Technical Note

Arthroscopy-Assisted Management of Schatzker Type III Lateral Tibial Plateau Fracture With Interference Screw Fixation

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Abstract: Tibial plateau fractures occur in both old and young patients and may be caused by low-energy trauma, as well as high-energy trauma. Owing to the variety of injury mechanisms and fracture patterns, tibial plateau fractures are very challenging to treat. One of the most demanding fractures is the type III fracture according to the Schatzker classification, which is a pure depression of the lateral tibial plateau. Treatment with open surgical procedures is associated with vast soft-tissue trauma and prolonged recovery after surgery. Although soft-tissue trauma is minimized and visual control is improved throughout arthroscopy-assisted surgical procedures, internal fixation using buttress plates or lag screws is still required to reduce and fix the depressed plateau. We present an arthroscopy-assisted technique of reduction and fixation of the lateral tibial plateau fracture with 3 BioComposite interference screws (Arthrex, Munich, Germany) that provides a high amount of stability and reduces patient immobilization, allowing for faster rehabilitation.

Tibial plateau fractures are estimated to account for 1% of all fractures and may be caused by both high-energy trauma, predominantly due to pedestrian or sporting accidents, and low-energy trauma in older patients owing to poor-quality osteoporotic bone.[1,2] Both mechanisms may lead to complex fractures with concomitant soft-tissue damage, thus being a challenge for treatment. The Schatzker classification is commonly used to categorize these fractures, and its reliability has been widely proved in the literature.[1,3,4] One of the most demanding fractures is a Schatzker type III fracture, which is a pure depression of the lateral tibial plateau (LTP). It is usually associated with low-energy trauma and poor bone quality. The injury to the joint cartilage, which is usually unavoidable because of the mechanism of trauma, leads to the development of early osteoarthritis (OA). However, patients in whom an anatomic reduction of the joint surface is achieved with preservation of the natural mechanical limb axis may remain asymptomatic.[5] Other factors preventing progression of OA are early surgical intervention and early passive and assisted range-of-motion exercises; thus, these factors are crucial to provide the best treatment outcomes.[5]

Open surgical procedures and minimally invasive procedures may be used to treat tibial plateau fractures. Classic open approaches cause significant trauma to the surrounding soft tissues and may require lateral femoral condyle or fibular head osteotomy to provide better visualization of the fracture.[6,7] Whereas arthroscopy-assisted surgical procedures avoid most of these limitations, they still require autologous bone grafts or bone substitutes and internal fixation using buttress plates or lag screws to reduce and fix the depressed plateau.[8,9] Both approaches, however, require a long recovery, which delays the time to start intensive rehabilitation. We present an arthroscopy-assisted technique for the treatment of a Schatzker type III tibial plateau fracture with BioComposite interference screw (Arthrex, Munich, Germany) stabilization, which avoids hardware fixation or bone graft use and minimizes soft-tissue trauma, allowing for early mobilization.

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Surgical Technique

Diagnosis

The diagnosis of a Schatzker type III LTP fracture is made based on anteroposterior and lateral knee radiographs. Computed tomography scans are used to confirm the diagnosis and plan the approach. To evaluate concomitant soft-tissue damage, magnetic resonance imaging is performed (Fig 1).

Indications and Contraindications

The indication for our technique is a type III tibial plateau fracture according to the Schatzker classification. The contraindications are as follows: comminuted tibial plateau fractures; Schatzker type I, II, IV, V, or VI fractures; massive cartilage injuries; deep osteochondral lesions of the LTP; poor bone quality; skin injuries with indications to use external fixation; compartment syndrome; and/or an unstable patient condition.

Patient Positioning

The patient is placed in a supine position. Both regional anesthesia and general anesthesia can be used. A nonsterile thigh tourniquet is applied. The operative leg is placed in a leg holder and prepared in a sterile fashion. The knee is bent to 90° in the figure-of-4 position for better lateral-compartment visualization. A C-arm is used to control drilling and screw placement.

