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Original Research Article

Prospective Outcome Assessment of Arthroscopic Suture Pulls out Fixation of Displaced Tibial Spine Avulsion Fracture

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Abstract

Aim: The aim of the present study was to evaluate functional outcome of arthroscopic suture pull out fixation of displaced tibial spine avulsion.

Methods: The prospective study was conducted in the Orthopaedics, institute of medical sciences BHU, Varanasi, Uttar Pradesh, India , for the period of six months with a sample size of 50 who are fulfilling the inclusion criteria.

Results: The mean age of subjects was 27.13 ± 10.298 years. The majority of subjects were in the age group 21 to 30 years (40%). In the study, 80% were males and 20% were females. In the study 6% had Fall from the cycle, 74% had fallen from Motorbike and 20% had Fall While Playing. The study Status of Physis was closed in 70% and open in 30%. In the study 72% had Type III and 28% had Type IV Meyers and McKeever's classification. At 3 months, the mean Post op Lysholm score was 86.07 ± 1.760, at 6 months was 97.87 ± 2.047 and at 12 months was 98.17 ± 1.599. There was a significant increase in Post op Lysholm score at 6 months and 12 months. At 12 months, when compared to 6 months Post op Lysholm score, there was no significant increase in Post op Lysholm score. In the study 6% had Post Op Knee Stiffness.

Conclusion: The goal of the treatment should be an anatomic reduction to restore joint congruity. This technique of arthroscopic fixation with transosseous sutures is very useful in treating these fractures. Approaching these injuries arthroscopically allows for complete inspection of the joint and dealing with associated injuries, early mobilization, fast rehabilitation, and decreased hospital stay.

Keywords: Tibial spine avulsion, pull-out suture, mayers and mckeever

Introduction

Anterior tibial spine fractures are relatively rare with an incidence of approximately 3/100,000/year. [1] They are believed to be more common in children and adolescents, [2,3] but recent literature suggests that the incidence in adults may be higher than previously thought. [4] As the tibial spine is the site of anterior cruciate ligament (ACL) attachment, tibial spine avulsion may be associated with ACL insufficiency.

Concomitant injury to a collateral ligament and menisci may also occur, and there is evidence that associated injuries are common in adults. [5]

Interestingly, the outcome of arthroscopic fixation in children and adolescents is usually satisfactory, but the results in adults are less predictable. [7] Hunter and Willis [8] found that the younger the patient is, the better the outcome after arthroscopic fixation for tibial eminence fracture. In literature, the reported complication of tibial spine fracture includes anterior knee instability, extension loss, quadriceps weakness, and chondromalacia. [6,9] Although arthroscopic treatment has the advantage of early mobilization and reduced hospital stay. [7,9] Berg [10] reported 2 cases in which postoperative arthrofibrosis developed, and Montgomery et al. [11] reported that 9 of 17 patients (53%) had severe difficulty in regaining motion postoperatively. Osti et al. [12] studied 10 patients and found no extension deficit but reported a rate of laxity of 30% (3 of 10 patients) with fair or poor results. On the other hand, Zhao and Huangfu [13] treated 18 patients with ununited ACL tibial avulsion fracture with arthroscopic suture fixation and reported no cases of arthrofibrosis or instability. Similar results were reported by other authors as well. [7,14]

Tibial spine or anterior cruciate ligament (ACL) bony avulsion is, usually, a result of low-velocity injuries, such as fall from a bicycle or motorcycle and sports. It occurs when an axially loaded knee undergoes hyperextension, and the femur rotates externally. [15] It is important to reduce accurately and fix type III and IV fractures and prevent such complications. Although Shelbourne et al recommend excision of displaced avulsed fragment and report good result, [16] we believe that displaced tibial spine fractures are best treated with fixation because the native ACL has mechanoreceptors for proprioception and neuromuscular control. [17] Meyers and McKeever classified avulsion into three types,2 Type I as undisplaced, type II as partially displaced with an intact posterior hinge, type 3 as completely displaced. Zaricznyi proposed a fourth category for comminuted avulsed fragments. [18] A complication of such untreated and displaced type III and type IV avulsion fracture include nonunion and malunion, which may lead to significant disability in the form of flexion deformity, loss of extension, instability.

The aim of the present study was to evaluate functional outcome of arthroscopic suture pull out fixation of displaced tibial spine avulsion.

Materials and Methods

The prospective study was conducted in the Department of Orthopaedics, institute of medical sciences BHU, Varanasi, Uttar Pradesh, India. for the period of six months with a sample size of 50 who are fulfilling the inclusion criteria.

