Technical Note

Tibial Plateau With Arthroscopic Reduction—Internal Fixation

Alyssa Alvarez, B.A., Gun Min Youn, B.A., Angelica Marie Remigio Van Gogh, B.S., Sophia Sarang Shin Yin, B.S., Moyukh O. Chakrabarti, M.B.B.S., Patrick J. McGahan, M.D., and James L. Chen, M.D., M.P.H.

Abstract: Arthroscopic-assisted internal fixation is an ideal technique for visualizing chondral reduction during tibial open reduction—internal fixation. Typically, open reduction—internal fixation is performed using radiographic and Fluoroscan imaging (Hologic, Bedford, MA) for reduction of subchondral bone. However, reduction without visualization does not ensure chondral surface reduction. This Technical Note and supplemental video describe an arthroscopic-assisted technique involving the tibial plateau that gives complete visualization as tamping occurs to restore the cartilage surface of the subchondral bone and elevate the fracture.

The incidence of tibial plateau fractures is 10.3 per 100,000 annually; they are often connected to motor vehicle accidents.[1] Tibial plateau fractures are categorized by a combination of physical and radiographic examination findings.[2] The Schatzker classification of fracture types allows orthopaedic surgeons to assess the initial injury as well as plan its management and choice of surgical route.[3] These specific types of fractures can be paired with ligament injuries; however, standard fractures to this part of the body often highlight depression or displacement of the proximal tibial surface.[3] Plateau fractures that involve depression typically require elevation of the depression.[3] Arthroscopic-assisted internal fixation is a technique that is less invasive and allows for direct visualization of the tibial plateau chondral surface.[4] The purpose of this Technical Note and Video 1 was to describe a variation of the arthroscopic surgical process used for a tibial plateau fracture by providing consistent imaging of the tibial plateau and by minimizing the need for open incisions.

Surgical Technique

Imaging

Magnetic resonance imaging and radiographs are necessary for confirmation of the tibial plateau fracture. An 8-mm depressed, intra-articular lateral tibial plateau fracture is illustrated in Figure 1. There are no overt ligament injuries.

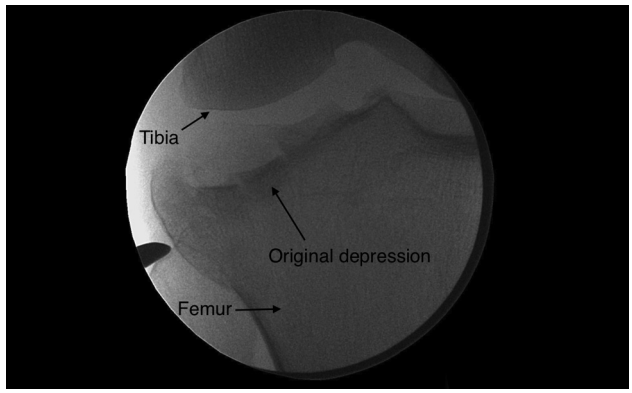

Figure 1. Intraoperative radiograph of the right knee, taken by C-arm, showing an intra-articular, 8-mm depressed lateral tibial plateau fracture.

From Advanced Orthopaedics and Sports Medicine, San Francisco, California, U.S.A.

The authors report the following potential conflicts of interest or sources of funding: J.L.C. is an educational consultant for Arthrex and receives compensation for medical lectures and instruction. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received July 12, 2019; accepted September 29, 2019.

Address correspondence to Alyssa Alvarez, B.A., Advanced Orthopaedics and Sports Medicine, 450 Sutter St, Ste 400, San Francisco, CA 94108, U.S.A. E-mail: aea483@nyu.edu