Diagnostic Arthroscopy

Diagnostic arthroscopy is performed through standard anterolateral and anteromedial portals using a 30° arthroscope (Arthrex). At the beginning, the diagnosis of a Schatzker type III LTP fracture is confirmed. Before we address the fracture, any concomitant intra-articular lesions must be excluded (Fig 2, Video 1). If found, these lesions ought to be treated at first.

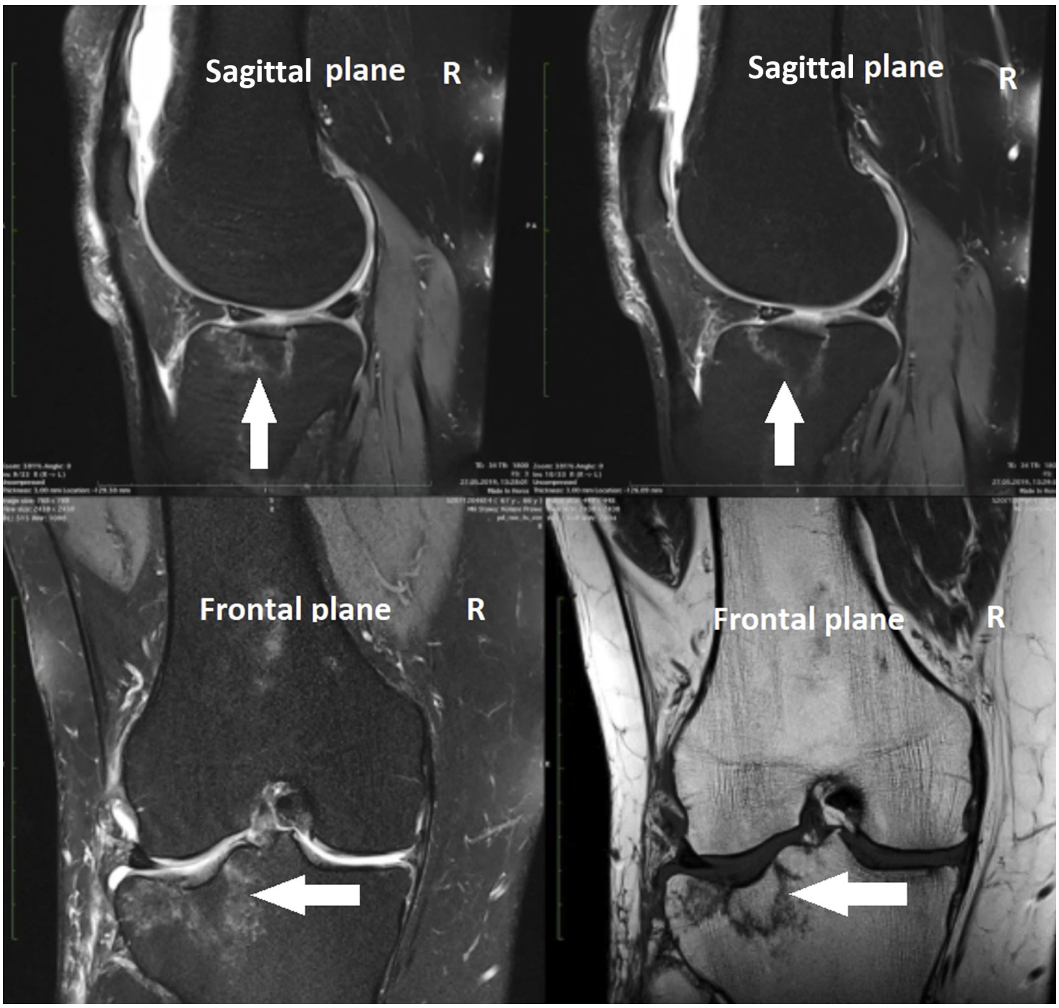

Fig 1. Schatzker type III tibial plateau fracture on anteroposterior and lateral magnetic resonance images of right (R) knee. The arrows indicate the tibial plateau depression.

