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Functional outcome of acute tibial eminence fractures treated with arthroscopic assisted pull-through suture technique: A prospective case series

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Abstract
Background and Objective: There is an increased incidence of tibial eminence fractures in skeletally mature adults due to increased road traffic accidents and participation in sports activities (reference). The study has been undertaken to evaluate the functional outcome of acute tibial eminence fractures treated arthroscopically with a pull-through suture technique.
Methods: This study included thirty-one patients with acute tibial eminence fractures treated arthroscopically between November 2019 and March 2021. All the fractures were fixed using a pull-through suture technique and tied over the suture disc.
Results: Among the thirty-one patients treated, the most common cause of injury was a road traffic accident, followed by sports injuries. Two patients were injured due to a kick by the bull. In sports injuries, Kabaddi was the most prevalent cause of anterior cruciate ligament damage. Males made up 29 (94%) cases, while females made up just 2 (6%). The majority of the patients were between the ages of 40 and 49 (45 per cent). 64.5 per cent of patients (n=20) had surgery within five days of their accident. In our study, the mean preoperative IKDC scores were 50.94, and the mean postoperative IKDC scores were 87.73, indicating a considerable improvement. The mean pre-operative Lysholm score was 60.1, and postoperative Lysholm scores were 91.5. One patient had five degrees of extensor lag, and one patient had a fixed flexion deformity at ten degrees due to poor compliance to rehabilitation. Patients showed significant improvement by the end of 3 months and were allowed to return to daily activities by the end of 3 months and sports by six months. The percentage of patients who ended up having good to excellent outcomes is 83.8 and the percentage of patients returning to pre-injury level is 70.
Conclusion: Treating acute tibial eminence fractures with an arthroscopic pull-through suture technique gives good rigid fixation and improves the functional outcome.

Keywords: Tibial eminence, pull-through suture, suture disc

Introduction
Acute tibial eminence fractures are common in the pediatric age group and are relatively uncommon in skeletally mature patients, with an annual incidence of about 3/100,000 [1].
A rise in the frequency of road traffic accidents and increased participation in sports activities has increased the incidence of knee ligamentous injuries.
If not treated surgically, the avulsions of the ACL results in nonunion and instability.
Although Shelbourne *et al*. recommend excision of displaced avulsed fragments and report good results [2], but displaced avulsed fragments are better treated with re-fixation because the native ACL is needed for proprioception and neuromuscular control [1].
Arthroscopy assisted fixation allows early mobilization and a shorter hospital stay [3].
We hypothesize, that the arthroscopic suture pull-through technique as a fixation method for tibial eminence fractures in adults will adequately restore knee stability, improves the outcome and return to preinjury status.

Materials and Methods
This study was done from November 2019 to March 2021 prospective research was done at Shri BM Patil Medical College, and BLDEDU deemed to be University, Vijayapura.

The study comprised 31 patients, 29 of whom (94%) were male, and two (6%) were female. Eighteen patients (58%) had injuries to their right knees, whereas 13 (42%) had injuries to their left knee adhering to inclusion and exclusion criteria.

Routine radiographs of both knees were obtained in the A-P and lateral views of the afflicted knee. All anterior cruciate ligament avulsion cases were confirmed using an MRI of the knee. (Figures 1.1 and 1.2)

Patients included were adult skeletally mature patients (age 18 years and above) with an acute tibial eminence fracture which could be classified under Meyers and McKeevers grade III and grade IV [4] without any associated ligamentous injury. (Figure 2)

All open knee injuries, multi ligamentous injuries and cases having associated meniscal lesions were excluded from the study.

All the patients were with arthroscopic assisted pull-through suture technique.

Postoperatively the patients were regularly followed up for an average of 13 months, ranging from 6 months to 18 months.

The International Knee Documentation Committee (IKDC) score and Lysholm Knee Scoring Scale were used to determine the postoperative outcomes.

Complications were noted for residual laxity, instability, pain during walking and any residual flexion or extension deformities.

