



The Intact Meniscal “Bucket-Handle” Technique to Expose Complex Lateral Tibial Plateau Fractures

Guillaume Demey, M.D., Echie Dwi Damayanthi, M.D., and ReSurg, David Dejour, M.D.

Abstract: There is no consensus on the optimal surgical approach to treat complex tibial plateau fractures, but careful selection of the appropriate surgical approach with clear access to the joint is crucial for successful anatomic reduction. Several articles have described techniques using a fibular or lateral femoral epicondylar osteotomy for improved visualization. Detachment of the anterior horn could facilitate treatment; however, inadequate reattachment of the anterior horn could hinder the healing process and create residual subluxation of the meniscus. This Technical Note describes a surgical technique to provide clear access to the articular surface for the treatment of complex lateral tibial plateau fractures by releasing the posterior meniscocapsular fibers up to the popliteus tendon and folding the lateral meniscus into the intercondylar notch, which exposes the articular surface.

Tibial plateau fractures represent less than 1% of all knee injuries and can be difficult to manage.¹ Treatment of such injuries often requires restoration of articular congruity, joint stability, and native knee alignment through open reduction and internal fixation.² Preoperative planning, and therefore the selection of the appropriate surgical approach with clear access to the joint, is crucial for successful anatomic reduction.²

There is no consensus on the optimal surgical approach to treat complex tibial plateau fractures. Several articles have described techniques using a fibular or lateral femoral epicondylar osteotomy for improved visualization³⁻⁶; however, complications such as nonunion, residual laxity, nerve injuries, and progression or onset of osteoarthritis have been reported. Detachment of the anterior horn could facilitate treatment; however, inadequate reattachment of the anterior horn could hinder the

healing process and create residual subluxation of the meniscus. An alternative technique could be to release the posterior meniscocapsular fibers up to the popliteus tendon and to fold the lateral meniscus into the intercondylar notch, which exposes the articular surface. The purpose of this Technical Note is therefore to describe a surgical technique to provide clear access to the articular surface for the treatment of complex lateral tibial plateau fractures.

Surgical Technique

The patient is placed in the supine position on a radiolucent table under anesthesia, with the knee in 90° flexion and a tourniquet on the thigh. A standard anterolateral approach is used with a longitudinal skin incision of approximately 12 to 15 cm (Video 1). The insertion of the iliotibial band is released subperiosteally from the Gerdy tubercle with a scalpel to maintain its continuity with the tibialis anterior muscle.⁷ The anterolateral aspect of the tibial metaphysis is exposed, and a varus stress is applied to the knee joint to identify the soft spot between the lateral meniscus and the tibia. A horizontal submeniscal arthrotomy is made to expose the anterior and central lateral tibial plateau (Fig 1A), but this exposure may be insufficient in cases with complex fractures, particularly if there are posterior bone fragments (Fig 1B). The horizontal submeniscal arthrotomy can therefore be extended vertically from the midportion of the lateral meniscus to the popliteus hiatus (Fig 1C). The capsule should be incised close to the synovial junction of the meniscus, keeping the meniscal wall intact. This arthrotomy allows folding of

From the Lyon-Ortho-Clinic, Clinique de la Sauvegarde, Ramsay Santé, Lyon, France (G.D., E.D.D., D.D.).

Contributors to ReSurg: Floris van Rooij, Chinyelum Agu, and Mo Saffarini.

Received March 12, 2024; accepted June 6, 2024.

Address correspondence to Floris van Rooij, M.Sc., ReSurg SA, Rue Saint Jean 22, 1260 Nyon, Switzerland. E-mail: journals@resurg.com

© 2024 THE AUTHORS. Published by Elsevier Inc. on behalf of the Arthroscopy Association of North America. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

2212-6287/24421

<https://doi.org/10.1016/j.eats.2024.103165>

the entire lateral meniscus into the intercondylar notch. This technique induces an iatrogenic “bucket handle” of an intact lateral meniscus without disrupting its continuity.