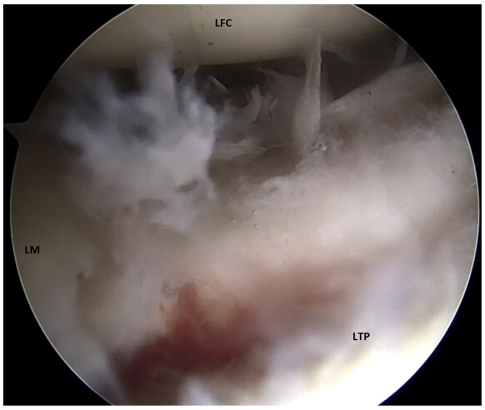

Fig 2. Arthroscopic view from anterolateral viewing portal into lateral compartment in right knee. The depression of the central part of the lateral tibial plateau (LTP), medially to the lateral meniscus (LM), is visualized. The diagnosis of a type III LTP fracture is confirmed. (LFC, lateral femoral condyle.)

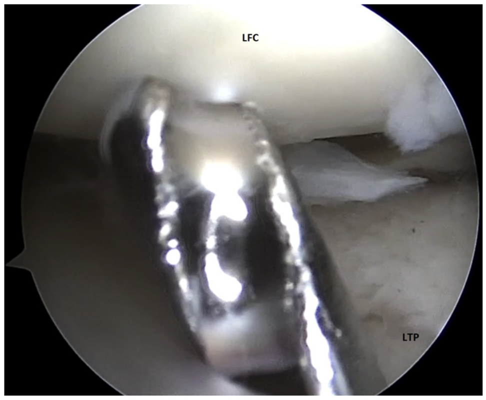

Fig 4. Arthroscopic view from anterolateral viewing portal into lateral compartment in right knee. The guidewire is fixed in the cortical bone layer, which prevents its accidental movement. Under fluoroscopic control, a 7-mm drill is used to create the tibial tunnel, ending approximately 1 cm below the fracture line. (LFC, lateral femoral condyle; LTP, lateral tibial plateau.)

Fracture Reduction and Stabilization

The whole procedure is performed using the anterolateral and anteromedial portals already created. With visualization through the anterolateral portal, an anterior cruciate ligament (ACL) drill guide (Arthrex) is inserted through the anteromedial portal and aimed in the center of depression on the surface of the LTP. A guidewire is drilled through the proximal tibia, starting from a point located medially to the tibial tuberosity, until it reaches the joint surface of the LTP (Fig 3, Video 1). After confirmation of its proper position in the center of depression, it is withdrawn to allow the ACL drill guide (Arthrex) to be removed. Then, the guidewire is again drilled forward to fix it in the cortical bone layer, which prevents its accidental movement (Fig 4, Video 1). Under fluoroscopic control, a 7-mm drill is used to create the tibial tunnel, ending approximately 1 cm below the fracture line. A 5-mm bone tamper introduced through the previously created tibial tunnel is used to elevate the depressed part of the articular surface. Arthroscopic visualization and intraoperative radiographs are used to control the fracture reduction (Fig 5, Video 1). When the proper articular surface reduction is achieved, the bone tamper is withdrawn and the aiming wire is introduced into the bone tunnel. Under fluoroscopic control, the first BioComposite interference screw, matched to the size of the bony defect, is placed under the elevated articular surface, filling the void created by fracture reduction, thereby becoming a support for reduced osteochondral

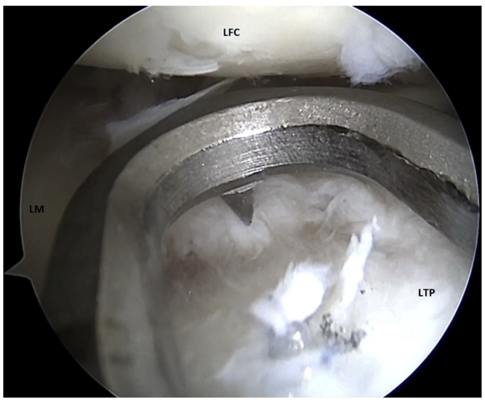

Fig 3. Arthroscopic view from anterolateral viewing portal into lateral compartment in right knee. A guidewire is drilled through the proximal tibia, starting from a point located medially to the tibial tuberosity, until it reaches the center of the depressed surface of the lateral tibial plateau (LTP). (LFC, lateral femoral condyle; LM, lateral meniscus.)

