Anterolateral Approach With Lateral Epicondyle Osteotomy in Tibial Plateau Fractures: Functional and Radiological Results at 6-Month Follow-Up

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ABSTRACT

Introduction: In tibial plateau fractures, achieving anatomical reduction of the articular surface is essential, and adequate visualization through an appropriate approach is indispensable to accomplish this. The aim of this study is to describe the surgical technique of the anterolateral approach with lateral epicondyle osteotomy and to report the functional and radiological outcomes in a series of patients with a minimum follow-up of 6 months. **Materials and Methods:** Over a 24-month period, nine anterolateral approaches with lateral epicondyle osteotomy were performed in five women and four men (mean age 40.1 years; range 18–62) presenting with lateral tibial plateau fractures involving the posterior sector. The mean follow-up was 13 months (range 6–24). **Results:** Radiographic assessment included evaluation of bone healing and comparison of condylar width, medial proximal tibial angle, and tibial slope with the contralateral knee. All fractures consolidated radiographically. No cases of nonunion or displacement of the osteotomy bone block were observed. Clinical and functional outcomes were assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS) and the Rasmussen score. Outcomes were good to excellent in all cases, with a mean KOOS score of 82. **Conclusion:** The anterolateral approach with lateral epicondyle osteotomy provides excellent visualization of the posterior aspect of the lateral tibial plateau, facilitating anatomical reduction of articular fragments. It is a valid and reproducible option that does not require special patient positioning and minimizes the risk of neurovascular injury.

Keywords: Knee; tibial plateau fractures; surgical approach; lateral femoral epicondyle osteotomy.
Level of Evidence: IV

Abordaje anterolateral con osteotomía del epicóndilo en fracturas de platillo tibial. Resultados funcional y radiológico a los 6 meses de seguimiento

RESUMEN

Introducción: En las fracturas de platillo tibial, uno de los requisitos fundamentales es la reducción anatómica de la superficie articular, su visualización con un abordaje correcto es indispensable para resolverlas. El objetivo de este estudio es detallar la técnica quirúrgica de este abordaje, y comunicar los resultados funcionales y radiográficos en una serie de casos con un seguimiento de 6 meses. **Materiales y Métodos:** En 24 meses, se efectuaron 9 abordajes anterolaterales con osteotomías del epicóndilo lateral en 5 mujeres y 4 hombres (edad promedio 40.1 años; rango 18-62), que tenían fracturas de platillo tibial lateral con compromiso del sector posterior. El seguimiento promedio fue de 13 meses (mín. 6, máx. 24). **Resultados:** Se realizó una evaluación radiográfica, donde se constató la consolidación ósea. Se midieron el ancho condilar, el ángulo tibial proximal medial y la pendiente tibial, comparativas con la rodilla contralateral. No hubo casos de seudoartrosis o desplazamiento del taco óseo de la osteotomía. Se llevó a cabo una evaluación clínica y funcional con las escalas *Knee Injury and Osteoarthritis Outcome Score* (KOOS) y de Rasmussen. Los resultados fueron buenos/excelentes en todos los casos, con un puntaje KOOS promedio de 82.
Conclusión: El abordaje anterolateral permite una óptima visualización y reducción de los fragmentos de la superficie articular, es una opción válida y reproducible para el cirujano, ya que no requiere un posicionamiento especial del paciente y minimiza el riesgo de lesión neurovascular.

Palabras clave: Rodilla; fracturas de platillo tibial; abordaje quirúrgico; osteotomía del epicóndilo femoral lateral.
Nivel de Evidencia: IV

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INTRODUCTION

The fundamental objective in the treatment of tibial plateau fractures is to restore the joint surface and axial alignment through anatomical reduction and absolute stability, thereby enabling early mobilization.[1,2]

Proper visualization of the articular surface through an appropriate surgical approach is essential for managing these fractures.[3-5]

The extended anterolateral approach with epicondyle osteotomy provides enhanced exposure of the lateral tibial plateau articular surface, allowing for accurate fragment reduction.[6] This has been correlated with improved clinical and radiographic outcomes.

