

Arthroscopic Staple Fixation of Displaced Anterior Cruciate Ligament Avulsion Fractures: Study of 60 CasesManthan Soni¹, Haresh Fatesinh Chaudhary^{2*}¹Assistant Professor, Department of Orthopaedics, Banas Medical College and Research Institute, Palanpur, Gujarat, India²Assistant Professor, Department of Orthopaedics, GMERS MEDICAL College, Vadnagar, Gujarat

Received: 18-06-2023 / Revised: 21-07-2023 / Accepted: 26-08-2023

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Conflict of interest: Nil

Abstract:**Background and Aim:** Arthroscopic Anterior Cruciate Ligament (ACL) avulsion fracture fixation has acquired popularity in recent years, but there is no consensus regarding the most effective method of fixation. Our study's objective was to evaluate the clinical and radiographic outcomes of arthroscopic staple fixation for the treatment of ACL avulsion fractures.**Material and Methods:** This two-year prospective study includes 60 patients who underwent arthroscopic fixation of displaced ACL avulsion fractures at a tertiary care institute in India. All patients were clinically evaluated by calculating their Lysholm and International Knee Documentation Committee (IKDC) scores, and their radiological union was evaluated using follow-up radiographs.**Results:** At the conclusion of the follow-up period, 58 patients' knees had regained their full range of motion. Two patients had a 5° fixed flexion deformity and a 15° terminal flexion restriction. The average IKDC score was 90.9, while the average Lysholm score was 95.1. In our study, 19 patients with large avulsed fragments underwent double staple fixation, while 41 patients with minor fragments underwent single staple fixation. At the ultimate follow-up, there was no difference in the functional outcome of the patients based on the number of staples.**Conclusion:** Using arthroscopic technique enables the surgeon to minimise soft-tissue injury and evaluate other potential knee injuries. According to our study, arthroscopic fixation is preferable to open fixation for the treatment of displaced ACL avulsion fractures in terms of earlier mobilisation, averting knee stiffness, and residual instability.**Keywords:** Anterior Cruciate Ligament, Arthroscopy, International Knee Documentation Committee Score, Staple.

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Introduction

The occurrence of anterior cruciate ligament (ACL) avulsion fracture, alternatively referred to as tibial spine fracture, is infrequent. Nevertheless, the prevalence of this condition is on the rise in both children and adults, mostly attributed to the heightened levels of physical activity among youngsters and the escalating number of high-energy motor vehicle accidents in adults. The prevalence of this phenomenon is primarily observed during the age range of 8 to 14 years. The user's text does not provide enough information to be rewritten academically. [1,2]

The injury in question was characterized by Meyers and McKeever [3] according to the degree of displacement exhibited by the ACL tibial fragment. There are three types of fractures in the tibial spine: type I, which involves no displacement; type II, which involves partial displacement with the

anterior fragment being avulsed and the posterior hinge linked to the tibia; and type III, which involves complete displacement. Type III fractures were further categorized into two subtypes, namely IIIA and IIIB. Subtype IIIA fractures were characterized by displacement without rotation, while subtype IIIB fractures exhibited complete displacement and rotation. Zaricznyj [4] introduced a classification system that included a type IV category, characterized by the presence of a comminuted misplaced fragment.

Type 1 fractures typically require non-operative therapy, which involves immobilization. The treatment of Type 2 fractures is a subject of ongoing controversy. [5] The user's text is too short to be rewritten in an academic manner. The function of conservative therapy in type 2 fractures is restricted and necessitates vigilant monitoring due

to its frequent association with reduction loss and ligament laxity. Therefore, it is typically advised to pursue surgical intervention for fractures classified as type 2, type 3, and type [4,6,7]

The objective of the operational intervention is to effectively reinstate the complete spectrum of mobility and stability in the knee joint. The arthroscopic approach has several advantages over open surgery, including limited invasiveness, improved visualization, the ability to manage related intra-articular diseases, and reduced morbidity. Arthroscopic fixation can be achieved through the utilisation of sutures or hardware, such as metal screws, Kirschner wires, and suture anchors. The optimal approach for reduction and fixing remains uncertain.