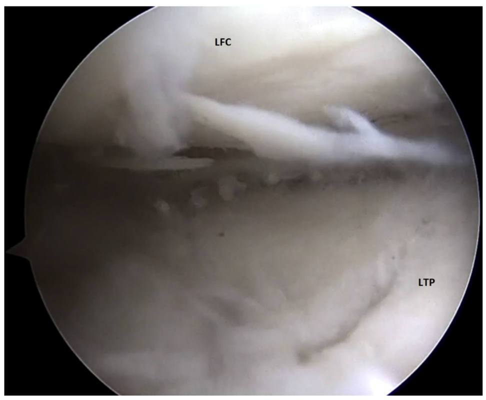

Fig 5. Arthroscopic view from anterolateral viewing portal into lateral compartment in right knee. A 5-mm bone tamper introduced through the previously created tibial tunnel is used to elevate the depressed part of the articular surface. Arthroscopic visualization and intraoperative radiographs are used to control the fracture reduction. (LFC, lateral femoral condyle; LTP, lateral tibial plateau.)

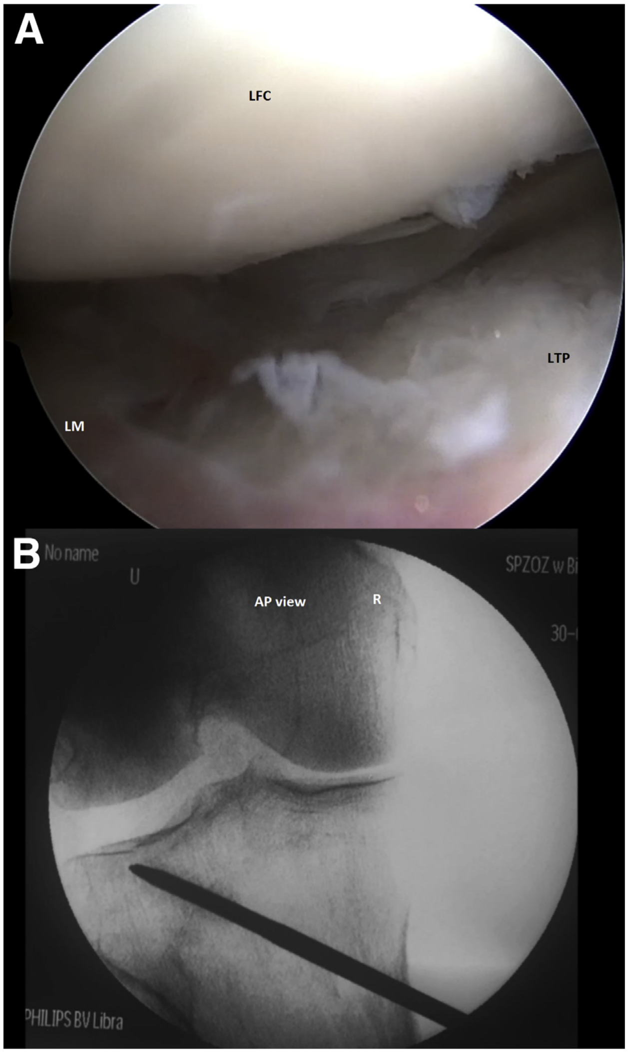

Fig 6. (A) Arthroscopic view from anterolateral viewing portal into lateral compartment in right knee. When the proper articular surface reduction is achieved, the bone tamper is withdrawn and the aiming wire is introduced into the bone tunnel. (B) Under fluoroscopic control, the first BioComposite interference screw, matched to the size of the bony defect, is placed under the elevated articular surface, filling the void created by fracture reduction, thereby becoming a support for osteochondral fragment. (AP, anteroposterior; LFC, lateral femoral condyle; LM, lateral meniscus; LTP, lateral tibial plateau; R, right.)