Fig 1.1: Plain radiograph of the right knee showing tibial eminence fracture in an Antero-posterior and lateral radiograph

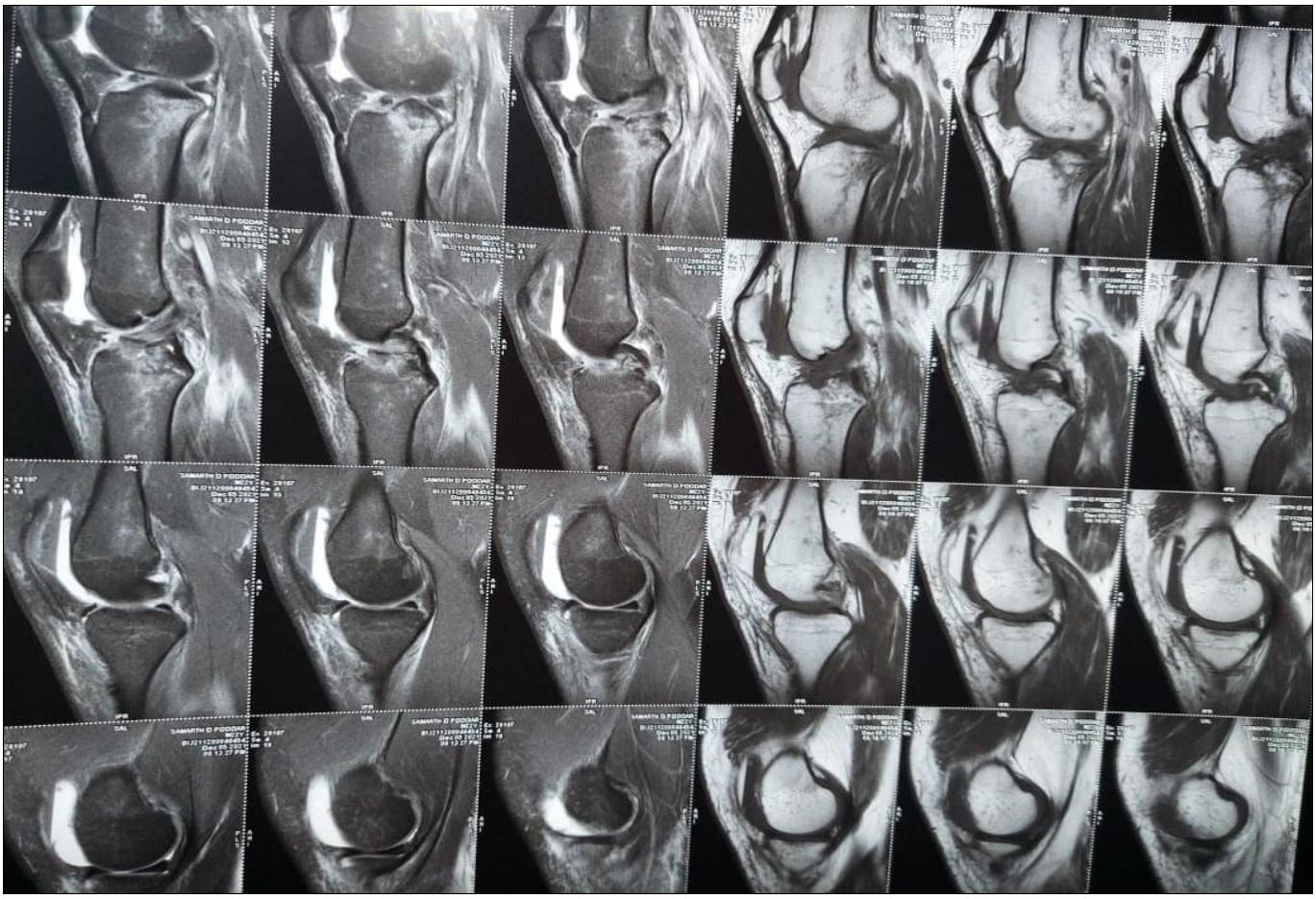


Fig 1.2: Sagittal MRI image showing an avulsed bony fragment of the tibial eminence from the anterior cruciate ligament attachment base.

