Arthroscopic Treatment of Type III Tibial Spine Fractures Using Absorbable Fixation

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abstract

Over 2 years, five patients (average age 15 years) were diagnosed with a type III tibial spine fracture. All five fractures were treated with arthroscopic reduction and internal stabilization using absorbable fixation. At average 8.5-year follow-up, patients were interviewed and examined. Results were documented regarding function, KT-1000 testing, range of motion, and radiographic findings. All five patients reported no functional limitations despite participation in high-demand sports. Stability testing by KT-1000 revealed no objective instability. Range of motion was normal when the knee was immobilized in full extension postoperatively. No radiographic abnormality was noted at follow-up.

An excellent result can be expected with arthroscopic treatment of these fractures using absorbable internal fixation. Postoperative immobilization in full extension is recommended.

Tibial spine fracture is a relatively rare injury in children and adolescents. It is the equivalent of an anterior cruciate ligament (ACL) injury in adults. The most widely used classification system for tibial spine fractures was published in 1959 by Meyers and McKeever. Three fracture patterns were identified—type I fracture shows minimal displacement of the anterior margin; type II fracture shows displacement of the anterior margin with hinging of the posterior margin; and type III fracture is completely displaced from its bony bed.

Treatment for types I and II fractures is generally straightforward. Closed management with casting in extension has been shown to be effective. However, type III fractures often require surgical management. Early reports of open reduction described long-term sequelae including instability, extension loss, and functional disability. Furthermore, use and type of internal fixation and position of postoperative immobilization have been debated.

More recent reports have shown the value of arthroscopy in the treatment of type III fractures. This study reports the results of arthroscopic reduction and internal stabilization using absorbable fixation for the treatment of a type III tibial spine fracture in five patients. Average follow-up was 8.5 years. All patients were evaluated clinically and objectively.

MATERIALS AND METHODS

From 1991 to 1993, five patients (two girls and three boys) with type III fractures were treated by the author. Average patient age was 15 years (range: 10-18 years).

All five patients underwent outpatient surgery using general anesthesia. A tourniquet and leg holder were applied to the affected leg. A standard arthroscopic examination was performed to assess the fracture and any other injuries. Two patients had associated lateral meniscal tears and a partial lateral meniscectomy was completed. The tibial spine fracture site was cleared of hematoma, unstable bone fragments, and soft tissue. In three patients, the medial meniscus was interposed in the fracture and was retracted using a probe. The fracture was then reduced and held in place with the probe. Knee extension was helpful in maintaining reduction.

If the fracture consisted of one large fragment, a spinal needle was used to...
identify the best position from which to place the fixation pins. Generally, this was from the medial or lateral border of the patella. A small incision was made and arthroscopic Orthosorb absorbable PDS pins (Johnson & Johnson, Raynham, Mass) were placed around the periphery of the fracture fragment. The pins were left 2 mm proud to ensure purchase on the fragment. Because of their anterior and peripheral position, pin impingement in the notch was not a problem.

If the fracture was comminuted, suture fixation was also performed. A 1-cm incision was made over the anteromedial metaphyseal flare of the tibia. An arthroscopic ACL guide was used to place two tunnels up through the medial and lateral aspects of the tibial spine fragment. Care was taken to start the tunnels proximal to the tibial physis. A suture passer was used to place a loop of #1 PDS suture over the fragment. The suture was tied over the bony bridge of the anterior tibia, holding the fracture in reduced position. PDS pins were placed around the fracture perimeter as needed to reinforce the reduction and fixation.

The type of fixation used for each of the five patients is shown in the Table. Pre- and postoperative radiographs for patient 3 are shown in the Figure.

Postoperatively, the first patient was immobilized in 30° of flexion. The subsequent four patients were placed in full extension in a knee immobilizer. Partial weight bearing was allowed for 4 weeks. Patients were then progressed to full weight bearing, using the immobilizer for at-risk activities. Heel slides and straight-
leg raising exercises were started. At 6 weeks, the immobilizer was discontinued and physical therapy was initiated. Return to sports was allowed when range of motion and strength had normalized.

All five patients underwent follow-up and were interviewed by the surgeon. Four patients were examined by the surgeon, whereas one patient was evaluated by a physical therapist. Follow-up evaluation consisted of functional ability, range of motion testing, radiographs, and KT-1000 testing (Medmetric, San Diego, Calif).

RESULTS

Average follow-up was 8.5 years (range: 7.5-9 years). Patients had few functional complaints despite participation in high-demand sports including football, volleyball, basketball, and downhill skiing. When asked to rate their involved knee function on a scale of 0 to 10, with 10 being normal excellent function, four patients rated it as 10 and one patient rated it as 9.

Physical examination revealed full range of motion in all patients except the first treated in this series. She had been immobilized in 30° of flexion postoperatively and exhibited full flexion with a 7° extension deficit at follow-up. Standing anteroposterior and lateral knee radiographs revealed anatomic position of the tibial spine fractures with no evidence of joint space narrowing. Stability was tested with KT-1000 measurements at 20 lbs (Table).

DISCUSSION

Successful treatment of type III tibial spine fractures allows patients to resume their preinjury activities. To accomplish this, knee range of motion and stability must be normalized. Past reports of closed treatment or open reduction of these fractures have shown difficulty in regaining extension and stability. More recent reports have shown the value of arthroscopy in the treatment of these injuries. McLennan found that arthroscopic reduction of these fractures resulted in improved stability when compared with closed treatment. Arthroscopy combined with internal fixation further improved the results.Mah et al showed similar good results using arthroscopy with suture fixation through an incision over the anterior tibia. Mulhall et al described arthroscopic reduction with internal fixation using a screw and washer.

In past series, recession of the tibial spine fragment has been suggested as a means of compensating for potential plastic deformation of the ACL. In this study, an anatomic reduction was the goal with no effort made to recess the fracture fragments. The satisfactory stability results found in this and other series suggest that recession is not necessary in all cases. Perhaps preoperative magnetic resonance imaging, paying special attention to the status of the ACL fibers, would be helpful in deciding whether to recess the tibial spine fragment.

The present study reports a technique of arthroscopic reduction of these fractures combined with absorbable pin fixation of a large tibial spine fracture fragment, or absorbable pin fixation combined with absorbable suture augmentation of a comminuted fracture. This procedure has the benefit of leaving no retained metal in the knee and alleviates the need for any additional surgeries. Immobilization postoperatively should be in full extension. At long-term 8.5-year follow-up, this allowed for normal range of motion with no loss of stability. A successful return to high-demand sporting activities was achieved in all five patients.

An excellent clinical and functional result can be expected with arthroscopic reduction and internal fixation of type III tibial spine fractures. Absorbable pins, with absorbable suture augmentation for comminution, were shown to be effective in maintaining fracture reduction.

REFERENCES