fragment (Fig 6, Video 1). Then, the aiming wire is withdrawn from the first BioComposite interference screw, but it remains in the bone tunnel. Afterward, another 2 BioComposite interference screws are sequentially introduced and placed underneath the first screw, positioning it parallel to the articular surface. Doing so reduces the risk of overcorrection; in addition, it fills the remaining bone gap and provides additional support to the reduced fragment. By use of arthroscopic visualization, an overcorrection of the fracture should be ruled out (Fig 7, Video 1). C-arm control of reduction as well as fixation is performed.

Rehabilitation

A continuous passive motion machine can be introduced on the first day after surgery, being used for 30 minutes 6 times per day for 9 weeks, with gradual flexion angle progression to 90° before the sixth week. Walking on crutches is recommended for 9 weeks. Progressive weight bearing is allowed from the fourth week. Manual therapy starts after the third postoperative day.

Discussion

The presented technique, being an arthroscopy-assisted procedure, provides excellent visualization

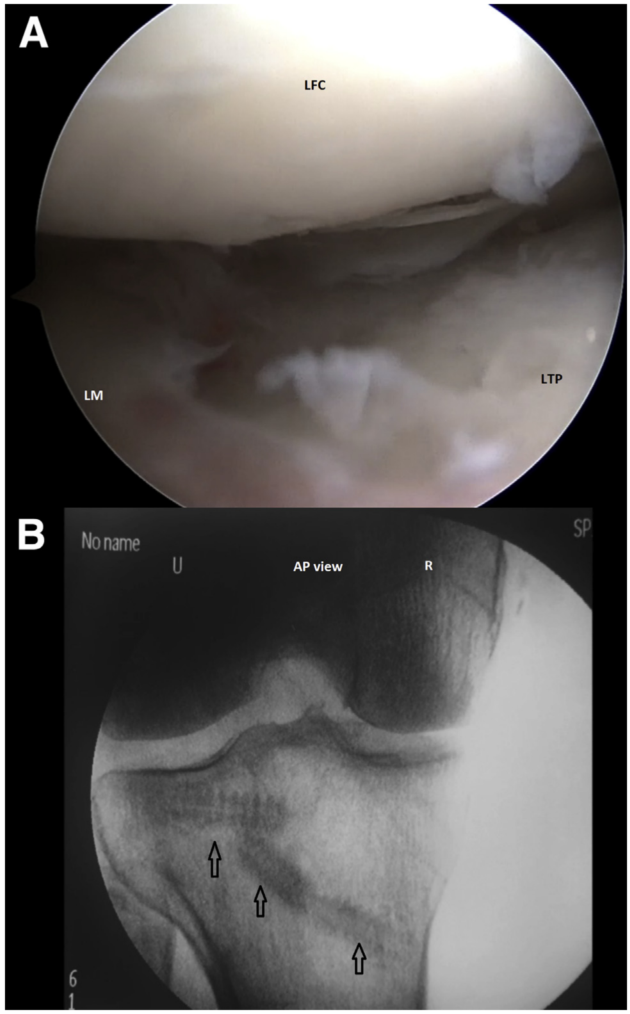

Fig 7. (A) Arthroscopic view from anterolateral viewing portal into lateral compartment in right knee. Two additional BioComposite interference screws are sequentially introduced and placed underneath the first screw, positioning it parallel to the articular surface. This reduces the risk of overcorrection, fills the remaining bone gap, and provides additional support to the reduced fragment. By use of arthroscopic visualization, an overcorrection of the fracture should be ruled out. (B) C-arm control of reduction and fixation is performed. The arrows indicate the positions of the BioComposite screws. (AP, anteroposterior; LFC, lateral femoral condyle; LM, lateral meniscus; LTP, lateral tibial plateau; R, right.)