2212-6287/19891

https://doi.org/10.1016/j.eats.2019.09.023

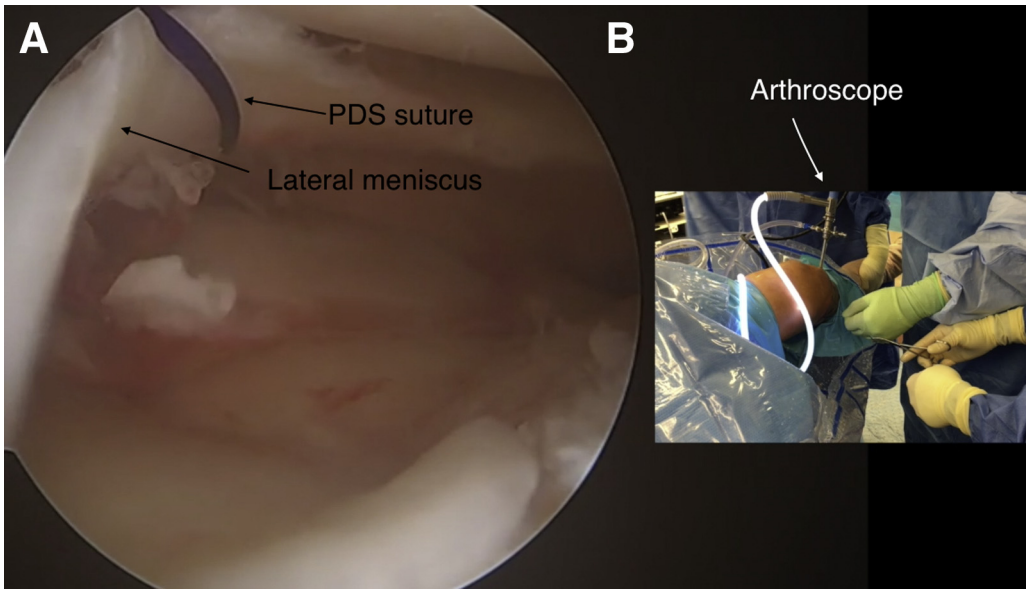

Figure 2. (A) Intraoperative arthroscopic image of the right knee viewed through the anterolateral portal. The lateral meniscus is retracted using a polydioxanone (PDS) suture to maximize visualization of the lateral tibial plateau edge. (B) Operative imaging of retraction of the lateral meniscus of the right knee.

Positioning

The patient is placed in the supine position on the operating table with the operative leg placed in an OSI leg holder (Mizuho OSI, Union City, CA). General anesthesia is induced, and the operative extremity is prepared and draped in the usual sterile fashion.

Incision

An incision is made laterally starting from above the patella along the iliotibial band down to the Gerdy tubercle. A spinal needle is used to pass a polydioxanone suture to tether and retract the meniscus for better visualization of the lateral tibial plateau edge (Fig 2). A tamp is then placed and impacted with a mallet through the fracture site of the lateral tibial cortex while the tibial plateau is observed through an arthroscope (Arthrex, Naples, FL). With proper applied force and direction, the reduction of the tibial plateau can be directly observed through the arthroscope (Fig 3). The tibial plateau should be reduced as close to

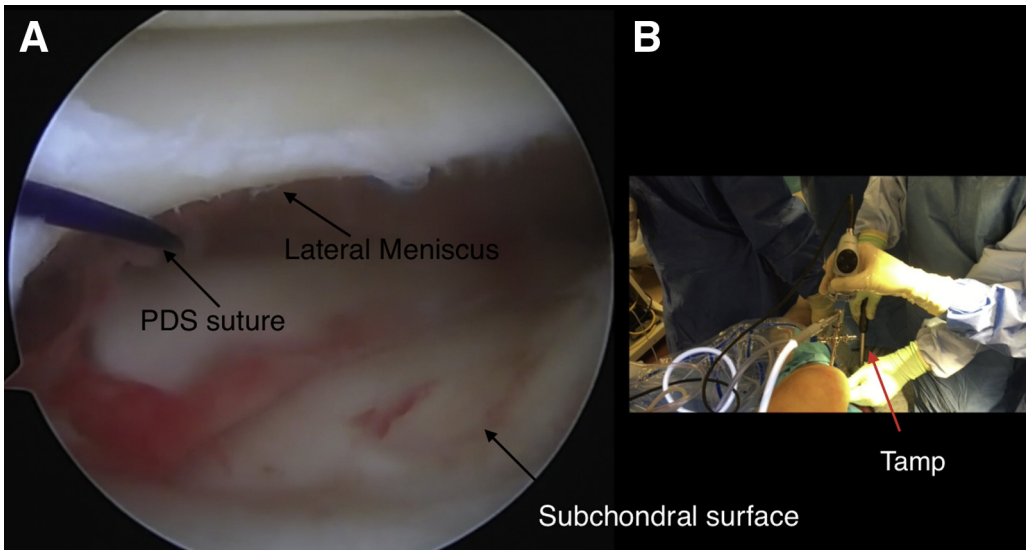

Figure 3. (A) Intraoperative arthroscopic image of the right knee viewed through the anterolateral portal. The subchondral surface is being raised owing to tamping. The lateral meniscus is retracted for improved visualization. (PDS, polydioxanone.) (B) Intraoperative photograph of a tamp being used to elevate the surface as congruency is facilitated through a bone window. This is observed and performed with arthroscopic assistance to avoid iatrogenic subchondral damage.