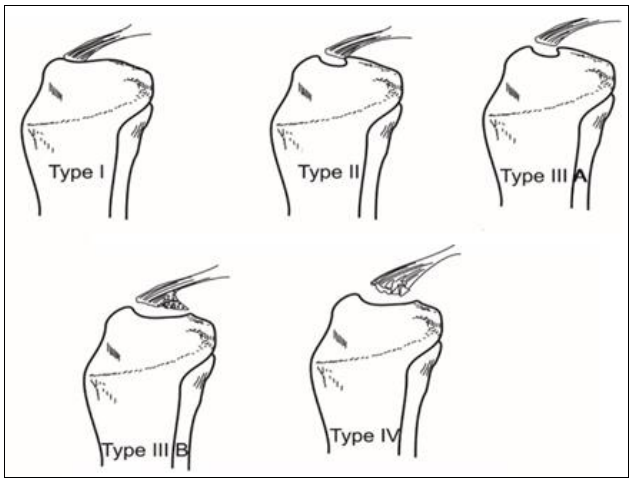


Fig 2: Meyer's and McKeever's classification of tibial eminence fractures

Operative Technique

Clinical examination under anaesthesia was done. (Figure 3)

The patient was placed in a supine position with the affected leg in the leg holder with a knee at 90° of flexion under tourniquet control. (Figure 4)

Arthroscopic views were obtained from standard anteromedial and anterolateral portals.

Fracture hematoma was evacuated to improvise the visualization (figure 5).

This was followed by identifying the fracture site at the base of the tibial eminence. The fracture fragment was adequately cleaned with the help of a shaver burr and the interposed soft tissue. The transverse ligament is prevented from getting entrapped in the fracture, and interrupted tissue is removed (Figure 6).

In the instance of comminuted fractures, the trial reduction was made using a probe or a blunt trocar. (Figure 7)

The reduction was achieved and confirmed and held provisionally with K-wire or ACL elbow jig. A single tunnel was drilled at the center of the base of the fracture with a guide pin using ACL on an elbow jig kept at 50 degrees angle. Using a 4.5mm cannulated drill bit the guide pin was over drilled (Figures 8.1 and 8.2).

Two sutures were applied one in AM and one in PL bundle using a suture passer device from the central portal.

After knotting the sutures sequentially to the ACL Stump, all the sutures were tailed to the medial portal and held with artery forceps.

All sutures were taken through the tunnel using a suture retriever and tied over the suture disc on the tibia with the knee in 60 degrees of flexion.

Reduction confirmed arthroscopically.