The objectives of this article are to describe the surgical technique of the extended anterolateral approach with epicondyle osteotomy for lateral tibial plateau fractures with posterior involvement, and to report the functional and radiological outcomes obtained in a series of patients treated with this technique.

MATERIALS AND METHODS

Over a 24-month period (2022–2024), 20 patients with tibial plateau fractures were admitted to our hospital. The study included patients presenting with lateral tibial plateau fractures with posterior involvement, according to the Schatzker and Kfuri classification,[7] with or without associated medial plateau involvement, and an *American Society of Anesthesiologists* (ASA) score of III or lower.[8]

Exclusion criteria were: ipsilateral lateral femoral condyle fracture, isolated medial tibial plateau fracture, external tibial plateau fractures with anterolateral involvement only, soft-tissue compromise at the planned approach site, and ASA score greater than IV.

Patients remained hospitalized for an average of 7 days prior to surgery. During this period, 7 were placed in transcalcaneal skeletal traction and 2 in external fixation, both applied on the day of emergency admission.

A total of nine lateral approaches with lateral epicondyle osteotomies were performed in five women and four men (mean age 40.1 years; range 18–62). Mean follow-up was 13 months (min. 6, max. 24).

Written informed consent was obtained from all participants. The study protocol was approved by the Ethics Committee of Hospital "Prof. Dr. Alejandro Posadas" and conducted in accordance with the Declaration of Helsinki.

Surgical Technique

The patient is placed in the supine position with the knee flexed to 90° on the surgical table. An anterolateral approach is performed from the femoral epicondyle to Gerdy's tubercle, which may be extended as needed by the surgeon (Figures 1 and 2).

Figure 1. Dermographic marking on the anterolateral aspect of the knee from the lateral epicondyle to Gerdy's tubercle.

Figure 2. Incision along the previous marking, with possible extension proximally or distally as needed.

A longitudinal incision is made through the iliotibial band, and the anterolateral muscles of the proximal tibia are sectioned. The lateral meniscus is identified, a submeniscal incision is carried out, it is repaired with sutures, and then elevated proximally to expose the anterolateral region of the tibial plateau.

The approach is then extended through a lateral epicondyle osteotomy. The insertions of the lateral collateral ligament and the popliteus tendon are identified in the epicondylar area (Figure 3). A rectangular area approximately 3 cm long × 2 cm wide (including both insertions) is outlined using electrocautery. This creates a larger bone block and decreases the risk of fracture during fixation.

Including the popliteus insertion also increases the visualization area.[2] A 3.5-mm cannulated drill bit is used to create a hole at 30° proximally and 30° anteriorly in the center of the marked rectangle, preparing the bone block for later reinsertion (Figure 4).

Figure 3. Identification of the insertions of the lateral collateral ligament and popliteus tendon in the epicondylar region.