The bone fragments are reduced using a small bone hook, and then fixed using 1 or more cannulated screws, and followed by internal plate fixation (4.5-mm LCP Proximal Tibia Plate; Depuy Synthes, Johnson & Johnson, Warsaw, IN) (Fig 1D). The meniscus is reduced to its anatomic position, and the vertical arthrotomy is simply sutured using 2 horizontal polydioxanone 0 sutures (Fig 1E). The sutures are passed outside-in, from the lateral aspect of the fascia lata into the meniscus, and then from the meniscus to the lateral aspect of the fascia lata, and tied with the knee flexed at 90°.

The patient follows a standard rehabilitation protocol for the treatment of the fractures with no particular

modifications relative to the meniscal bucket-handle technique.

Discussion

The limited visualization of the tibial plateau after fragment reduction through the standard anterolateral approach is the most common reason for articular malreduction,⁸⁻¹¹ especially in the posterior segments of the lateral tibial plateau. This approach could result in inaccurate reconstruction, as it provides limited access to the fracture site, and can complicate reduction as a result of the posterior convex shape of the tibial plateau.^{8,9,12}

The standard anterolateral approach only exposes one third of the lateral tibial plateau,³ whereas more than 83% of the articular surface can be exposed^{5,13} by using a horizontal submeniscal arthrotomy, which is then extended vertically. With an additional release of