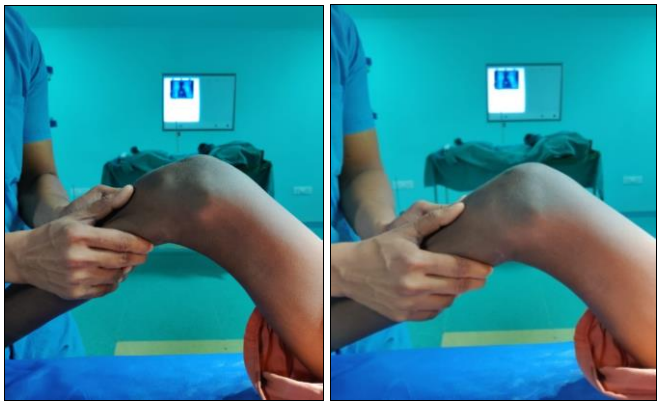


Fig 3.1 and 3.2: Laxity and anterior drawer test in anaesthesia

Fig 4: Leg holder and draping of parts

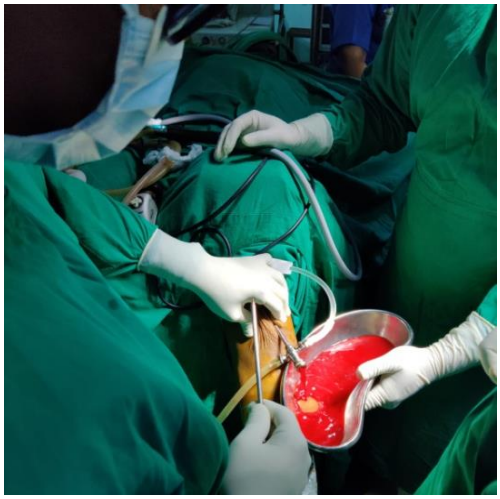


Fig 5: Hemarthrosis of joint

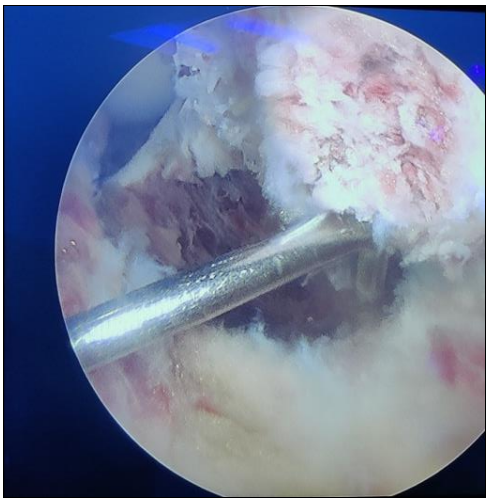


Fig 6: Clinical picture showing fracture fragment

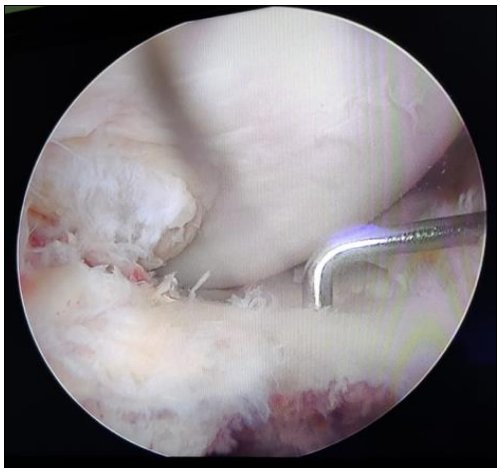


Fig 7: reduction of the fragment with blunt trocar

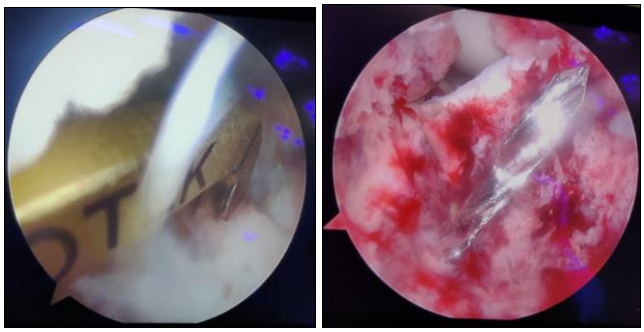


Fig 8.1 and 8.2: ACL kept at 55º and drilled with a 2.7mm drill bit into the center of the crater of ACL avulsion