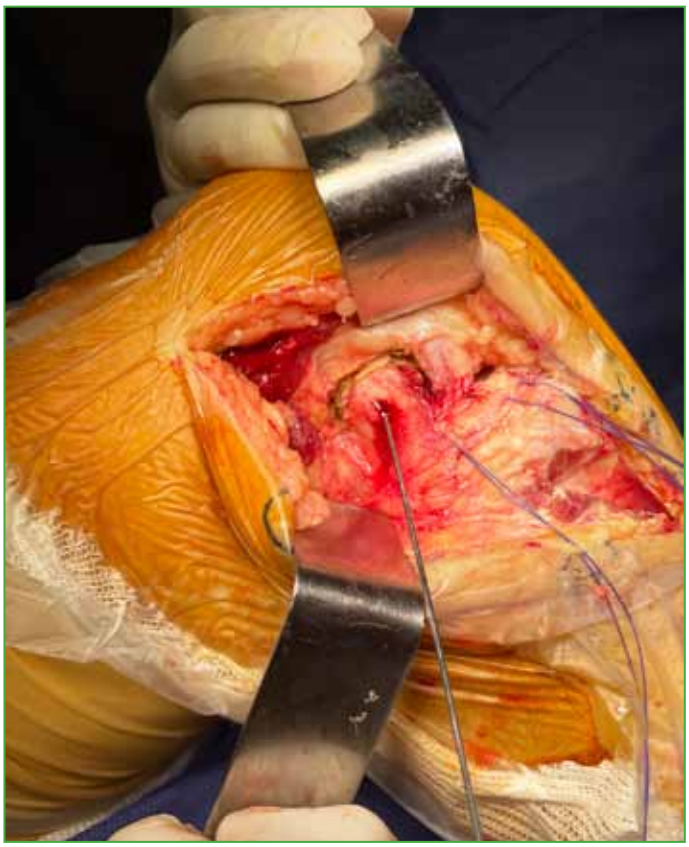

Figure 4. Delimitation of the osteotomy area and placement of a guide pin for a cannulated drill bit at the center of the marked zone.

Osteotomy of the previously marked area is then completed, to a depth of approximately 1 cm. The bone block is gently released, taking care to avoid injury to the articular surface of the lateral femoral condyle.

By applying internal rotation and varus stress to the limb, a wide portion of the articular surface of the lateral tibial plateau is exposed, including medial intercondylar and posterolateral sectors (Figure 5).

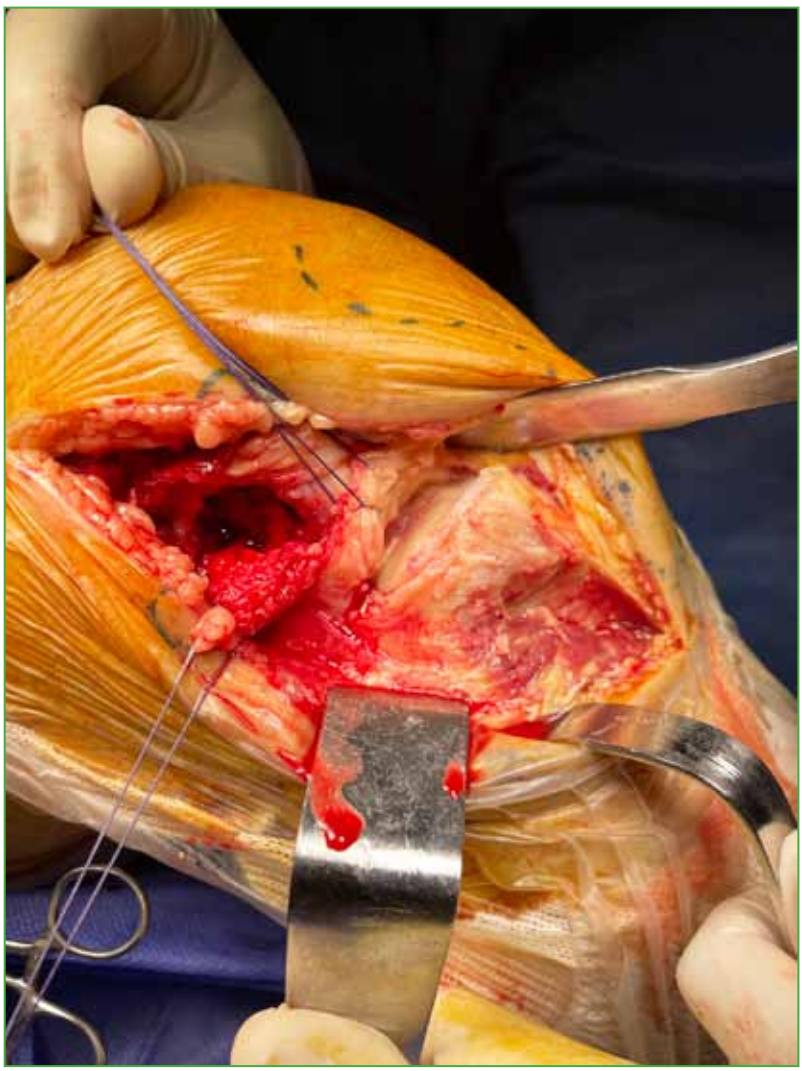

Figure 5. Completed epicondyle osteotomy, repaired proximally, with meniscal elevation and exposure of the lateral tibial plateau articular surface.

