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Arthroscopic suture pulls out fixation of displaced tibial spine avulsion fracture: Prospective outcome assessment study

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Abstract
Aim: The present study was conducted to assess the functional outcome of arthroscopic suture pull out fixation of displaced tibial spine avulsion fracture.
Methods: The present prospective study was conducted in the Department of Orthopedics, ACS medical college and hospital, India, over a period of two year with a sample size of 50.
Results: 50 patients with tibial spine avulsion were operated on with arthroscopic pull out suture technique. The majority of subjects were in the age group 18 to 30 years (60%).In the study, 80% were males and 20% were females.
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: Arthroscopic suture pull out fixation, tibial spine avulsion fracture

Introduction
Anterior tibial spine fractures are relatively rare with an incidence of approximately 3/100,000/year [1]. Anterior cruciate ligament (ACL) avulsed mostly from tibial attachment. According to Meyers and McKeevers classification [2] these injuries can be classified in to 3 types. Type 1: minimal or no displacement and is usually treated conservatively; Type 2: partially displaced, where posterior hinge attached to tibia and only anterior fragment avulsed and superiorly displaced, showing as beak in lateral X-ray. Type 3: complete fragment elevation anteriorly and posteriorly; it has two sub types Type 3a: involves small portion of eminence Type 3b: involves the majority of the eminence. Type 4: displaced, comminuted fracture and type 4 added by Zariczynj [3].
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 [4].
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. Hence it is important to reduce accurately fix type III and type IV and prevent complication [6].
Interestingly, the outcome of arthroscopic fixation in children and adolescents is usually satisfactory, but the results in adults are less predictable [7]. Hunter and Willis8 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 [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.

The present study was conducted to assess the functional outcome of arthroscopic suture pull out fixation of displaced tibial spine avulsion fracture.

Methods

The present prospective study was conducted in the Department of Orthopaedics, ACS medical college and hospital, India over a period of two year with a sample size of 50.

Inclusion criteria

Patients who had pain and disability resulting from tibial spine avulsion inactive patient type II, type III and type IV, Age: < 60 years, the patient must be able to use crutches / walker, the patient should have sufficient muscle strength and motivation to carry out a rehabilitation program, closed injuries were included in the study.

Exclusion criteria

Patients with Type I tibial spine avulsion according to Meyers and McKeever classification, associated with Proximal tibia fracture, associated with Multiple ligaments injuries, present or past history of inflammatory arthritis, open injuries, previous operated or infected knee for any reason were excluded from the study.

Methodology

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.

Results

Table 1: Age and gender distribution of subjects

Age group (years)	N (%)
18-30	30 (60%)
31-40	12 (24%)
>40 years	8 (16%)
Total	50 (100)
Gender	**N (%)**
Male	40 (80%)
Female	10 (20%)
Total	50 (100)

Total 50 patients with tibial spine avulsion were operated on with arthroscopic pull-out suture technique. The majority of subjects were in the age group 18 to 30 years (60%).In the study, 80% were males and 20% were females.

Table 2: Mode of trauma distribution

Mode of trauma distribution	N (%)
Fall from Cycle	5 (10%)
Fall from Motorbike	30 (60%)
Fall While Playing	15 (30%)
Total	50 (100)

10% had fall from the cycle, 60% had fallen from motorbike and 30% had fall while playing.

Table 3: Status of Physics distribution

Status of Physics distribution	N (%)
Closed	32 (64%)
Open	18 (36%)
Total	50 (100)

Status of Physics in 64% was closed and opens in 36%.

Table 4: Meyers and McKeever's classification distribution

Meyers and McKeever's classification distribution	N (%)
Type III	35 (70%)
Type IV	15 (30%)
Total	50 (100)

In the study 70% had Type III and 30% had Type IV Meyers and McKeever's classification.

Table 5: Post op Lysholm score distribution

Post op Lysholm score	Mean±SD	p-value
3 months	86.14±1.46	<0.001
6 months	96.84±2.05	<0.001
9 months	96.14±1.36	<0.001

At 3 months, the mean Post op Lysholm score was 86.14±1.46, at 6 months was 96.84±2.05 and at 12 months 96.14±1.36. 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 6: Complication distribution

Complication	N(%)
Nil	46 (92%)
Post Op Knee Stiffness	4 (8%)
Total	50 (100)

8% subjects had Post Op Knee Stiffness.

Discussion

Tibial eminence fractures commonly occur in children and adolescents and are less common in skeletally mature individuals [13, 14]. 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 [15]. Both sutures and hardware fixation techniques have been studied in cadavers.

Although variety of implants (screws, staples, wires, anchors, and sutures) have been used for arthroscopic fixation of tibial spine, but currently arthroscopic suture pull-out fixation seems to be the most preferred fixation method in all age groups [16, 17].

In the present study, The majority of subjects were in the age group 18 to 30 years (60%). In the study, 80% were males and 20% were females. 10% had fall from the cycle, 60% had fallen from motorbike and 30% had fall while playing. Status of Physics in 64% was closed and opens in 36%. In the study 70% had Type III and 30% had Type IV Meyers and McKeever's classification. At 3 months, the mean Post op Lysholm score was 86.14±1.46, at 6 months was 96.84±2.05 and at 12 months 96.14±1.36. 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. 8% subjects had Post Op Knee Stiffness.

Tsukada *et al*. studied that there was significant anterior translation with cyclic loading in fractures treated with pullout suture compared with screw fixation [18]. On the contrary, Bong *et al*., in their study of screw versus pull out suture fixation concluded that fibre wire fixation was stronger than screw fixation [19].

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 comminuted fractures and to incorporate the ACL into the fixation structure. Furthermore, sutures allow for stable fixation and aggressive early rehabilitation. Arthroscopic suture fixation uniformly leads to excellent outcomes.

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