Inclusion criteria

1. Pain and disability resulting from tibial spine avulsion inactive patient type II, type III and type IV
2. Age: < 60 years
3. The patient must able to use crutches / walker
4. The patient should have sufficient muscle strength and motivation to carry out a rehabilitation program
5. Closed injuries.
6. Ability to understand the content of the subject information / informed consent form and to be willing to participate in the clinical investigation.
7. Written informed consent

Exclusion criteria

1. Type I tibial spine avulsion according to Meyers and McKeever classification
2. Associated with Proximal tibia fracture
3. Associated with Multiple ligaments injuries

4. Present or past history of inflammatory arthritis
5. Open injuries
6. Previous operated or infected knee for any reason

Surgical Technique

Diagnostic arthroscopy was performed under spinal or general anesthesia through the standard anterolateral portal. The joint and fracture bed was cleared of hematoma using continuous irrigation. Then, the standard anteromedial portal was established. Chondral and meniscal injuries were assessed and managed as per established guidelines. The tibial spine avulsion was identified, and the type of fracture was confirmed by probing. Next, 1-inch-long skin incision was made parallel and medial to the tibial tuberosity. The remaining dissection was done with care to arrive up to the periosteum protecting the pes anserinus tendons and underlying medial collateral ligament. The tip of the ACL tibial guide was subsequently placed via an anteromedial (AM) portal on the medial-most edge and at the equator of the avulsion crater. Next, a tibial tunnel was drilled using a 1.8 mm K-wire. Once the K-wire tip was visualized emerging out at the crater edge, the tibial guide was disengaged and the K-wire was left in situ. A similar step was performed for the lateral edge of the crater with another K-wire keeping 1 cm of the bone bridge intact between two tunnels over the tibia. Once the needle tip was visualized on the lateral side of ACL, the PDS suture was advanced through the lateral PDS loop. The advanced end of the PDS was pulled out of the joint via AM portal using an arthroscopic grasper. Frequently, the suture grasper was used to pull the PDS out of the lateral loop in a case where it did not enter into the lateral loop. A similar step was repeated by taking a bite through the anterior third of the ACL substance, and PDS was pulled out via AM portal. Next, the shuttling technique replaced the two PDS sutures by ethibond. Then, the needle and PDS loops were pulled out of the tunnel, which further pulls the ethibond sutures out of the joint through the tibial tunnels. Ethibond sutures were tied one by one over the bone bridge or suture button keeping the knee in 30-degree flexion.

Statistical Analysis

All statistical analysis was performed using IBM SPSS Statistics software (version 16.0; IBM, Armonk, NY). Frequency was used to determine the descriptive statistics for categorical variable (sex, side of injury, and Meyer and McKeever type of fracture), whereas descriptive statistics were used to describe the continuous variables (age, follow-upmonths, IKDC and Lysholm scores, and KT-1000 readings). Independent sample t-test was used to compare various groups and functional scores.

Results

Table 1: Age, Gender, Mode of trauma and Status of Physis distribution

Age in years	**N%**
18 to 20 years	16 (32)
21 to 30 years	20 (40)
31 to 40 years	8 (16)
>40 years	6 (12)
Gender	
Male	40 (80)
Female	10 (20)
Mode of trauma	
Fall from Cycle	3 (6)
Fall from Motorbike	37 (74)

Fall While Playing	6 (20)
Status of Physis	
Closed	35 (70)
Open	15 (30)

The mean age of subjects was 27.13 ± 10.298 years. The majority of subjects were in the age group 21 to 30 years (40%). In the study, 80% were males and 20% were females. In the study 6% had Fall from the cycle, 74% had fallen from Motorbike and 20% had Fall While Playing. The study Status of Physis was closed in 70% and open in 30%.

Table 2: Meyers and McKeever's classification and Post op Lysholm score distribution

Meyers and McKeever's classification	**N%**	
Type III	36 (72)	
Type IV	14 (28)	
Post op Lysholm score (n=50)	**Mean±SD**	**P value**
3 months	86.07 ±1.760	-
6 months	97.87 ±2.047	<0.001
12 months	98.17±1.599	<0.001

In the study 72% had Type III and 28% had Type IV Meyers and McKeever's classification. At 3 months, the mean Post op Lysholm score was 86.07 ± 1.760, at 6 months was 97.87 ± 2.047 and at 12 months was 98.17 ± 1.599. There was a significant increase in Post op Lysholm score at 6 months and 12 months. At 12 months, when compared to 6 months Post op Lysholm score, there was no significant increase in Post op Lysholm score.

Table 3: Complications

Complications	**N%**
Nil	47 (94)
Post Op Knee Stiffness	3 (6)

In the study 6% had Post Op Knee Stiffness.