The articular fragments are then reduced and elevated. Temporary stabilization is achieved with Kirschner wires, followed by compression with 4.5-mm cannulated screws and placement of an anatomical proximal tibial plate in an anti-shear configuration.

After stabilization, the epicondylar bone block is reinserted into its bed using a 4.5-mm cannulated screw, with or without a washer, depending on compression needs. The meniscus is repaired, and the wound is closed (Figure 6).

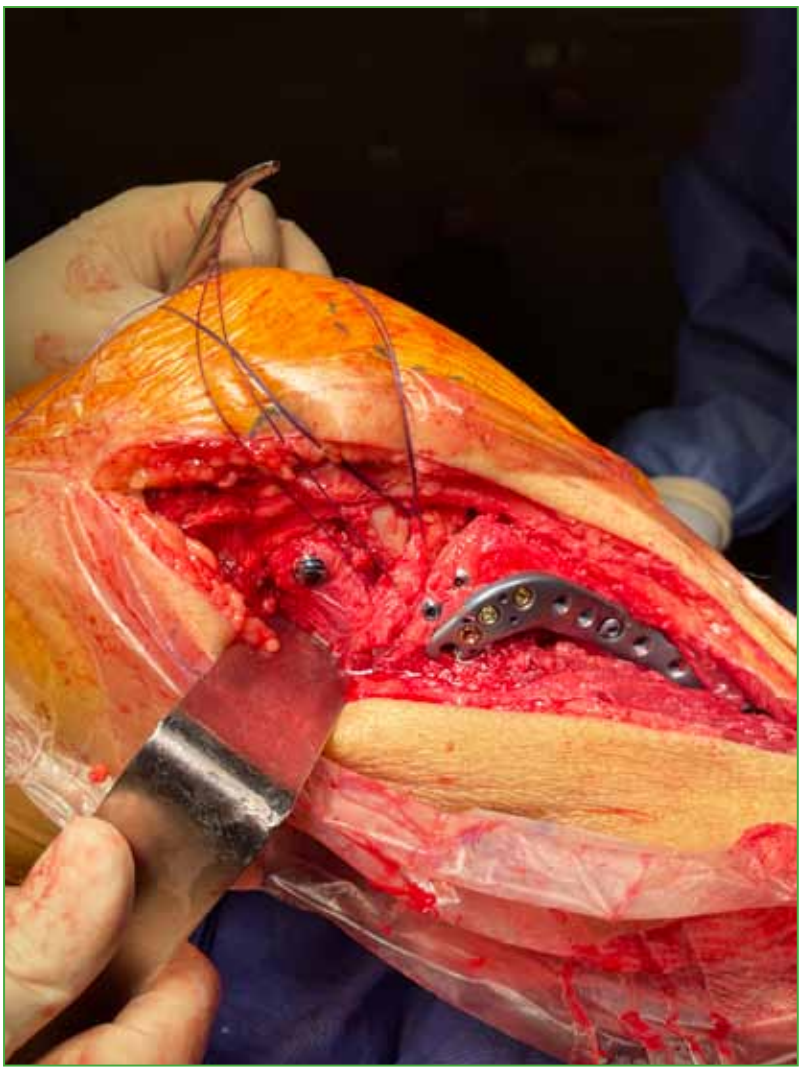

Figure 6. Reinsertion of the bone block into its bed following completion of osteosynthesis.

RESULTS

Patients remained hospitalized for an average of 3 days (min. 1, max. 4) after surgery. Postoperative follow-ups were performed once a week during the first month and subsequently at weeks 6, 8, 12, and 16.

No wound complications or signs of surgical site infection were observed in this series. Radiographic and CT evaluations confirmed bone union.

Condylar width, the medial proximal tibial angle, and tibial slope were measured and compared with the contralateral knee, all of which fell within normal parameters. All patients had <2 mm of articular depression, except for one patient with a 3-mm depression. No cases of nonunion or displacement of the epicondylar osteotomy bone block were observed (Figures 7 and 8).