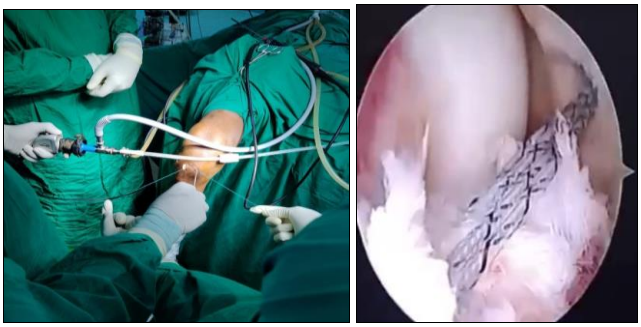


Fig 9.1 and 9.2: With lasso, ACL remnant is held with 2 sets of bio-fibre wires

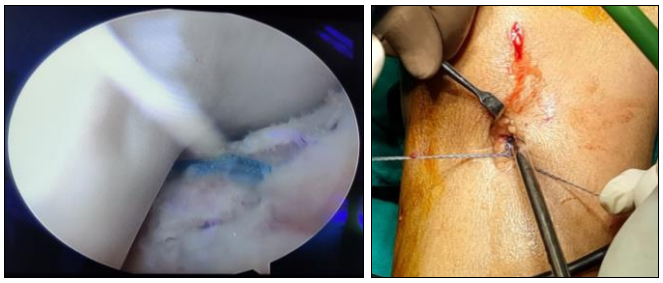


Fig 10.1, 10.2: Reduction achieved and bio-fibers are secured to the tibia using a suture disc

Postoperative rehabilitation

Extension static knee brace applied from immediate post-operative period till suture removal. Patients were advised to do static quadriceps exercises from the first post-operative day. The strict non-weight bearing was instructed for 4 weeks. Knee range of motion started from the end of 2nd week as allowed in a dynamic knee brace with a goal of achieving 90* by end of 4th week. Partial weight-bearing started at 4 weeks with crutches and a brace. Complete weight-bearing was started at six weeks, and return to daily activities was permitted at three months. Return to sports activity was allowed at six months postoperatively, the knee stability, range of motion, muscle strength, and proprioception were restored.

Post-operative evaluation

Immediate Post-operative anteroposterior and lateral radiographs were taken on all patients to assess fracture reduction and suture disc location.

Patients were evaluated for functional results at six weeks, three months, and six months.

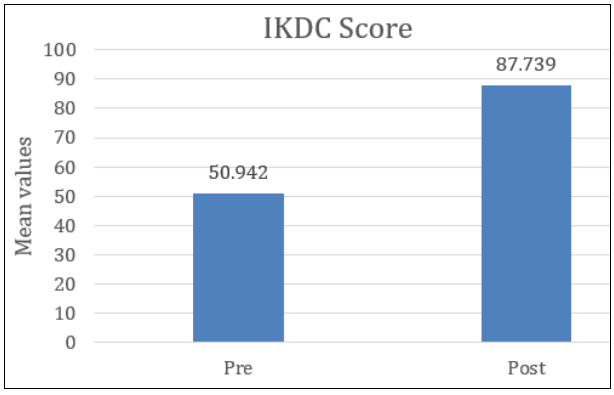
The International Knee Documentation 2000 score (IKDC) and the Lysholm Knee Scoring Scale evaluated the patients.

Outcome

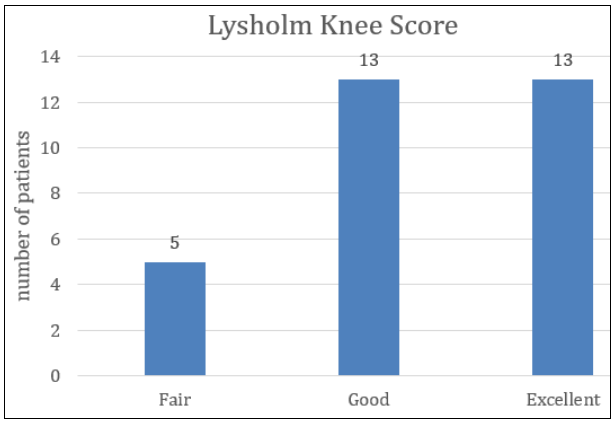
Among the thirty-one patients treated, the most prevalent type of injury in our analysis was a car accident, followed by sports injuries. Due to a bull's kick, two patients were injured. In sports injuries, Kabaddi was the most prevalent cause of anterior cruciate ligament damage.

