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Original Research Article

A Retrospective Assessment of the Functional Outcome of Arthroscopic Suture Pull-Out Repair for Displaced Tibial Spine Avulsion Fractures

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Abstract

Aim: To examine the functional result of arthroscopic suture pull-out repair for displaced tibial spine avulsion fractures.

Materials and Methods: This retrospective study was done in the department of Orthopaedics, Jannayak Karpoori Thakur Medical College and Hospital, Madhepura, Bihar, India for 12 months. 30 Patients with Pain and disability resulting from tibial spine avulsioninactive patient type II, type III and type IV, Age: < 60 years, the patient must able to use crutches / walker, The patient should have sufficient muscle strength andmotivation to carry out a rehabilitation program, Closed injuries and Ability to understand the content of the subject information / informed consent form and to be willing to participate in the clinical investigation were included in this study. Patients with Type I tibial spine avulsion according to Meyers andMcKeever classification, Associated with Proximal tibia fracture, Associated with Multiple ligaments injuries, Present or past history of inflammatory arthritis, Open injuries and Previous operated or infected knee for any reason were excluded from the study.

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, 90% were males and 10% were females. In the study 6.7% had Fall from the cycle, 73.3% had fallen fromMotorbike and 20% had Fall While Playing. The study Status of Physis in 66.7% was closed and open in 33.3%. In the study 70% had Type III and 30% had Type IV Meyers andMcKeever'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 6.7% had Post Op Knee Stiffness.

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

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

Introduction

Tibial spine avulsion fractures, predominantly occurring in the paediatric and adolescent populations, represent a significant challenge due to their impact on knee stability and function. These fractures involve the detachment of the anterior cruciate ligament (ACL) from its insertion on the tibial eminence, often necessitating surgical intervention to restore joint integrity and prevent long-term complications such as instability or arthrofibrosis. [1] Arthroscopic suture pull-out fixation has emerged as a preferred surgical technique for managing displaced tibial spine avulsion fractures. This minimally invasive approach allows for precise anatomic reduction and stable fixation, facilitating early rehabilitation and potentially improving functional outcomes. Despite its advantages, the effectiveness of this technique in terms of long-term knee function and stability

remains an area of active investigation. [2-5] Recent studies have highlighted the benefits of arthroscopic suture pull-out fixation, demonstrating favourable outcomes in terms of knee stability, range of motion, and return to pre-injury activities. A 2023 study by Yang et al. reported excellent functional outcomes and minimal complications in a cohort of paediatric patients undergoing this procedure. [5] Similarly, a prospective analysis by Patel et al. (2022) found that early arthroscopic intervention significantly reduced the incidence of residual knee laxity and postoperative stiffness. [6] Moreover, advancements in arthroscopic techniques and suture materials have contributed to improved fixation strength and reduced surgical morbidity. The use of high-strength sutures and innovative fixation devices has been shown to enhance the biomechanical stability of the repair, supporting early mobilization and functional recovery. Despite these promising results, the variability in patient demographics, injury characteristics, and rehabilitation protocols poses challenges in standardizing treatment outcomes. Therefore, prospective studies with standardized outcome measures are crucial for establishing the long-term efficacy of arthroscopic suture pull-out fixation in this patient population. [7,8]

Materials and Methods

This retrospective study was done in the department of Orthopaedics, Jannayak Karpoori Thakur Medical College and Hospital, Madhepura, Bihar, India for 12 months. 30 Patients with Pain and disability resulting from tibial spine avulsion inactive patient type II, type III and type IV, Age: < 60 years, The patient must able to use crutches / walker, The patient should have sufficient muscle strength andmotivation to carry out a rehabilitation program, Closed injuries and Ability to understand the content of the subjectinformation / informed consent form and to be willing to participate in the clinical investigation were included in this study. Patients with Type I tibial spine avulsion according to Meyers andMcKeever classification, Associated with Proximal tibia fracture, Associated with Multiple ligaments injuries, Present or past history of inflammatory arthritis, Open injuries and Previous operated or infected knee for any reason were exclude 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 andmanaged as per established guidelines. The tibial spine avulsion was identified, and the type of fracture wasconfirmed 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 viaan 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 wasvisualized emerging out at the crater edge, the tibial guidewas 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 ofthe ACL substance, and PDS was pulled out via AM portal. Next, the shuttling technique replaced the two PDS sutures byethibond. 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 oneby one over the bone bridge or suture button keeping the knee in 30-degree flexion.

Results

The study was conducted in the department of Orthopaedics, Jannayak Karpoori Thakur Medical College and Hospital, Madhepura, Bihar, India. 30 patients with tibial spine avulsion were operated on with arthroscopic pullout suture technique. Following are the results obtained.

