iatrogenic fracture.
6 Maintaining reduction of the tibiobibular joint with a periarticular clamp during repair of tibiobibular ligaments.

**Conclusion**

This series demonstrates that the transfibular approach can be an effective and safe procedure for the treatment of posterolateral fractures of the tibial plateau. Despite the potential complications associated with the transfibular approach, such as peroneal nerve palsy and fibular osteotomy nonunion, simple techniques can prevent them. We strongly recommend careful dissection and visualization of the peroneal nerve and fixation of the fibular osteotomy with a 3.5 mm or 4.5 mm extra long cortex screw to prevent nerve injury and osteotomy nonunion.

The primary benefit of this technique is optimal joint visualization allowing for anatomical reduction. A larger prospective study would likely help determine the true complication rates of this procedure and verify its safety and utility.

**Conflict of interest**

The authors declare absence of conflict of interest related to this article.

**References**


