ARTHROSCOPIC FIXATION OF ANTERIOR CRUCIATE LIGAMENT TIBIAL AVULSION FRACTURES USING FIBRE WIRE WITH OR WITHOUT ENDOBUTTON

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ABSTRACT

BACKGROUND

Anterior Cruciate Ligament (ACL) avulsion fracture is commonly associated with knee injuries and its management is controversial ranging from conservative treatment to various modalities in arthroscopic fixation. The aim of our study is to assess the clinical and radiological results of arthroscopic fixation using fibre wire with or without Endobutton in the management of ACL avulsion fractures using a simpler technique.

MATERIALS AND METHODS

Fifteen patients (10 males and 5 females) who underwent arthroscopic fixation with standard anteromedial and anterolateral ports using fibre wire with or without Endobutton (9 cases only fibre wire was used, 6 cases Endobutton was used in addition) for displaced ACL avulsion fractures (Meyers and McKeever's classification grade 2, grade 3 and grade 4) were analysed. The average age was 26.1 years with a mean follow up of 1 year. All patients were assessed clinically by calculating their Lysholm scores, Lachman test and the radiological union was assessed in the follow up radiographs.
Study Design- Retrospective observational case series.

RESULTS

The mean Lysholm score was 94.93 ± 2.81 (mean ± SD). In 14 patients, Lachman test was negative at the end of final follow up while 1 patient had grade I laxity compared to normal knee. At final followup, all the patients were able to return to their preinjury activity level except one who had an extension lag, underwent arthrolysis subsequently and is improving.

CONCLUSION

Arthroscopic fixation using this technique of using fibre wire with or without Endobutton is a safe and reliable technique for producing clinicoradiological outcome in displaced ACL avulsion fractures.

KEYWORDS

Anterior Cruciate Ligament, Arthroscopic Fixation, Arthroscopy, Avulsion Fracture, Endobutton, Knee Joint, Fibre Wire, Tibia.

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BACKGROUND

Avulsion fracture of the tibial attachment of the Anterior Cruciate Ligament (ACL) is more common in children and adolescents than in adults.[1] Avulsion fractures account for only 1% to 5% of ACL injuries in adults.[2] Meyers and McKeever[3,4] developed a system for classifying these fractures. Type I fractures produced minimal fragment displacement, type II fractures exhibited elevation of the anterior half of the fragment with the posterior half remaining well seated on the tibia and type III fractures were those with complete displacement. This system was modified by Zaricznyj[5] who suggested that comminution of a displaced avulsion fracture should be classified as a type IV fracture. The Anterior Cruciate Ligament (ACL) contains large blood vessels and the avulsed bone fragment receives sufficient nourishment from this blood supply. The Anterior Cruciate Ligament (ACL) receives its nourishment from branches of middle geniculate artery,[6] which runs in the connective tissue of the synovial membrane covering the ligament. Atrophy of the ligament following its detachment at one end can be expected if the stimulus of tension thereby removed. Hence, such type of fractures need to be fixed. Surgical intervention is indicated for Meyers and McKeever types II, III and IV because displaced fractures may cause nonunion or malunion as well as loss of knee extension or instability.[5,7,8,9]

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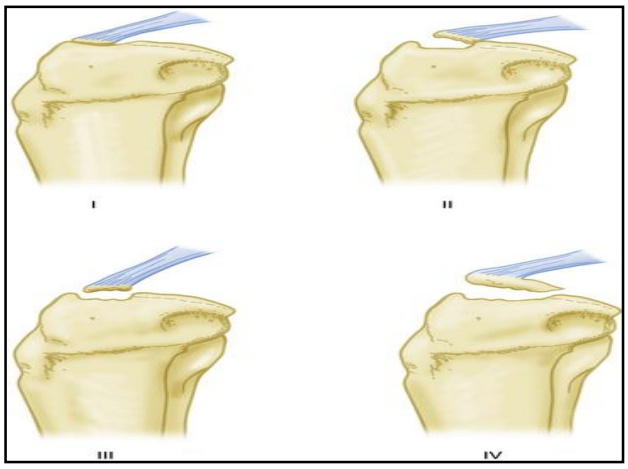

Figure Showing ACL Avulsion Fracture Types as per Meyers and McKeever System of Classification

(Adapted from Lubowitz, J, Elson, W, Guttmann D. Part II- arthroscopic treatment of tibial plateau fractures-intercondylar eminence avulsion fracture. Arthroscopy 2005;21:86-92).[10]

