Tibial Plateau With Arthroscopic Reduction—Internal Fixation

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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.

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.
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 (PDS) 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 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.

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.
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 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. A study conducted by Dall’oca et al. 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. Duan et al. 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.

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. Meniscal tears, cruciate ligament injuries, or collateral ligament injuries are often associated with tibial plateau fractures and can be diagnosed and treated...
arthroscopically. 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). A retrospective study conducted by Fowble et al. 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 ($P < .05$). 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.

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. 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. Further studies are needed to analyze if our proposed technique leads to better outcomes in the treatment of tibial plateau fractures.

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