Figure 7. 25-year-old patient involved in a traffic accident. Schatzker–Kfuri V PM + PL fracture. **A.** AP knee radiograph. **B.** Lateral knee radiograph. **C.** Axial CT scan of the knee. **D.** Coronal CT scan of the knee. **E.** Postoperative AP radiograph of the knee. **F.** Postoperative lateral radiograph of the knee.

Figure 8. 18-year-old patient in a motorcycle–car accident. Schatzker–Kfuri II AL + PL fracture. **A.** AP knee radiograph. **B.** Lateral knee radiograph. **C.** Axial knee CT scan. **D.** Computed tomography of the knee, coronal section. **E.** Computed tomography of the knee, sagittal section. **F.** Postoperative AP view of the knee. **G.** Postoperative lateral view of the knee.

All patients were able to bear full weight at 5 months postoperatively. Clinical and functional assessment was performed using the *Knee Injury and Osteoarthritis Outcome Score* (KOOS) and the Rasmussen scale.[9,10] Outcomes were good to excellent in all cases, with a mean KOOS score of 82 (Table).

DISCUSSION

Seventy percent of tibial plateau fractures involve the lateral plateau. A poor reduction rate of 77% has been reported in the posterocentral quadrant, followed by 50% in the posterolateral quadrant.[11] For this reason, adequate visualization of the joint surface is essential to achieve an appropriate reduction. The posterior sector of the lateral tibial plateau can be accessed through several approaches, each with its benefits and limitations, and none universally preferred.

We use the extended anterolateral approach with epicondyle osteotomy when the posterior portion of the lateral plateau is involved, as it provides several advantages.[6]

Positioning the patient supine eliminates the need for intraoperative repositioning.

Luo et al. describe the "floating position," initially placing the patient prone to perform a posterior approach, mobilizing the gastrocnemius from medial to lateral to expose the entire posterior surface of the proximal tibia, and then turning the patient supine, when necessary, to stabilize the anterior columns.[12] Another prone alternative is the intergastrocnemius anatomic approach described by Zublin et al., which allows medial or lateral mobilization of the neurovascular bundle according to the surgeon's needs.[13]

Table. Results of functional and radiological evaluations.

Patient	Age	Gender	Type of fracture Schatzker-Kfuri	KOOS	Rasmussen	Follow-up (months)	Condylar width	Collapse	MPTA	Slope
1	62	F	II AL+PL	70.8	Good	6	Normal	2 mm	91	6
2	58	M	II PL	81.6	Excellent	9	Normal	2 mm	88	5
3	24	M	II AL+PL	93.3	Excellent	18	Normal	No	88	5
4	45	F	II PL	91.8	Excellent	7	Normal	2 mm	88	3
5	40	F	II AL+PL	86.2	Good	7	Normal	2 mm	88	7
6	18	F	II AL+PL	95.9	Excellent	16	Normal	No	87	5
7	25	F	V PL+PM	71.9	Good	14	Fair	2 mm	88	7
8	37	F	II AL+PL	69.4	Excellent	24	Normal	2 mm	89	5
9	52	M	II PL	76.7	Excellent	16	Normal	3 mm	87	7
Average	40.1			82.0	Good/ Excellent	13.0				

F = female; M = male; A = anterior; P = posterior; L = lateral; M = medial; KOOS = Knee Injury and Osteoarthritis Outcome Score; MPTA = medial proximal tibial angle.

Lobenhoffer et al. and Carlson propose a direct posterolateral approach in the prone position, protecting the common peroneal nerve. Although this provides access to the posterolateral quadrant, the distal working window is limited because the anterior tibial artery crosses from posterior to anterior approximately 5 cm below the joint line, and visualization of the articular surface is generally restricted.[14,15]

Frosch et al. also place the patient prone and use a posterolateral approach through two windows, anterior and posterior, without requiring fibular osteotomy.[16]

A major advantage of our approach is the reduced risk of injury to critical structures such as the peroneal nerve or the popliteal neurovascular bundle.