Various fixation devices have been introduced for Arthroscopic Reduction and Internal Fixation (ARIF) of Anterior Cruciate Ligament (ACL) tibial avulsion fractures such as cannulated screws, staples, Kirschner wires, wires and non-absorbable sutures.[11-20] Several biomechanical studies have been performed to assess the strengths and weaknesses of the various methods used for fixation of ACL tibial avulsion fractures.[21-25] However, till now, no equivocally accepted technique is available that can be applied regardless of skeletal maturity, fragment size or comminution. The authors describe a technique for ARIF of ACL tibial avulsion fractures using fibre wire with or without Endobutton using simpler instrumentation. The purpose of this study was to assess the clinicoradiological outcome of patients with comminuted ACL avulsion fracture fixed arthroscopically using fibre wire and Endobutton if bone bridge less than 10 mm at 1 year follow up.

MATERIALS AND METHODS

Fifteen patients (10 males and 5 females) underwent arthroscopic fixation with standard anteromedial and anterolateral portals using fibre wire with or without Endobutton (9 cases only fibre wire was used and in 6 cases Endobutton was used in addition) for displaced ACL avulsion fractures (modified Meyers and McKeever's classification grade 2 and above) were analysed retrospectively. All patients were skeletally mature. Average age was 26.1 years (range 20-32). The mean followup period was of 1 year. All patients had haemarthrosis and positive Lachman test on presentation. The mode of trauma was RTA in 11 patients and sports injury in 4 others. All patients were assessed clinically at final follow up by calculating their Lysholm score in form of a subjective questionnaire and Lachman test with knee in 30-degree flexion. Radiological union was assessed by antero-posterior and lateral x-rays of the involved knee.

Operative Technique

After written informed consent, all patients were placed in a supine position and surgery was performed under tourniquet control under suitable anaesthesia. Through anterolateral portal, scope was introduced. Haemarthrosis drained. ACL avulsion was identified. Fracture bed was prepared. Trial reduction was performed with a probe and was fixed temporarily with a 2 mm K-wire. Using ACL zig, 2 tunnels were made from anteromedial aspect of tibia into the joint cavity such that both tunnels open anteromedially and posterolaterally to the ACL footprint. Fibre wire was railroaded through two tunnels passing through ACL substance using an 18G (Figure 1 A, B, C, D) spinal needle and the two ends of the fibre wire coming out from the anteromedial aspect of tibial cortex were tied outside over the bony bridge with or without (bony bridge >10 mm) suture disc (Figure 2 A, B, C, D).

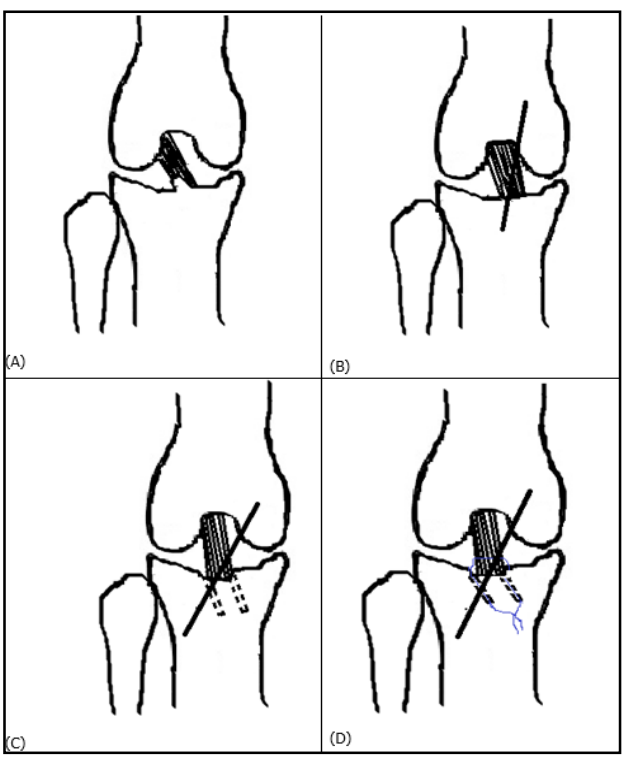

Figure 1 (A, B, C, D). Schematic Representation of Operative Procedure

- ***A. Showing Avulsion Fracture of Tibial Attachment of ACL.***
- ***B. Showing Temporary Fixation Using K Wire.***
- ***C. Showing Tunnel Preparation around ACL Footprint for Wire Passing.***
- ***D. Showing Tightening of Wire outside Using Suture Disc after Railroading through the ACL Substance and Both Tunnels.***