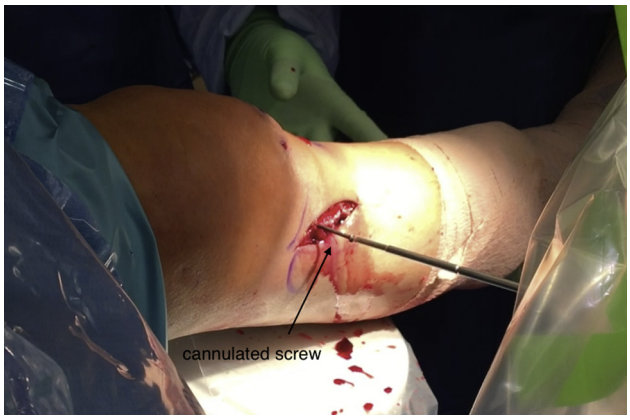

Figure 4. Intraoperative photograph of a 4.0 × 70−mm cannulated cortical screw being implanted to support the articular surface of the plateau of the right knee. This is 1 of 3 screws used.

the anatomic position as possible. A shaver or suction may be used to remove intra-articular debris. The reduction is then confirmed with C-arm radiographs.

The reduction is secured with K-wires (Arthrex) fired distal and parallel to the tibial plateau. Fixation is performed with cannulated screws (Arthrex) being drilled in over the K-wires and then tightened by hand (Fig 4). Final C-arm radiographs are taken to confirm appropriate anatomic reduction and fixation, as well as to ensure that the screws are of appropriate length and trajectory (Fig 5). These keys steps are shown in Video 1.

Final Examination and Postoperative Care

The patient is required to be non−weight bearing for 6 to 8 weeks in a hinged brace. Range of motion is allowed immediately after surgery. The patient must return for a postoperative consultation 2 weeks after the procedure. Serial radiographs will then be taken every 2 weeks for 6 to 8 weeks to check for proper alignment and healing. Finally, the patient can return to full activity after 3 to 4 months.

Discussion

The treatment of tibial plateau fractures is based on the Schatzker classification; this is based on energy impact to the bone at the time of impact, increasing in severity with numerical order.[3] A study conducted by Dall'oca et al.[5] found that arthroscopic-assisted internal fixation provided the opportunity to treat associated knee injuries. Particularly, the technique at hand was preferred in the cases in which meniscal tears were present with the fractures because treatment of both could improve surgical and clinical results.[5] Duan et al.[6] completed a clinical study highlighting 39 patients with Schatzker type I to V tibial plateau fractures treated with arthroscopic internal fixation. Among 36 patients, 92.3% obtained satisfactory results and 90% had no pain while walking. Range of motion was not affected, resulting in 77% of patients recovering to their previous activity level, including sports. Osteoarthritis, including complete loss of joint space or bone trauma, was not reported in any cases.[6]

The technique we propose maximizes visualization, facilitating precise tamping and reduction of the tibial plateau fracture, compared with fluoroscopic guidance only (Table 1). Arthroscopic fracture fixation allows for a clear sight of the intra-articular space, less intrusiveness, and the opportunity for multiple interventions, in which fixation of the fracture and repair of the meniscus and cartilage can occur simultaneously.[7] Meniscal tears, cruciate ligament injuries, or collateral ligament injuries are often associated with tibial plateau fractures and can be diagnosed and treated

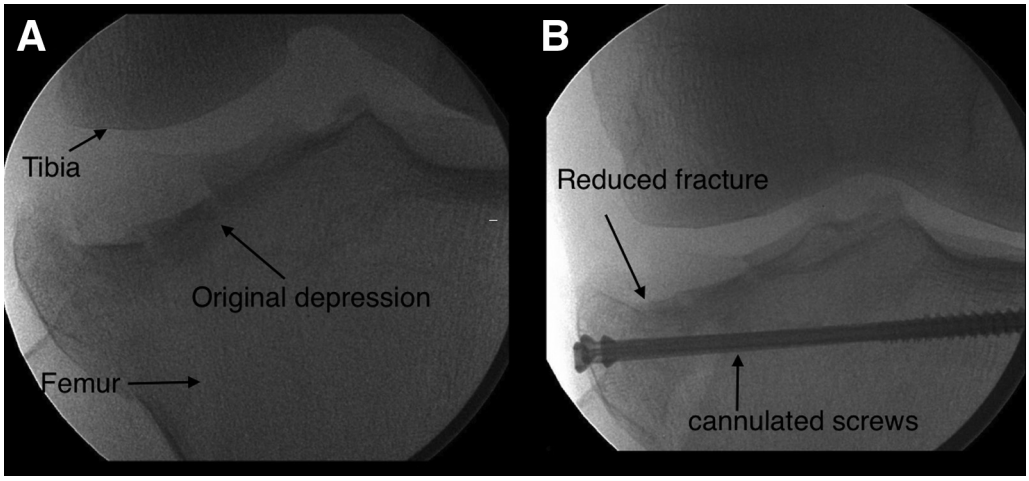

Figure 5. (A) Initial fluoroscopic image of the right knee. The depressed type II tibial plateau fracture can be appreciated. (B) Final fluoroscopic image of the right knee. The reduction of the tibial plateau fracture with screw fixation can be appreciated.