The epicondyle osteotomy can be reinserted easily and provides inherent stability that facilitates early motion. In our series, there were no cases of nonunion of the osteotomy block.

Brilhaut et al. reported a 7.6% rate of nonunion of the bone block in a series of patients undergoing lateral femoral epicondyle osteotomy for severe valgus deformity.[17]

Solomon et al. described a fibular head osteotomy involving the proximal tibiofibular joint. Beyond increasing the risk of nerve injury, the subsequent reduction and fixation of the fibula may introduce additional risk of nonunion.[18]

As a limitation, our approach does not allow placement of a buttress plate on the posterior cortex of the proximal tibia, as accessing the posterior metaphysis for osteosynthesis is challenging.

Cho et al. use a 2.7-mm belt-shaped reconstruction plate to fix posterolateral fragments, providing absolute stability to the entire proximal tibial ring.[19]

We chose the KOOS scale because it is age-independent and reproducible across all age groups, acknowledging that other tools (such as the Lysholm Score, the *Oxford Knee Score*, and the *Knee Society Score*) are more appropriate for evaluating ligament surgeries or knee arthroplasties.[9,20-22]

The mean KOOS score in our series was 81.9, similar to the 82.9 reported by Van Dreumel et al. in their cohort of 71 patients with medium- to long-term follow-up.[23]

We believe our approach is conventional and familiar to orthopedic surgeons, who generally view it as a natural extension of the anterolateral approach. It reduces surgical time and avoids additional soft-tissue disruption. Furthermore, it can be combined with a posteromedial or anteromedial approach when required by the fracture pattern.

This study has limitations: it is a case series with a limited number of patients. Although short-term functional and radiological outcomes are excellent, longer follow-up is necessary to accurately assess final outcomes.

CONCLUSIONS

The extended anterolateral approach with epicondyle osteotomy for fractures involving the posterior sector of the lateral tibial plateau allows optimal visualization and reduction of the articular surface fragments. It is a valid and reproducible option for the surgeon, as it is a familiar approach, does not require a special patient position, and minimizes the risk of neurovascular injury. The short-term functional and radiographic results are excellent.

Conflicts of interest: The authors declare no conflicts of interest.

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REFERENCES

1. Rosteius T, Rausch V, Pätzholz S, Lotzien S, Königshausen M, Armin Schildhauer T. Factors influencing the outcome after surgical reconstruction of OTA type B and C tibial plateau fractures: how crucial is the restoration of articular congruity? *Arch Orthop Trauma Surg* 2023;143(4):1973-80. https://doi.org/10.1007/s00402-022-04405-5
2. Schatzker J, Kfuri M. Revisiting the management of tibial plateau fractures. *Injury* 2022;53(6):2207-18. https://doi.org/10.1016/j.injury.2022.04.006
3. Krause M, Frings J, Hüseyin I, Frosch K-H. Comparison of extended lateral approaches to the tibial plateau: the articular exposure of lateral epicondyle osteotomy with and without popliteus tendon vs. fibula osteotomy. *Injury* 2020;51:1874-8. https://doi.org/10.1016/j.injury.2020.05.038
4. Krause M, Krüger S, Müller G, Püschel K, Frosch K-H. How can the articular surface of the tibial plateau be best exposed? A comparison of specific surgical approaches. *Arch Orthop Trauma Surg* 2019;139(10):1369-77. https://doi.org/10.1007/s00402-019-03200-z
5. Frosch K-H, Korthaus A, Thiesen D, Frings J, Krause M. The concept of direct approach to lateral tibial plateau fractures and stepwise extension as needed. *Eur J Trauma Emerg Surg* 2020;46:1211-9. https://doi.org/10.1007/s00068-020-01422-0
6. Kfuri M, Schatzker J, Teixeira Castiglia M, Giordano V, Fogagnolo F, Stannard JP. Extended anterolateral approach for complex lateral tibial plateau fractures. *J Knee Surg* 2017;30(3):204-11. https://doi.org/10.1055/s-0037-1598077
7. Kfuri M, Schatzker J. Revisiting the Schatzker classification of tibial plateau fractures. *Injury* 2018;49(12):2252-63. https://doi.org/10.1016/j.injury.2018.11.010
8. Daabiss M. American Society of Anaesthesiologists physical status classification. *Indian J Anaesth* 2011;55:111-5. https://doi.org/10.4103/0019-5049.79879
9. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS) -- development of a self-administered outcome measure. *J Orthop Sports Phys Ther* 1998;28(2):88-96. https://doi.org/10.2519/jospt.1998.28.2.88
10. Rasmussen P. Tibial condylar fractures impairment of knee joint stability as an indication for surgical treatment. *J Bone Joint Surg Am* 1973;55(7):1331-50. PMID: 4586086
11. Meulenkamp B, Martin R, Desy NM, Duffy P, Korley R, Puloski S, et al. Incidence, risk factors, and location of articular malreductions of the tibial plateau. *J Orthop Trauma* 2017;31(3):146-50. https://doi.org/10.1097/BOT.0000000000000735
12. Luo C-F, Sun H, Zhang B, Zeng B-F. Three-column fixation for complex tibial plateau fractures. *J Orthop Trauma* 2010;24(11):683-92. https://doi.org/10.1097/BOT.0b013e3181d436f3