Material and Methods

This prospective study included 60 patients who had arthroscopic repair of displaced ACL avulsion fractures at an Indian tertiary care institute for two years. The inclusion criterion was ACL avulsion fractures of type II, III, and IV as classified by modified Meyers-McKeeever. Chronic damage, simultaneous tibial plateau fractures, and other serious injuries that will affect knee joint stability, such as osteochondral lesion, meniscal injury, and knee ligament injury, were all eliminated. The study required written agreement from the patients as well as approval from the institute's ethical committee.

Data from medical records were obtained, including demographics, injury data, and complications. The outcome was assessed both radiologically and clinically. Careful physical examinations to rule out related injuries, as well as a plain radiograph of the knee joint, were performed on all patients in the casualty.

Thirty-five patients experienced type II ACL injury (anterior third displacement of the avulsed fragment) and twenty-five patients had type III ACL injury (avulsed fragment totally displaced). Polytrauma and contra-lateral limb injuries were omitted from the study.

Eleven patients with severe avulsed fragment comminution received MRI of the knee to determine the size of the largest bone fragment linked to the ACL that could be fixed with a staple and the integrity of the ACL fibres.

All of the patients had arthroscopic staple fixation. The knee joint was evaluated using typical medial and lateral para patellar arthroscopic portals while wearing a tourniquet. The medial portal was taller and more vertical than the lateral portal to permit staple fixation. To fix the fragment from the lateral side, an extra higher lateral portal was sometimes required. The hematoma was thoroughly washed, and the avulsed ACL fragment was visualised to

ensure that there was no meniscal interposition. The titanium staple features two "v"-shaped teeth and is 2 centimetres long. It was attached to the introducer, introduced through the high medial portal, and positioned over the avulsed fragment. The fragment was arthroscopically reduced to its insertion bed by using the staple as a joystick. The staple was then pushed through the avulsed fragment and into the tibial plateau by gently pressing on the introducer. The introducer was then removed from the staple head. Depending on the size of the avulsed fragment, it was secured with one or two staples. In comminuted fractures, the largest fragment containing the majority of the ACL fibres was stapled, and the other free small fragments were removed since they could cause locking, resulting in a fixed flexion deformity later.

The stability of the fixation was evaluated intraoperatively by tugging the ACL with a probe and performing full range of motion of the knee. The related ipsilateral knee injuries were treated concurrently. Nineteen participants in our study suffered knee injuries. Nine patients had tibial condyle fractures that were repaired percutaneously with screws prior to ACL avulsion fracture fixation to improve staple purchase. Five patients had partial menisectomies for meniscal injuries, while five patients had PCL avulsion fractures corrected with cancellous screws via a posterior route. All patients were mobilised with a knee brace for the first four weeks, then with full weight bearing and knee bending exercises starting four weeks later. Then, to progressively regain complete range of motion, an intensive rehabilitation programme was initiated. At the end of the third and sixth months, as well as at the final follow-up, patients were evaluated functionally by looking for clinical symptoms of laxity and using the Lysholm score and the International Knee Documentation Committee (IKDC) score. Follow-up radiographs were used to evaluate radiological healing.

Statistical analysis

The collected data was assembled and input into a spread sheet programme (Microsoft Excel 2007) before being exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). The confidence level and level of significance for all tests were set at 95% and 5%, respectively.

Results

Sixty individuals were studied after surgery and followed for an average of 16 months. In 58 individuals, complete range of motion of the knee joint was achieved at the end of the study. Two individuals had a 5° permanent flexion deformity and a 15° terminal flexion restriction. The anterior drawer's test was negative in 58 patients at the conclusion of the last follow-up, while 2

individuals had grade I laxity. None of the patients experienced symptoms of the knee joint giving way during daily routine activities, and all returned to their pre-injury activity level. In our study, there were no surgical site infections. The average IKDC score was 90.9, whereas the average Lysholm score was 95.1. Radiologically, the average time to union was 8 weeks, and all instances unified.

In our study, 19 patients had double staple fixation for large avulsed fragments and 41 patients had

single staple fixation for minor fragments. The number of staples had no effect on the functional result of the patients at the last follow-up. At the time of the last follow-up, patients with concomitant injuries had returned to their pre-injury occupation, and their Lysholm and IKDC ratings were equivalent to those of the other patients with solely ACL injuries.

