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Technical Note

Arthroscopic Management of Tibial Plateau Fractures

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Summary: We report our initial experience with the arthroscopic management of tibial plateau fractures. The known benefits of arthroscopy include better evaluation of the entire joint, limited dissection, and thorough irrigation. We have maximized the potential of arthroscopy through the use of additional instrumentation. With this technique, arthroscopy is used as an operative tool, with the addition of instruments previously used only for ligamentous reconstruction. Some tibial plateau fractures can be treated exclusively arthroscopically, obviating the wide surgical exposures that commonly increase morbidity in these cases. **Key Words:** Tibial plateau fractures—Percutaneous fixation.

The management of tibial plateau fractures has been debated in the literature for many years. Treatment options available in the past had been limited to plaster immobilization, skeletal traction, and open reduction with internal fixation (1–3).

More recently, studies have advocated the use of indirect reduction techniques with the concomitant use of image intensification (4). These techniques, although limiting surgical trauma, still lack the ability to directly visualize the knee joint.

Most recently the management of tibial plateau fractures has been via arthroscopy (5–7). Proponents of arthroscopic techniques advocate their use not only to better visualize the surface of the tibia, but also for the evaluation of the rest of the joint (5). Although some series (6,7) have used operative techniques, it is our contention that these studies have not maximally used the arthroscopic armamentarium that is available today.

This study describes our technique involving the arthroscopic management of tibial plateau fractures. We have used arthroscopy not only as a diagnostic tool, but also as an operative tool. The assistance of several devices previously used only for ligamentous reconstruction are utilized.

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OPERATIVE TECHNIQUE

Before beginning the surgical procedure, an examination is performed using anesthesia in order to evaluate the ligamentous stability of the joint. Arthroscopy of the knee joint is then undertaken, after exsanguination of the extremity and inflation of the tourniquet.

A standard superomedial portal is established. Fluid is introduced with the use of gravity inflow only. A lateral parapatellar portal is then established. Portal placement must be performed with much care because the normal landmarks may be distorted as a result of the fracture. However, the inferolateral edge of the patella is usually palpable, and may be used as a guide. The portal is established 1 cm distal and 1 cm lateral to this point. Outflow is also established via the arthroscopic canula sheath. This is an important step in order to minimize unnecessary increases in intraarticular pressures, thus minimizing the potential occurrence of a compartment syndrome.

Copious irrigation of the joint is now performed, before insertion of the arthroscope. Once the irrig-

ant clears, diagnostic arthroscopy is undertaken. It is important to minimize flexion and extension of the knee in order to decrease the potential increases in intraarticular pressures associated with these maneuvers (8). Limitation of the increases in pressure minimize the potential for fluid extravasation and subsequent formation of a compartment syndrome. A thorough evaluation of the joint is now performed. At this time a medial parapatellar portal may be established under direct visualization.

Once the medial portal is established, an arthroscopic probe is used to loosen any residual clots from the fracture surface. An arthroscopic shaver may be used at this point to aspirate clots from the joint. A careful evaluation of the fracture is now undertaken (Fig. 1). The fracture should be confined to the lateral plateau. We do not feel that bicondylar and medial plateau fractures (Schatzker types IV–V) are amenable to this technique because they tend to require more rigid fixation such as a buttress plate. The lateral meniscus should also be carefully evaluated for any peripheral detachment.

Reduction of the fracture is now undertaken. With the use of a tibial guide used in ligamentous reconstruction (Precise Tibial Guide no. 8500, Linvatec Corp, Largo, FL), the central portion of the fracture is located, and the guide is placed at this point. With the guide in place, a 2.0-mm Kirschner (K)-wire is then advanced into the central area of depression (Fig. 2). It is felt that penetration of the joint with a K-wire of such small dimension does not alter the tibial surface to any great degree.

With the use of image intensification, the position of the wire is confirmed. This should be in the center of the fracture in both the anteroposterior (AP) and lateral planes. Additionally, the wire should enter the fragment from the intact tibial metaphyseal area.

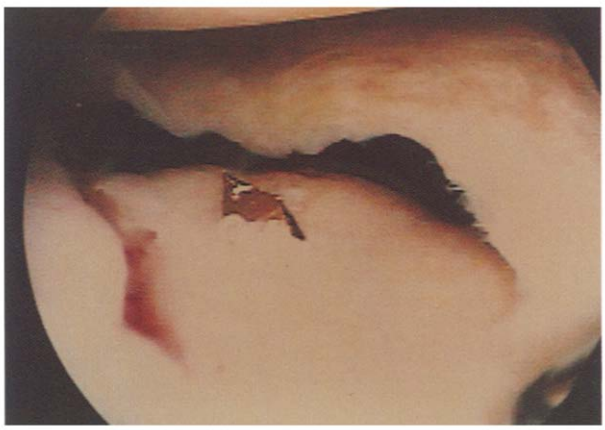

FIG. 1. Arthroscopic view of lateral plateau in a 56-year-old man (patient 1) before reduction.