Discussion

Tibial eminence fractures commonly occur in children and adolescents and are less common in skeletally mature individuals.[19,20] In adults the treatment option for displaced tibial eminence fractures are, suture or hardware fixation of the avulsed fragment and ACL reconstruction. Native ACL should be retained so as to maintain the proprioceptive function and neuromuscular control provided by the presence of mechanoreceptors in ACL.[21] Both sutures and hardware fixation techniques have been studied in cadavers. Tsukada et al.[22] found that there was significantly greater anterior translation after cyclic loading in fractures stabilized with pullout suture fixation compared with antegrade screw fixation. Bong et al.[23] reported that the initial ultimate strength was higher with 3 No. 2 fiber wire sutures than with a 4 mm × 40 mm partially threaded cannulated screw with washer, whereas Eggers et al.[24] in a procine model, found that under cyclic loading, suture fixation provides greater strength then screw fixation.

The most significant finding of our study, which concurs with the available literature, is that suture pull-out fixation of displaced ACL avulsion from tibia utilizing an I.V. cannula needle gives excellent results in all age groups (skeletally immature and mature) without any significant

complications. The mean subjective Lysholm scores reported in our series in all age groups and all types of fractures (McKeever type III and IV) were similar to the ones written by other authors who used the suture pull-out technique to fix ACL bony avulsion, suggesting that arthroscopic suture fixation provides excellent clinical outcome after ACL bony avulsion. [25]

The I.V. cannula needle used in all our cases is readily available in all operating rooms. The diameter of the 18 gauge I.V. cannula needle is quite narrow to damage the ACL substance even if the bite has to be repeated. It is also easy to take a bite from the medial to the lateral side of the ACL in a straight line, and it does not require the use of complex maneuver inside the knee joint. [26] The majority of the patients reported in our series were males (40 cases; 80%). However, we believe that this factor may have no clinical relevance. The mean age of subjects was 27.13 ± 10.298 years. The majority of subjects were aged 21 to 30 years (40%). ACL avulsion is more common in children than adults (3:2) because of the relatively unossified state of the tibial eminence and the highly elastic nature of ACL. [27] In our study Status of Physis was closed in 70% and open in 30%. In the study, there was no significant difference in the mean Post op Lysholm score with respect to the Status of Physis at 3 months, 6 months and 12 months. There can be associated injuries to menisci, cartilage, capsule, and MCL in up to 59% of the patients in the children and adolescent age group. [28] Meniscal tear is the most frequently associated intraarticular pathology along with tibial spine avulsion.

Displaced ACL tibial avulsion fractures result in anterior knee instability and occasionally in loss of knee extension. [29] Therefore, surgical treatment is recommended for all Meyers and McKeever type III and IV fractures and should be considered in all cases of displaced type II fractures.in our study 72% had Type III and 28% had Type IV Meyers and McKeever's classification. [30] In the study there was no significant difference in the mean Post op Lysholm score with respect to Meyers and McKeever's classification at 3 months, 6 months and 12 months.

The postoperative laxity is attributed to an initial stretch of ACL before giving away at the tibial attachment site, unrecognized intra-substance tears, and improper anatomical reduction. [30] Even though literature reports suggest increased postoperative laxity up to 6 mm in 10 to 20% of the patients treated with tibial spine fixation, we did not find such increased laxity tendency in our patients. [31] Postoperative stiffness of the knee is the most common complication observed in many series, and is because of arthrofibrosis or mechanical impingement of displaced bony fragment. However, recently many authors report the minimal incidence of arthrofibrosis after arthroscopic rigid fixation and early mobilization within 2 to 4 weeks, indicating that early mobilization can reduce the rate of arthrofibrosis and improve the outcome. [32] In our study, 6% had postoperative knee stiffness who recovered completely after arthroscopic adhesiolysis. Also, we did not find any growth disturbance or deformity in our series of patients with open physis following the pull-out suture technique. [33]

Conclusion

The goal of the treatment should be an anatomic reduction to restore joint congruity. This technique of arthroscopic fixation with transosseous sutures is very useful in treating these fractures. Approaching these injuries arthroscopically allows for complete inspection of the joint and dealing with associated injuries, early mobilization, fast rehabilitation, and decreased hospital stay.

Suture fixation has the advantages of being more versatile and biomechanically superior to screw fixation and has the ability to fix not only isolated large but also small and comminated fractures and to incorporate the ACL into the fixation structure. Also, there is minimal risk of damage to the epiphyseal plate in children, and there is no need for hardware removal. Furthermore, sutures allow for stable fixation and aggressive early rehabilitation. Arthroscopic suture fixation uniformly leads to excellent outcomes.

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