

# Outcomes After Arthroscopic Excision of the Bony Prominence in the Treatment of Tibial Spine Avulsion Fractures

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**Purpose:** The purpose of this study was to determine the outcomes after arthroscopic excision of the bony prominence after a tibial spine avulsion fracture. **Methods:** This study included 7 subjects (5 female and 2 male subjects; mean age, 21.4 years). All subjects underwent preoperative rehabilitation focused on range of motion (ROM) and swelling control. Postoperative rehabilitation focused on regaining symmetric knee hyperextension and flexion. Objective examinations and subjective surveys were obtained at least 1 year after surgery. **Results:** All subjects achieved normal knee extension; 6 patients achieved normal knee flexion, whereas 1 patient had nearly normal flexion. Physical examination showed a negative Lachman test with a firm end point in all patients, and the mean side-to-side difference for the KT-1000 manual maximum test (MEDmetric, San Diego, CA) was 1.3 mm. No subjects required subsequent anterior cruciate ligament reconstruction. All subjects returned to their previous level of activity without instability symptoms. At a mean of 5.7 years after surgery, the mean International Knee Documentation Committee subjective survey score was 90.6 points overall, with 4.7 out of 5 possible points for the instability question. At latest follow-up, the mean ROM was from 6° of hyperextension to 147° of flexion in the involved knee, compared with 6° of hyperextension to 148° of flexion for the noninvolved knee. **Conclusions:** The results of arthroscopic excision of the bony fragment after type II, III, or III+ tibial spine avulsion fracture are positive, with good stability, symmetric ROM, and high subjective scores. Most importantly, this procedure allows patients to regain full, symmetric hyperextension of the knee, avoiding the complications associated with extension loss. **Level of Evidence:** Level IV, therapeutic case series.

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**A** vulsion fracture of the tibial attachment to the anterior cruciate ligament (ACL) is an uncommon injury. Although this injury was initially believed to be almost exclusive to children,<sup>1,2</sup> it also occurs in adults.<sup>3-12</sup> A review of the recent literature shows that the most common treatment is either open or arthroscopically assisted reduction and internal fixation by various methods.<sup>6-8,11-23</sup> However, the best method of treatment for this injury remains contro-

versial,<sup>13,15,24</sup> and loss of range of motion (ROM) has been reported in 10% to 53% of patients after surgical fixation of these fractures.<sup>6,8,11,12,16,17</sup>

A review of the literature found only 2 studies that report excision of the bony prominence as a treatment method for tibial spine avulsion fracture.<sup>25,26</sup> Panni et al.<sup>26</sup> describe a series of 10 cases of malunited or nonunited tibial spine avulsion fractures that were treated with arthroscopic debridement and abrasion of the elevated fragment rather than attempts to reduce the fragment. Postoperatively, all of the patients had a firm end point on Lachman testing, and the mean side-to-side difference for the manual maximum KT-1000 test (MEDmetric, San Diego, CA) was 3.2 mm.<sup>26</sup> Meyers and McKeever<sup>2,25</sup> reported on 4 patients who were treated with excision of the avulsed fragment and had no instability at latest follow-up.

The purpose of this study was to determine the clinical outcomes of patients who were treated with

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arthroscopic excision of the bony prominence after a tibial spine avulsion fracture. The hypothesis was that patients would achieve good ROM, stability, and functional outcomes after arthroscopic excision of the bony prominence, regardless of the fracture type.

## METHODS

This study was approved by the institutional review board at the hospital where surgery was performed, and all patients gave informed consent and/or minor assent to participate in the study. Patients undergoing arthroscopy for the treatment of a tibial spine avulsion fracture between 1992 and 2008 were included in this study. Patients were excluded from this study if objective follow-up was not obtained for at least 1 year after surgery. Subjective follow-up was obtained at least 2 years after surgery for all patients.

Data were prospectively collected regarding patient demographics, mechanism of injury, details of the surgery and rehabilitation, knee ROM, KT-1000 arthrometer testing, and scores from the International Knee Documentation Committee (IKDC) subjective survey. ROM was measured in degrees with a goniometer, and measurements were recorded as hyperextension lack of extension from 0° flexion. ROM was graded as normal, nearly normal, abnormal, or severely abnormal based on IKDC criteria (Table 1). Bilateral posteroanterior, lateral, and Merchant view radiographs were obtained for all subjects before and after surgery. The fracture type was graded according to the classification of Meyers and McKeever<sup>25</sup>: type I fractures are minimally displaced, type II fractures remain attached posteriorly but have more extensive displacement than type I, type III fractures are completely separated from the bone bed, and type III+ fractures are completely separated with rotation of the avulsed fragment.

Before surgery, all subjects underwent rehabilitation to improve knee extension and reduce the effu-

sion. The goal was to achieve hyperextension symmetric to the opposite knee. Rehabilitation continued until extension ROM progress reached a plateau. If full, symmetric hyperextension could not be achieved with rehabilitation, surgical intervention was planned to excise the elevated bony fragment. However, any patients who were able to regain full hyperextension and flexion ROM symmetry with rehabilitation did not undergo surgery and were therefore not included in this study. If instability became a problem after arthroscopic excision of the bony fragment, ACL reconstruction would be considered. The treatment algorithm used for patients diagnosed with tibial spine avulsion fractures is shown in Fig 1.

## Surgical Technique

All patients were examined under general anesthesia for stability. Arthroscopic examination was performed to evaluate the extent of the avulsion fracture and the status of the ACL, menisci, and articular cartilage. Arthroscopic excision of the displaced bony fragment was performed beginning with gradual excision of the anterior portion of the bony fragment. Any fibers of the ACL that were attached to the bony fragment were sharply resected off of the bone with a banana knife and electrocautery. Excision of the fragment continued until no further impingement was noted with full hyperextension of the knee. The posterior footprint of the ACL insertion appeared normal in all subjects and was left alone. With the knee in full hyperextension, the anterior fibers of the ACL were observed to make solid contact with the tibia, indicating that retraction of the ligament had not occurred. This surgical technique was used for all patients in this study, regardless of the fracture type.

A light dressing, anti-embolism stockings, and a cold/compression device (Cryo/Cuff; DJO, Vista, CA) were applied to the knee immediately after surgery. A continuous passive motion machine was used to elevate the leg above the level of the heart to help prevent a hemarthrosis postoperatively. Subjects remained in the hospital overnight to allow for immediate rehabilitation and a continuous intravenous drip of ketorolac for inflammation and pain control.

## Postoperative Rehabilitation

All subjects remained on bed rest with the knee elevated above the level of the heart in the continuous passive motion machine and a cold/compression device on their knee for the first 3 to 5 days after surgery. Subjects were permitted to ambulate with full weight

**TABLE 1.** Rating of Knee ROM According to IKDC Criteria

IKDC Rating	Extension Difference (°)	Flexion Difference (°)
Normal	≤2	≤5
Nearly normal	3-5	6-15
Abnormal	6-10	16-25
Severely abnormal	>10	>25

NOTE. The difference in ROM is compared with the opposite, normal knee to include the evaluation of hyperextension.

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