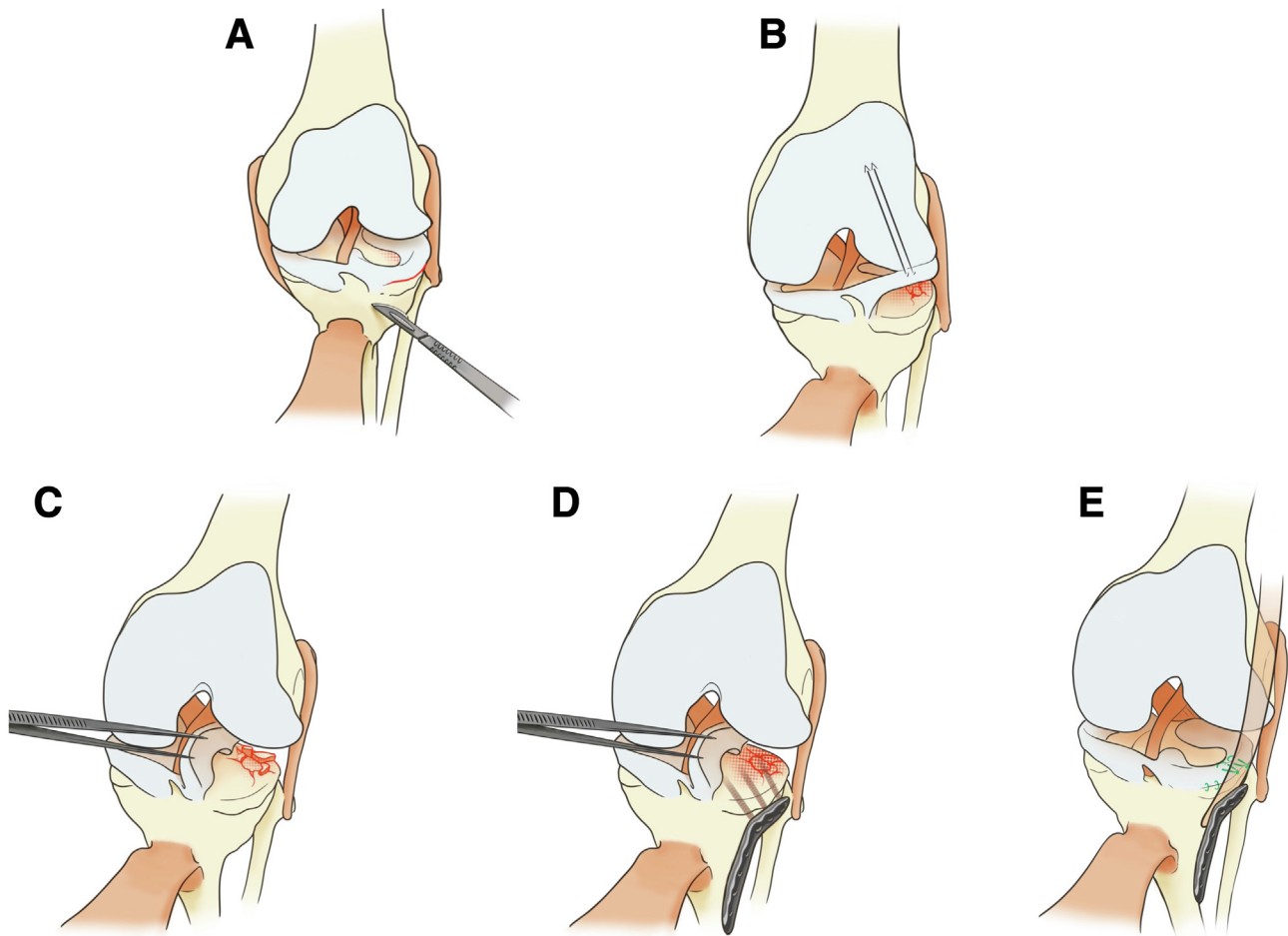


Fig 1. (A) A horizontal submeniscal arthrotomy is made to expose the anterior and central lateral tibial plateau. (B) Sutures are passed through the meniscus to raise and expose the plateau fracture. (C) The horizontal submeniscal arthrotomy can therefore be extended vertically from the midportion of the lateral meniscus to the popliteus hiatus, which allows folding of the entire lateral meniscus into the intercondylar notch. (D) The bone fragments are reduced using a small bone hook, and then fixed using one or more cannulated screws, and followed by internal plate fixation. (E) The meniscus is reduced to its anatomic position, and the vertical arthrotomy is simply sutured using 2 horizontal polydioxanone 0 sutures.

Table 1. Pearls, Advantages, and Pitfalls

Pearls	Advantages	Pitfalls
Standard anterolateral approach	Rapid and reproducible technique	Risk of bucket-handle tear
Horizontal submeniscal arthrotomy	Small and simple vertical arthrotomy	Inability for posterolateral plate (can only be anterior or lateral)
Vertically extended arthrotomy	Easy reattachment of the meniscus	
Meniscal wall kept intact	Intraoperative choice of steps as required	
Folding of the entire lateral meniscus into the intercondylar notch	Visualization of the entire lateral tibial plateau	
No disruption of the lateral meniscus continuity		
Vertical arthrotomy simply sutured using 2 horizontal polydioxanone sutures		
Standard rehabilitation protocol with no particular modification		

meniscocapsular fibers, posterior to the popliteus hiatus and central fold of the lateral meniscus, almost 100% of the articular surface of the lateral plateau can be visualized.^{4,14} This technique facilitates manipulation of the posterolateral fracture fragments, and intra-articular pathologies, including meniscal tears. Vertical arthrotomy also serves as a temporary release for the posterolateral corner complex, and permits increased joint distraction through a varus load when compared with a native knee.^{4,15}

Lobenhoffer et al.¹⁶ described an extended lateral approach, using fibular osteotomy, for posterolateral fractures. The approach allows exposure of the posterolateral plateau but might be difficult for placing plates and screws, and it increases the risks of posterolateral instability as well as injury to the common peroneal nerve. This technique also requires fixation of the fibular neck after the tibial plateau, and implant removal would require a new osteotomy of the fibular neck.¹⁵ In select cases, with extensive comminution of the lateral tibial plateau compromising its anterior and posterior quadrants along with the tibial spines, a careful detachment of the anterior horn of the lateral meniscus may be considered. However, the surgeon should ensure the anterior horn is reattached and the coronary ligament is repaired after internal fixation of the articular surface, as detachment of the anterior horn could lead to accelerated osteoarthritis.⁵

This Technical Note describes an alternative approach for the treatment of complex lateral tibial plateau fractures. The intact meniscal “bucket-handle” technique enables opening the posterolateral compartment without osteotomy of the lateral epicondyle and fibular head nor damage to soft-tissue structures (Table 1).