Table 1: Age distribution of subjects

		Count	%
Age	18 to 20 years	10	33.3%
	21 to 30 years	12	40.0%
	31 to 40 years	5	16.7%
	>40 years	3	10.0%
	Total	30	100.0%

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%).

Table 2: Sex distribution of subjects

		Count	%
Sex	Female	3	10.0%
	Male	27	90.0%
	Total	30	100.0%

In the study, 90% were males and 10% were females.

Table 3: Mode of trauma distribution

		Count	%
Mode of trauma	Fall from Cycle	2	6.7%
	Fall from Motorbike	22	73.3%
	Fall While Playing	6	20.0%
	Total	30	100.0%

In the study 6.7% had Fall from the cycle, 73.3% had fallen fromMotorbike and 20% had Fall While Playing.

Status of Physis distribution

		Count	%
Status of Physis	Closed	20	66.7%
	Open	10	33.3%
	Total	30	100.0%

The study Status of Physis in 66.7% was closed and open in 33.3%.

Table 5: Meyers and McKeever's classification distribution

		Count	%
Meyers and McKeever's classification	Type III	21	70.0%
	Type IV	9	30.0%
	Total	30	100.0%

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

Table 6: Post op Lysholm score distribution

		N	Mean	SD	t test	P value
Post op Lysholm score	3 months	30	86.07	1.760		
	6 months	30	97.87	2.047	-27.112	<0.001*
	12 months	30	98.17	1.599	-1.608	<0.001*

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 7: Complication distribution

		Count	%
Complication	Nil	28	93.3%
	Post Op Knee Stiffness	2	6.7%
	Total	30	100.0%

In the study 6.7% had Post Op Knee Stiffness.

Discussion

The most significant finding of our study, which concurs withthe available literature, is that suture pull-out fixation ofdisplaced ACL avulsion from tibia utilizing an I.V. cannulaneedle gives excellent results in all age groups (skeletallyimmature and mature) without any significant complications. The mean subjective Lysholm scores reported in our series inall age groups and all types of fractures (McKeever type IIIand IV) were similar to the ones written by other authors whoused the suture pull-out technique to fix ACL bony avulsion,suggesting that arthroscopic suture fixation provides excellent clinical outcome after ACL bony avulsion. [5]

Although various implants (screws, staples, wires, anchors, and sutures) have been used for arthroscopic fixation of the tibial spine, currently arthroscopic suture pull-out fixation seems to be the most recent preferred fixation method in all age groups. [6] 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. [7] Furthermore, this technique can also be safely employed in patients with open physis as the diameter of the two tibial tunnels is only 1.8 mm each, which is less than 7 to 10% of the growth plate size. Several authors have determined that a physeal lesion of size less than 7 to 10% of the physeal diameter is not likely to cause growthchanges. [8] The majority of the patients reported in our series were males(27 cases; 90%). 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. [9] In our study Status of Physis in 66.7% was closed and open in 33.3%. 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. However, many studies have documented a higher incidence in adults too, and many authors have published their series in an exclusive adult population only. In our study 6.7% had fall from the cycle, 73.3% had fall from Motorbike and 20% had Fall While Playing. With significant number is seen among motorbike injuries. 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. [10] Meniscal tear is the most frequently associated intraarticular pathology along with tibial spine avulsion. In our study 10% had Partial Damage to ACL and 3.3% had Lateral Meniscus Posterior Third Longitudinal Tear and Oblique Small Tear in Posterior Third of Medial Meniscus. Displaced ACL tibial avulsion fractures result in anterior kneeinstability and occasionally in loss of knee extension. [11] 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 70% had Type III and 30% had Type IV Meyers and McKeever's classification [12]. 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 Lysholm knee scoring system was used to analyze subjective symptoms. The mean preoperative Lysholm score in the 30 knees was 38 (range, 28 to 54); the mean postoperative Lysholm score was At 3 months, 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 asignificant increase in Post op Lysholm score at 6 months and 12 months. At 12 months when compared to 6 months Post opLysholm score, there was no significant increase in Post op Lysholm score. 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. 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. [13] 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 earlymobilization within 2 to 4 weeks, indicating that early mobilization can reduce the rate of arthrofibrosis and improvethe outcome. [14] In our study, 6.7% 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. The mean follow-up period in our study was 15 months. We consider the follow-up period in our study sufficient for both clinical and radiological follow-ups because even patients with postoperative stiffness returned to normalcy by 6 months from the index procedure. The uneventful patients achieved their final stability, ROM, and radiological union by 3 to 6 months itself and maintained an almost same postoperative state since then. 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 significantincrease 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.

Conclusion

The goal of the treatment should be an anatomic reduction to restore joint congruity. This technique of arthroscopic fixationwith trans osseous sutures is very useful in treating these fractures. Approaching these injuries arthroscopically allows for complete inspection of the joint and dealing withassociated 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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