Table 1: IKDC score among study participants

IKDC score	Number	Percentage (%)
91-100	39	65
81-90	10	16.6
71-80	11	18.3
Total	60	100

Table 2: Lysholm score among study participants

Lysholm score	Number	Percentage (%)
100-90	38	63.3
85-89	18	30
80-84	4	6.6
Total	60	100

Discussion

Since Poncet [8] described ACL avulsion fracture in 1875, various surgical therapeutic approaches for ACL avulsion have been offered. McLennan discovered in 1982 that arthroscopy fixation is a viable technique with less soft tissue injury than standard open fixation. [9] However, the question of which fixation device to use during arthroscopy remains unresolved.

Fixation options for ACL avulsions range from cancellous screws to staples, sutures, K wires, and bio-absorbable suture anchors. [10] The cautious approach has the drawbacks of prolonged immobilisation, knee stiffness, and residual instability. Because of the substantial dissection, open methods of fixation cause varying degrees of knee stiffness and necessitate a lengthy period of immobilisation. These disadvantages are resolved with arthroscopic staple fixations.

In our study, ACL avulsions were more prevalent in people aged 16 to 32. Kendall et al discovered that the incidence of damage in adults was higher than in children. [11] Song EK et colleagues discovered no significant difference in final range of motion between adults and children in surgically treated avulsion fractures. [12] Wilfinger et al [5] demonstrated a favourable prognosis at 1 year follow up in their study of 38 paediatric cases managed conservatively; however, no studies on conservative management in adults have been conducted.

Screws have the strongest theoretical purchase for fracture fixation. However, because the proximal

tibia is a cancellous bone, the fixation strength may be less stiff than expected. A screw put into the ACL may tear it or cause minor avulsed bone fragments. Furthermore, an applied screw increases the likelihood of subsequent impingement during knee extension or neurovascular compression. Huang et al [13] found that arthroscopic suture fixing produced good results with high functional ratings. However, when compared to staple fixation, it is a technically demanding technique. When arthroscopic reduction and percutaneous pin fixation of ACL avulsions were compared to arthroscopic staple fixation, McLennan's series revealed that lack of extension, persistence of ligamentous instability, and quadriceps wasting were observed in patients treated by arthroscopic reduction and percutaneous pin fixation. [9]

At the final follow-up, there was no difference in the functional outcome of the patients depending on the number of staples used to repair the fragment and, indirectly, the size of the avulsed fragment. Song et al [12] achieved a Lysholm score of 89.5 using sutures and anchors for ACL avulsion. Using suture fixation, Ahn et al [14] achieved a Lysholm score of 95.6. Using only screws and suture, Robert et al achieved a Lysholm score of 94.2.

When compared to open fixation procedures, arthroscopic staple fixation allows for earlier knee mobilization and reduces the likelihood of knee stiffness. It also cuts down on surgery time and hospitalization. Arthroscopic staple fixation is a technically simple procedure when compared to the screw fixation or suturing techniques. Staple

fixation obviates the need for drilling or tapping and also the difficulties in insertion of long screws can be avoided. The rare chances of the screw slipping from the driver during introduction and falling into the joint cavity do exist, whereas the staple pre-threaded to the driver avoids such problems. The most common complications of arthroscopic fixation of ACL avulsion include arthrofibrosis, decreased knee range of motion, remained anterior knee laxity, and fracture nonunion. Complete irrigation and debridement of the fracture site is essential as it prevents fracture non-union. When there is a severe comminution of the fragment, ACL fibers can be detached from the fragments and the staples might not have a good purchase and may result in early back out of the staple. In such special circumstances, ACL reconstruction at later date is the preferred treatment of choice. Also, in the cases where avulsion of ACL is accompanied with ACL mid-substance tear, ACL reconstruction should be planned. When avulsion fracture is combined with a partial tear of ACL, the largest fragment can be fixed by a staple and the torn fibers can be debrided preventing the need for ACL reconstruction.

Conclusion

The arthroscopic approach allows the surgeon to minimise soft-tissue harm while also allowing the surgeon to analyse other probable related knee problems. According to our findings, arthroscopic fixation is superior to open fixation for treating displaced ACL avulsion fractures in terms of earlier mobilisation, avoidance of knee stiffness, and residual instability. Among the different arthroscopy procedures, staple fixation is a straightforward and effective treatment that, when performed correctly, yields good clinical and functional results.

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