In our study, the mean pre-operative IKDC scores were 50.94, and the mean postoperative IKDC scores were 87.73(Graph 1). The mean postoperative Lysholm scores were 91.5. (Graph 2)

One patient had five degrees terminal loss to extension, and one patient had a fixed flexion deformity at ten degrees due to poor compliance to rehabilitation.



Graph 1: The mean preoperative and postoperative IKDC scores



Graph 2: Postoperative Lysholm knee scoring scale

Discussion

Tibial eminence fractures are more prevalent in children and adolescents and less common in adults with more developed skeletons [4].

Adults' suture or metal fixation of the avulsed fragment and anterior cruciate ligament repair are the treatment options for displaced tibial eminence fractures.

Because mechanoreceptors in the anterior cruciate ligament provide proprioceptive function and neuromuscular control, the native anterior cruciate ligament should be preserved [4].

Our detailed study was then juxtaposed with studies done by Sapre *et al*. [4], Yanhuo *et al*. [5], Pandey *et al*. [6], Kuang *et al*. [7]. The average age of patients in this study was 36.9 years while those in Sapre *et al*. was 29.2, Yanhuo *et al*. were 34.2, Pandey *et al*. 24.5, and Kuang *et al*. were 15.8 years respectively.

The average Lysholm score at the end of Sapre *et al*., Yanhuo *et al*., Pandey *et al*., and Kuang *et al*. studies was 96.9, 96, 97.7 and 93.04. The average lysholm score at the end of our study was 91.5, which was comparable to the above studies.

In comparison with the above studies, we can see that the functional outcomes after a tibial eminence fracture fixation via the arthroscopic pull through suture technique are comparable.

In our study, the mean preoperative IKDC scores were 50.94, and the mean postoperative IKDC scores were 87.73, indicating a considerable improvement. The mean postoperative IKDC scores in Sapre *et al*., Yanhuo *et al*., Pandey *et al*., Kuang *et al*. studies were 87.9, 94, 95.5 and 90.26, respectively.

From the data seen above, it is observed that postoperative IKDC scores in this study are relatable to other studies.

The patients were given detailed instructions about the rehabilitation program postoperatively, and the results achieved were very good.

One case of arthrofibrosis required arthroscopic adhesion lysis and intensive physiotherapy to achieve complete extension, and another patient had a 10-degree permanent flexion deformity. This patient was momentarily lost to follow-up following surgery, and the rehabilitation program followed was not detailed. All of the other patients had no trouble restoring sufficient knee mobility, and the range of motion assessment was satisfactory at the last follow-up.

After a tibial eminence fracture, there is a risk of loss of mobility and arthrofibrosis.

Mechanical impingement of the displaced fracture or arthrofibrosis might induce loss of mobility. The entire extension also permits the femoral condyles to contract, reducing the fracture anatomically. [8]

Two reasons most likely cause the remaining laxity and instability. Malunion and anterior cruciate ligament lengthening may occur due to the incomplete reduction, and anterior cruciate ligament incompetence may be caused by plastic deformation of the ligament before the eventual avulsion fracture. The anterior cruciate ligament is incapable of remodelling.

Overall, the results were positive, with 29 of 31 patient's knees being classified as normal or nearly normal, and two patient's knees being classified as abnormal due to a 5° extension loss in one patient and a fixed flexion deformity in the other.

Limitations of the study

The main limitations were inadequate sample size, limited follow-up period, and only subjective score results.

Case Illustrations

Case 1

Fig 11: Pre-operative and post-operative Antero-posterior and lateral radiographs showing a fracture of the tibial eminence reduced with suture disc fixation

Fig 12: Post-operative clinical photographs showing complete knee range of motion at three months

Case 2

Fig 13: Antero-posterior. And Lateral radiographs of the knee joint showing preoperative tibial eminence fracture reduced and fixed with endo-button postoperatively.

Fig 14: Clinical photographs at three-month follow-up showing complete knee range of motion.

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