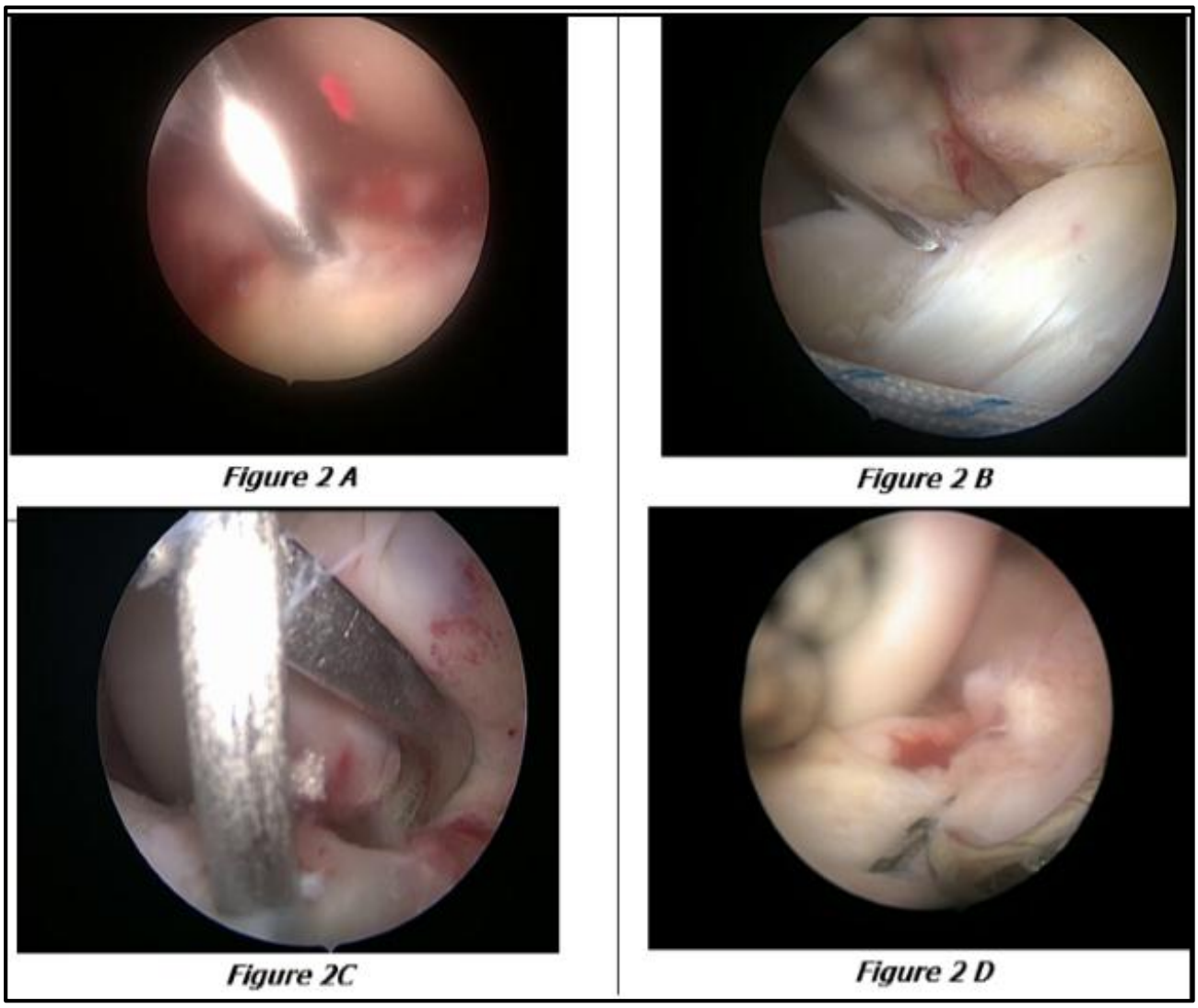

Figure 2 A. Shows Temporary Fixation of Avulsed Fragment Using K Wire.
Figure 2 B. Shows Spinal Needle Use for Railroading of Fibre Wire through the ACL Substance.
Figure 2 C. Shows Making of Tibial Tunnels with the Help of ACL Jig.
Figure 2 D. Shows Arthroscopic View of Final Fixation of Avulsed Fragment.

Postoperative Rehabilitation

Postoperatively, patients were mobilised immediately on bed, were kept in a limited motion brace in full extension and instructed not to bear weight for 2 weeks. In case of comminuted fracture, it was delayed. At this time, patients began range of motion exercises and partial weightbearing, which was increased to full weightbearing as tolerated. Physical therapy was required to achieve a full range of motion by 6 weeks when the brace was discontinued.