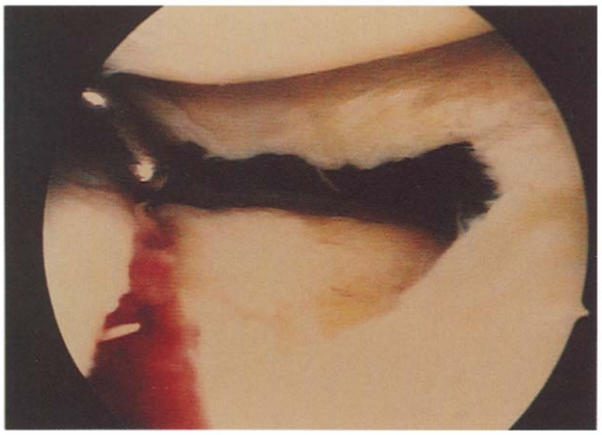

FIG. 2. Guide wire is visualized within the central portion of the fracture site. The tibial guide has already been removed from the joint.

After confirmation of its placement, a 2-cm incision is performed directly over the wire's entrance into the tibial metaphysis. An ~1 × 1 cm cortical window is then created immediately adjacent to the K-wire. A bone impactor is then advanced along the wire (Fig. 3). As the impactor is advanced, the arthroscope is used to confirm as near an anatomic reduction as possible.

Once the reduction is completed (Fig. 4), the image intensifier is used to insert two guide wires across the fracture site and parallel to the joint line. The bone impactor is kept in place throughout this procedure in order to prevent collapse of the elevated fracture site.

The position of the wires is then confirmed in both the AP and lateral planes (one anterior and one

FIG. 3. Intraoperative radiograph depicting the bone impactor being advanced along the previously placed guide wire.

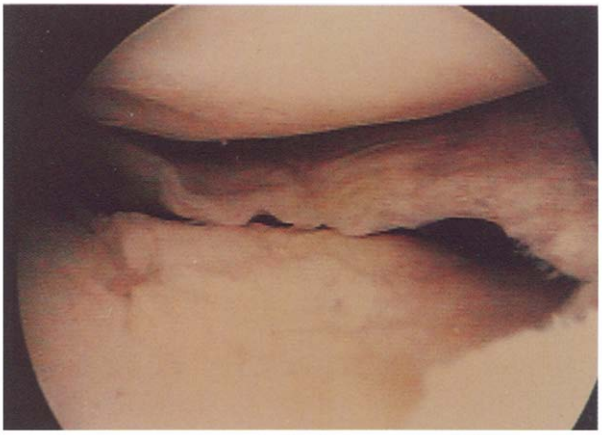

FIG. 4. Arthroscopic view of reduced lateral plateau fracture (patient 1) after advancement of bone impactor into position.

FIG. 6. Lateral radiograph of completed reduction (patient 1).

posterior to the impactor). Cannulated screws 6.5 mm in diameter (Ace Medical, Los Angeles, CA) are then inserted over the wires (Fig. 5). The bone impactor is now removed, and cancellous allograft or autograft is packed into the defect. Final radiographs confirm adequate reduction (Fig. 6).

The wounds are closed in a routine manner and covered with sterile dressings. An articulated brace allowing free range of motion is then placed on the leg. The patient is admitted to the hospital overnight and discharged the next day.

Before discharge, the patient is instructed on non–weight-bearing ambulation. This is maintained for a period of 6 weeks, while still in the brace. At 6 weeks postsurgery, weight bearing on the extremity is advanced, ~25% per week. At 10 weeks the patient begins weight bearing as tolerated, with the brace still in place. At 12 weeks the brace is discontinued. Graded return to activity is then allowed on an as-tolerated basis.

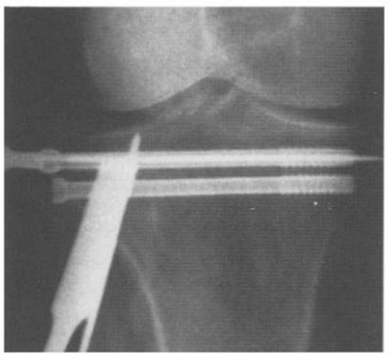

FIG. 5. Intraoperative radiograph depicting the insertion of guide wires and cannulated screws across the fracture site. Note that the bone impactor is maintained in position until the screws are inserted.

CASE REPORTS

From May 1992 to October 1992, five patients (Table 1) underwent arthroscopic repair of their tibial plateau fractures. All of the fractures had occurred within the previous 10 days (range 4–10). There were three men and two women in the study, who ranged in age from 21 to 56 years.

Indications for the surgery were a fracture of the lateral tibial plateau that was displaced or depressed by >5 mm. The fractures were classified according to the classification of Schatzker et al. (3). All of the patients have been followed to fracture union.

All five fractures have healed, with all patients having returned to their previous activity levels (Table 1). Fracture classification using the Schatzker scheme showed two type I, one type II, and two type III fractures. All of the fractures were stabi-

TABLE 1.