13. Beatti MA, Zublin Guerra CM, Guichet DM, Pellecchia TS. Abordaje intergemelar posteromediano del platillo tibial. Descripción de la técnica quirúrgica. *Rev Asoc Argent Ortop Traumatol* 2022;87(2):273-84. https://doi.org/10.15417/issn.1852-7434.2022.87.2.1437
14. 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(12):957-67. [German] https://doi.org/10.1007/s001130050218
15. Carlson DA. Bicondylar fracture of the posterior aspect of the tibial plateau. A case report and a modified operative approach. *J Bone Joint Surg Am* 1998;80(7):1049-52. https://doi.org/10.2106/00004623-199807000-00014
16. Frosch KH, Balcarek P, Walde T, Stürmer KM. A new posterolateral approach without fibula osteotomy for the treatment of tibial plateau fractures. *J Orthop Trauma* 2010;24(8):515-20. https://doi.org/10.1097/BOT.0b013e3181e5e17d
17. Brilhault J, Lautman S, Favard L, Burdin P. Lateral femoral sliding osteotomy lateral release in total knee arthroplasty for a fixed valgus deformity. *J Bone Joint Surg* 2002;84(8):1131-7. https://doi.org/10.1302/0301-620x.84b8.12824
18. Solomon LB, Stevensonm AW, Baird RPV, Pohl AP. Posterolateral transfibular approach to tibial plateau fractures: Technique, results, and rationale. *J Orthop Trauma* 2010;24:505-14. https://doi.org/10.1097/BOT.0b013e3181ccba4b
19. Cho J-W, Kim J, Cho W-T, Kim J-K, Samal P, Gujjar PH, et al. Approaches and fixation of the posterolateral fracture fragment in tibial plateau fractures: a review with an emphasis on rim plating via modified anterolateral approach. *Int Orthop* 2017;41(9):1887-97. https://doi.org/10.1007/s00264-017-3563-6
20. Lysholm J, Briggs KK, Tegner Y, Rodkey WG, Kocher MS, Steadman JR. The reliability, validity, and responsiveness of the Lysholm score and Tegner activity scale for anterior cruciate ligament injuries of the knee: 25 years later. *Am J Sports Med* 2009;37(5):890-7. https://doi.org/10.1177/0363546508330143
21. Dawson J, Fitzpatrick R, Murray D, Carr A. Questionnaire on the perceptions of patients about total knee replacement. *J Bone Joint Surg Br* 1998;80(1):63-9. https://doi.org/10.1302/0301-620x.80b1.7859
22. Scuderi GR, Bourne RB, Noble PC, Benjamin JB, Lonner JH, Scott WN. The new Knee Society Knee Scoring System. *Clin Orthop Relat Res* 2012;470(1):3-19. https://doi.org/10.1007/s11999-011-2135-0
23. 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(8):1608-12. https://doi.org/10.1016/j.injury.2015.05.035