Table 1. Advantages and Disadvantages of Tibial Plateau Arthroscopic Reduction–Internal Fixation

Advantages
Maximization of visualization of subchondral surface for precise tamping
Opportunity for repair of ligaments and cartilage simultaneously
Retraction of lateral meniscus for better sight, rather than detachment
Less risk of wound complications or infections
Disadvantages
Longer learning curve for surgeons owing to time and difficulty
Possibility of fluid leakage leading to compartment syndrome
Limited fixation alternatives

arthroscopically.[4] Moreover, completing this procedure arthroscopically allows for the meniscus to be retracted for improved visualization of the tibial plateau, negating the necessity for complete detachment of the meniscal cartilage (Table 2).[4] A retrospective study conducted by Fowble et al.[8] found that patients who underwent arthroscopic repairs of isolated tibial plateau fractures were able to fully bear weight at an average time of 8.95 weeks whereas tibial plateau fractures treated by open reduction–internal fixation took 12.30 weeks ($P \leq .05$). In addition, this study noted that open techniques did not always result in proper anatomic reductions whereas arthroscopic fracture repair techniques had a 100% success rate of anatomic reductions.[8]

The disadvantages of our proposed technique include the difficulty and time necessary to complete this procedure arthroscopically. In comparison with open reduction–internal fixation, there is a steeper learning curve for surgeons and limited fixation alternatives.[7] The procedure also has the possibility of fluid leakage increasing the risk of compartment syndrome. The operative limb needs to be constantly monitored intraoperatively as well as postoperatively to ensure that any developing compartment syndrome is immediately assessed and treated.[9] Further studies are needed to analyze if our proposed technique leads to better outcomes in the treatment of tibial plateau fractures.

Table 2. Pearls and Pitfalls of Tibial Plateau Arthroscopic Reduction–Internal Fixation

Pearls
Care should be taken when tamping the subchondral surface to not violate the structure.
The meniscus can be retracted and tethered using polydioxanone suture.
Pitfalls
A disrupted view of the bone surface can lead to inaccurate elevation of the tibial plateau.

References

1. Elsoe R, Larsen P, Nielsen NPH, Swenne J, Rasmussen S, Ostgaard SE. Population-based epidemiology of tibial plateau fractures. *Orthopedics* 2015;38:e780-e786.
2. Waddell JP, Cooper Johnston DW, Neidre A. Fractures of the tibial plateau: A review of ninety-five patients and comparison of treatment methods. *J Trauma* 1981;21:376-381.
3. Markhardt BK, Gross JM, Monu J. Schatzker classification of tibial plateau fractures: Use of CT and MR imaging improves assessment. *Radiographics* 2009;29:585-597.
4. Zawam SHM, Gad AM. Arthroscopic assisted reduction and internal fixation of tibial plateau fractures. *Open Access Maced J Med Sci* 2019;7:1133-1137.
5. Dall'oca C, Maluta T, Lavini F, Bondi M, Micheloni GM, Bartolozzi P. Tibial plateau fractures: Compared outcomes between ARIF and ORIF. *Strategies Trauma Limb Reconstr* 2012;7:163-175.
6. Duan X, Yang L, Guo L, Chen G, Dai G. Arthroscopically assisted treatment for Schatzker type I-V tibial plateau fractures. *Chin J Traumatol* 2008;11:288-292.
7. Atesok K, Doral MN, Whipple T, et al. Arthroscopy-assisted fracture fixation. *Knee Surg Sports Traumatol Arthrosc* 2010;19:320-329.
8. Fowble CD, Zimmer JW, Schepsis AA. The role of arthroscopy in the assessment and treatment of tibial plateau fractures. *Arthroscopy* 1993;9:584-590.
9. Hartigan DE, McCarthy MA, Krych AJ, Levy BA. Arthroscopic-assisted reduction and percutaneous fixation of tibial plateau fractures. *Arthrosc Tech* 2015;4:e51-e55.