Table 1. Advantages and Disadvantages of Arthroscopy-Assisted Technique for Treatment of Type III LTP Fracture With BioComposite Screw Stabilization

Advantages
Direct visual control of fracture reduction and stabilization
No need for lateral femoral condyle or fibular head osteotomy to enhance visualization
Minimal invasiveness: reduced soft-tissue trauma, as well as minimal risk of proximal tibiofibular joint instability, common peroneal nerve injury, and anterior tibial artery injury
BioComposite interference screws' dual role as support for reduced fragment and fulfillment of bony defect
No need for additional internal fixation using lag screws or buttress plates
No need for autologous bone harvesting or use of bone substitutes
Fast patient mobilization and recovery
Ability to address concomitant intra-articular lesions during same procedure
Easy to revise
Easy to convert to open surgery
No skin irritation over implant
Disadvantages
Risk of radiation to patient and staff during fluoroscopic control
Risk of iatrogenic cartilage lesions
ACL aiming guide is required
Creation of tunnel in proximal tibia, which could lead to tunnel convergence if ligamentous reconstructions will be performed in the future
Risk of bony lesions and tunnel widening around BioComposite interference screws
Risk of cartilage injury using ACL aiming guide
Risk of overcorrection
Risk of cartilage perforation with BioComposite interference screws

ACL, anterior cruciate ligament; LTP, lateral tibial plateau.

during the operation, avoiding specific disadvantages of open procedures such as soft-tissue trauma, as well as the possible necessity for a lateral femoral condyle or fibular head osteotomy. It implies a faster recovery, minimizes the risk of infection, and allows for an early introduction of rehabilitation, which is crucial to avoid knee stiffness.[2,3,6] Moreover, this technique allows other complications associated with open surgical procedures to be avoided, such as proximal tibiofibular joint instability, common peroneal nerve injury, and anterior tibial artery injury.[2,10] Using arthroscopy in the treatment of tibial plateau fractures creates the possibility to address concomitant intra-articular lesions in a 1-stage procedure. Because the whole procedure is performed through standard anteromedial and anterolateral portals and creating a more advanced approach in the back of the knee is not required, it does not demand a high amount of arthroscopic experience. It is also easily revisable if necessary and can be converted to open surgery at every stage of the procedure.

It is worth noting that arthroscopic visualization facilitates fracture reduction and minimizes the risk of overcorrection. Using the BioComposite interference screws as a support and fixation of the reduced fragment allows one to avoid the titanium or steel implants usually used for depressed tibial plateau fracture fixation.[1-3,11] This technique also eliminates the necessity for a second operation performed for implant removal and eliminates the risk of skin irritation over the implants. A similar technique was described by Lubowitz et al.[12] In our technique, we use more BioComposite interference screws, potentially creating more stable support beneath the fracture. Their second purpose is to fulfill the bony void created during the procedure, so no autologous bone graft or bone substitutes are required. Thereby, there is no concern of donor-site morbidity.

As in every technique, some disadvantages are typical for the described procedure. Fluoroscopy is required to create a tunnel beneath the articular surface and to perform BioComposite interference screw placement, which puts the patient and operating staff at risk of radiation exposure.[11] Drilling a guidewire through the articular surface creates a risk of iatrogenic cartilage lesions on the femoral side or displacement of the fracture fragment into the joint. Furthermore, this technique requires drilling of the tunnel in the proximal tibia; thus, an ACL aiming guide is necessary. Use of the ACL aiming guide also creates the possibility of cartilage injury. Moreover, this is an additional tunnel in the proximal tibia, which could lead to tunnel convergence in case of possible ligamentous reconstructions in the future. Advantages and disadvantages are summarized in Table 1.

The presented technique creates alternative possibilities in Schatzker type III tibial plateau fracture management. It does not require a high amount of arthroscopic experience, it causes less soft-tissue trauma than other techniques, and it allows for fast patient mobilization and recovery, which are crucial to avoid many postoperative complications such as knee stiffness or OA.

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