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: D.D. has patent with royalties paid to SBM. All other authors (G.D., E.D.D.,

F.v-R., C.A., M.S) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. This work was supported by GCS Ramsay Santé pour l'Enseignement et la Recherche.

References

1. van Dreumel RL, van Wunnik BP, Janssen L, Simons PC, Janzing HM. Mid- to long-term functional outcome after open reduction and internal fixation of tibial plateau fractures. *Injury* 2015;46:1608-1612.
2. Partenheimer A, Gosling T, Muller M, et al. Management of bicondylar fractures of the tibial plateau with unilateral fixed-angle plate fixation. *Unfallchirurg* 2007;110:675-683 [in German].
3. Krause M, Kruger S, Muller G, Puschel K, Frosch KH. How can the articular surface of the tibial plateau be best exposed? A comparison of specific surgical approaches. *Arch Orthop Trauma Surg* 2019;139:1369-1377.
4. Yoon YC, Sim JA, Kim DH, Lee BK. Combined lateral femoral epicondylar osteotomy and a submeniscal approach for the treatment of a tibial plateau fracture involving the posterolateral quadrant. *Injury* 2015;46:422-426.
5. Kfuri M, Schatzker J, Castiglia MT, Giordano V, Fogagnolo F, Stannard JP. Extended anterolateral approach for complex lateral tibial plateau fractures. *J Knee Surg* 2017;30:204-211.
6. Frosch KH, Balcarek P, Walde T, Sturmer KM. A new posterolateral approach without fibula osteotomy for the treatment of tibial plateau fractures. *J Orthop Trauma* 2010;24:515-520.
7. Neyret P, Butcher C, Demey G. *Surgery of the knee*. Springer, 2020.
8. Meulenkamp B, Martin R, Desy NM, et al. Incidence, risk factors, and location of articular malreductions of the tibial plateau. *J Orthop Trauma* 2017;31:146-150.
9. Krause M, Preiss A, Meenen NM, Madert J, Frosch KH. "Fracturosopy" is superior to fluoroscopy in the articular reconstruction of complex tibial plateau fractures—an arthroscopy assisted fracture reduction technique. *J Orthop Trauma* 2016;30:437-444.

10. Singleton N, Sahakian V, Muir D. Outcome after tibial plateau fracture: How important is restoration of articular congruity? *J Orthop Trauma* 2017;31:158-163.
11. Haller JM, O'Toole R, Graves M, et al. How much articular displacement can be detected using fluoroscopy for tibial plateau fractures? *Injury* 2015;46:2243-2247.
12. Eggli S, Hartel MJ, Kohl S, Haupt U, Exadaktylos AK, Roder C. Unstable bicondylar tibial plateau fractures: A clinical investigation. *J Orthop Trauma* 2008;22:673-679.
13. Krause M, Muller G, Frosch KH. Extended medial and extended lateral approach for tibial plateau fractures. *Oper Orthop Traumatol* 2019;31:127-142 [in German].
14. Guttowski D, Krause M, Puschel K, Kolb JP, Hartel M, Frosch KH. Improved visualization by central subluxation of the lateral meniscus in comminuted lateral tibial plateau fractures. *J Knee Surg* 2021;34:1408-1412.
15. Garner MR, Warner SJ, Lorch DG. Surgical approaches to posterolateral tibial plateau fractures. *J Knee Surg* 2016;29:12-20.
16. Lobenhoffer P, Gerich T, Bertram T, Lattermann C, Pohlemann T, Tscheme H. Particular posteromedial and posterolateral approaches for the treatment of tibial head fractures. *Unfallchirurg* 1997;100:957-967 [in German].