Patient	Age (yr)	Fracture type[a]	Fracture status	Time from injury (days)[b]
1	56	II	Healed	10
2	21	III	Healed	4
3	45	III	Healed	5
4	27	I	Healed	6
5	25	I	Healed	5

[a] Fracture classification of Schatzker et al. (3).
[b] Time from initial injury at which patient underwent described procedure.

lized with the use of two cannulated screws (Fig. 7). There were no complications in our series.

DISCUSSION

The ideal result in a tibial plateau fracture should be an anatomic reduction with stable fixation allowing an early range of motion. In the past this has been difficult to achieve in some cases and impossible in others. The difficulties are threefold.

First, in some cases achievement of an adequate reduction has meant extensive surgical dissection. These approaches have not only included extensive soft tissue dissection, but also disruption and, in some cases, transection of the menisci in order to achieve the required exposure.

Second, the surgical exposure in most cases calls for disruption of the entire fracture site in order to reconstruct it in a more anatomic fashion. This procedure may be simple in those cases without much comminution. In those with extensive comminution, however, the reconstruction is extremely difficult.

Finally, the surgical approach to these injuries requires an arthrotomy. Problems inherent to an arthrotomy are those of prolonged stiffness, increased pain, and wound complications.

The method of fixation described in this study obviates many of these problems. Surgical trauma involves minimal soft tissue dissection. More importantly, there is no need to disrupt any meniscal or ligamentous attachments. Lastly, the reduction of the fracture is performed in an indirect manner, bypassing the need for extensive dissection of bone fragments.

Additional benefits of the procedure include adequate visualization of the joint throughout, removal of chondral debris and hematoma through irrigation (5), and the opportunity to treat any meniscal pathology by routine arthroscopic methods. Perhaps most importantly, a formal arthrotomy is not necessary, and this allows rehabilitation and, consequently, cartilage healing to progress more rapidly (9).

However, although arthroscopic management of selected tibial plateau fractures appears to be efficacious, not all plateau fractures are amenable to this technique. Careful analysis of the fracture pattern should be performed before undertaking the procedure. In cases of medial plateau fractures, a portion of the procedure may be performed. However, fixation may require the use of a buttress plate or external fixation once reduction is performed. A buttress plate would involve an incision over the medial tibia. However, the incision may still remain extraarticular, and as noted above, disruption of the menisci is not necessary (7). Fixation with lateral screws appears to be adequate fixation for isolated lateral plateau fractures. This has not only been borne out in our series but also in that of Jennings (7).

Although the occurrence of a compartment syndrome associated with arthroscopy is rare (9–12), some of the cases have been associated with capsular rents (9,12) and/or fascial defects as a result of proximal fibular fractures (11). Although these pathologies have not been observed in our limited experience, they are certainly entities that may be observed with these fractures. Periodic assessment of the leg for evidence of fluid extravasation is an important principle. With the creation of an incision over the tibial metaphysis and the subsequent bony window, some decompression of the joint may occur. With the window, fluid should preferentially egress via this larger portal rather than via any small capsular deficiency. With experience, the time of diagnostic arthroscopy and the time under which the knee experiences maximal pressures can be minimized to only a few minutes. In cases where extravasation is a question, the more prudent approach is to abandon the arthroscopic procedure altogether.

Until the bony window is created, careful attention should be paid to maneuvers involving flexion and extension of the knee. If these must be per-

7A,B

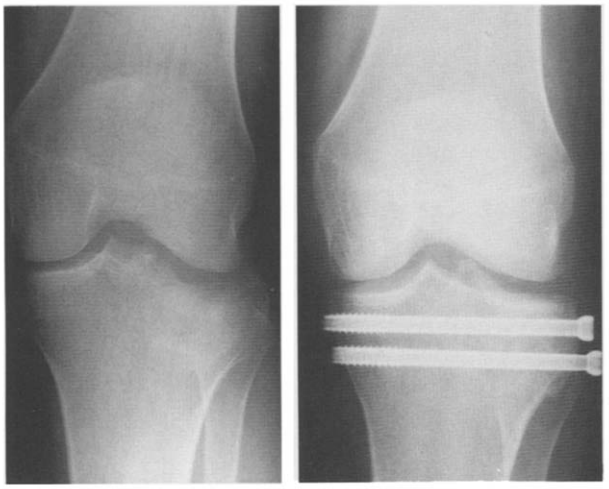

FIG. 7. A: Preoperative AP view of lateral plateau fracture (patient 2). B: Healed fracture 12 weeks postoperatively.

formed, they should be performed slowly in order to allow the outflow portal to increase its output, thus decreasing the intraarticular pressure.

In summary, arthroscopic fixation of tibial plateau fractures is a viable option in some cases. However, a considerable amount of arthroscopic skill is required not only in the reduction, but also in the diagnostic portion. This approach should be undertaken only by those individuals possessing such skills. The potential complication of a compartment syndrome should also be kept in mind. The procedure should be aborted if the concern arises.

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