RESULTS

At the final followup, the mean Lysholm score was 94.93 ± 2.81 (mean ± SD). In 14 patients, Lachman test was negative while 1 patient had grade I laxity. Followup radiographs (Figure 3 a, b) showed bony union in all cases. At final followup, all the patients were able to return to their preinjury activity level except one patient who had a restricted terminal extension due to noncompliance to physiotherapy regime for which she underwent arthroscopic release and is improving currently. There were no intraoperative or postoperative complications such as fixation, failure or infection.

Figure 3a

Figure 3b

Figure 3a. Shows Preoperative X-Ray of Tibial Avulsion Fracture
Figure 3b. Shows Postoperative X-Ray of Fixed Tibial Avulsion Fracture

Lachman Test- done with knee 30-degree flexion below table showing preop and postop comparison.

Lachman Grading	Preop	Postop
Negative	0	14 (93.3%)
Grade 1	0	1 (6.6%)
Grade 2	6 (40%)	0
Grade 3	9 (60%)	0

Table 1. Lachman Test

Lysholm Score at Final Follow Up- Table below showing distribution of patients as per Lysholm score at final follow up.

Result	Range	Number of Patients
Excellent	95-100	8 (53.3%)
Good	84-94	7 (46.6%)
Fair	65-83	0 (0%)
Poor	<65	0 (0%)

Table 2. Lysholm Score at Final Follow up

DISCUSSION

We found that 94% of the patients with displaced tibial avulsion fracture treated by ARIF using fibre wire achieved a clinically stable knee with negative Lachman test and excellent to good, Lysholm score with radiological evidence of union at an average follow up of 1 year. This technique with simpler modification using easily available instrumentation and no intraarticular metal implant use makes this procedure a useful tool in the armamentarium of future arthroscopic surgeons in dealing with such type of fractures.

Displaced ACL tibial avulsion fractures result in anterior knee instability and occasionally in loss of knee extension.[26,3] Therefore, surgical treatment is recommended for all Meyers and McKeever[10] type III and IV fractures and should be considered in all cases of displaced type II fractures. The goals of fixation are to restore the articular surface, provide rigid internal fixation and to locate the ACL to its anatomic insertion at its proper length. With regard to surgical technique, arthroscopic treatment has become a popular procedure for ACL tibial avulsion fractures. Successful arthroscopic reduction and fixation has been described in several studies.[27,28]

Many fixation methods have been reported with promising results.[29,30] Although, it is simple to use, K-wire fixation has difficulty in holding the fragment if the size is small and also the wire must be removed. Screw fixation, though it has strong purchasing power can be generally applied only to a large fracture fragment, although small sizes of screws are being developed.[31] Other possible disadvantages in screw fixation are possible breakage of fracture fragment during insertion, possible impingement of screw head during knee extension and the requirement of a secondary procedure for screw removal.[28] Both of these fixation methods cannot be applied to comminuted type IV fractures.[32]

Suture cerclage is also popularly used.[32,33,34] Eggers et al reported that suture fixation of tibial eminence fractures provides more fixation strength than screw fixation using the biomechanical study. Hunter and Willis[35] reported that suture fixation produced slightly better results than screw fixation, although without statistical significance. Bong et al showed similar result showing superiority of suture fixation over cannulated screws.

In our technique, we used fibre wire with or without Endobutton for fixation, which we consider a good alternative to suture fixation. The operative technique presented here has many potential qualitative advantages-

a) First, this fixation technique requires no further surgery for implant removal.
b) Second, fibre wires are sewn into the ACL base rather than into the avulsed bone; thus even reduction and fixation of type III or IV fractures are easily performed.
c) Fibre wire fixation is superior to screw fixation for treating avulsion fracture of the ACL because screw fixation may potentially break the bone fragments, hence can be used in comminuted fractures.
d) Moreover, with use of Endobutton, the fixation becomes more rigid with less hardware related problems.
e) Finally, special instruments such as suture punches are not required and can be done using simple 18G spinal needle.

The results of our study should be viewed in light of limitations in hand like retrospective case series study, smaller sample size, lack of preoperative Lysholm score, lack of biomechanical study in evaluation was not sought for. In future, it would be prudent to plan a controlled study having biomechanical evaluation in a larger size sample.

CONCLUSION

This retrospective observational case series study shows qualitative advantage of this modified surgical technique of arthroscopic fixation of comminuted ACL avulsion fracture using fibre wire with or without Endobutton. Larger control studies would be required for improving the evidence for the desired technique.

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