

Efficacy of Arthroscopic suture fixation technique in comminuted avulsion fractures of Anterior Cruciate Ligament

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Abstract

Background: Treatment of comminuted avulsion fractures of Anterior Cruciate Ligament (ACL) is challenging. Arthroscopic fixation techniques such as fixation with Screws, staples, k-wires and Sutures are described to achieve this. But in comminuted avulsion fractures of ACL (Meyers and McKeever Type IV), attempts at internal fixation with screws, staples or k-wires often becomes impossible as small fragments of avulsed bone may further shatter while fixing them with implant. Hence we decided to perform arthroscopic reduction and fixation with sutures. Aim of this study is to demonstrate efficacy and benefits of fixation of ACL avulsion fractures with arthroscopic reduction and suture fixation technique.

Methods: Patients diagnosed as having comminuted avulsion fractures of ACL and treated at our institute between November 2012 to January 2015 and those who were followed up in Out Patient Department or on telephone up to January 2016 were retrospectively studied. We could trace records of 23 patients who fulfilled our inclusion, exclusion and follow up criteria. Fixation of ACL avulsion fractures was performed with arthroscopic reduction and suture fixation technique.

Results: 23 patients with comminuted avulsion fracture of Anterior Cruciate Ligament were studied retrospectively. Post-operatively 17 patients had full range of motion by 8 weeks. The remaining 6 patients had a range of 5⁰ to 110⁰ at the 8 week. This was improved to 5⁰ to 125⁰ till 12 weeks of follow up. 19 patients had a negative Lachman test postoperatively, and 4 patients had a grade I Lachman, but with a firm end point. 2 patients had deep vein thrombosis on 3rd and 5th post-operative day. These patients were treated with low molecular weight heparin injections subcutaneously for 1 week followed by oral anticoagulants and physiotherapy. At an average of 27 months' follow-up (range, 12 to 39 months), all of the patients were satisfied with their outcome and returned to their pre-injury functional activity.

Conclusion: Arthroscopic suture fixation of comminuted avulsion fractures of ACL gives acceptable results and reduces implant related complications.

Keywords: Avulsion fracture, Anterior Cruciate Ligament, Arthroscopy.

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plant.^{11,12} Hence we decided to perform arthroscopic reduction and fixation with sutures. This avoided the risk shattering small fragments in comminuted avulsion fractures during fixation with implants.^{12,13} Aim of this study is to demonstrate efficacy and benefits of fixation of ACL avulsion fractures with arthroscopic reduction and suture fixation technique.

Introduction

Treatment of comminuted avulsion fractures of Anterior Cruciate Ligament (ACL) is challenging. These fractures are more common in adolescents and young adults.¹⁻⁴ They cause knee instability, and intra-articular fragments may cause mechanical blocking to knee range of motion. In this situation normal knee function could be achieved by reduction and a stable internal fixation of avulsed fracture fragments to allow healing and eliminate any mechanical block to range of motion.^{1,3,5-10}

Arthroscopic fixation techniques such as fixation with Screws, staples, k-wires and Sutures are described to achieve this. But in comminuted avulsion fractures of ACL (Meyers and McKeever Type IV), attempts at internal fixation with screws, staples or k-wires often becomes impossible as small fragments of avulsed bone may further shatter while fixing them with im-

Materials and Methods

Patients diagnosed as having comminuted avulsion fractures of ACL and treated at our institute between November 2012 to January 2015 and those who were followed up in Out Patient Department or on telephone up to January 2016 were retrospectively studied. Patients diagnosed as having comminuted avulsion fracture of ACL due to recent trauma, those who are skeletally mature or near to skeletal maturity were included in the study. Patients with poly-trauma, very young patients (below 14 years of age) and patients with old neglected avulsion fractures were excluded. The study was approved by the research ethics committees and informed written consent was obtained from all patients. We could trace records of 23 patients who fulfilled our inclusion, exclusion and follow up criteria.

Antero-posterior and lateral radiographs were performed in all patients. On physical examination, all patients had a variable degree of hemarthrosis and positive Lachman test. Five patients had a concomitant grade I medial collateral ligament sprain. Twelve patients had medial or lateral meniscal injuries. Therefore we performed diagnostic arthroscopy as first step before fixing fracture fragments. Surgeries were performed after an average of 7 days (range 3 to 10 days) from the time of injury. The procedures were performed with patients in supine position and spinal anesthesia. Under anesthesia, all patients had a grade 2+ Lachman test. Five patients with grade I medial collateral ligament injuries were stable on examination in the operating room. Sterile painting and draping with leg u drape was performed. Diagnostic scopy was done through antero-medial and antero-lateral portals and haematoma was drained. Associated meniscal injuries were addressed before avulsion fracture reduction and fixation.¹¹ A two centimeter anterior oblique incision was made over the antero-medial aspect of the tibia about 4 centimeter distal to the joint line and medial to tibial tuberosity. Tibial tunnels are made on either side of the avulsed fragment using the tibial ACL zig and 4mm drill.¹²

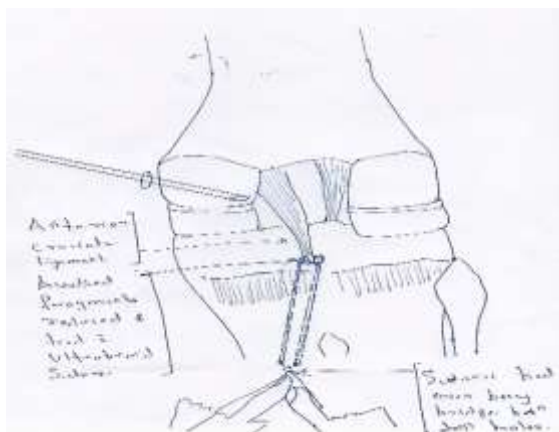


Fig. 1: Diagram showing position of tibial tunnels and operative plan for suture fixation of avulsed fragments with knots tied over bony bridge between tunnels



Fig. 2 A & B: Pre-operative Antero-posterior and Lateral Radiographs showing comminuted avulsion fracture of ACL

Arthroscopic reduction of the fracture fragments was done by retracting the anterior portion of the lateral meniscus combined with a posterior drawer maneuver. No. 2 Ultrabraid suture was then passed through insertion of ACL with Accupass suture passer.



Fig. 2 C & D: Intra-operative Arthroscopic picture showing reduction of the fracture fragments and fixation with No. 2 Ultrabraid suture

Fracture fragments were held in reduced position with 'Fig. of 8' suture technique. Then sutures were retrieved through the tunnels (drill holes) made in tibia with the help of ICE tong suture retriever, thereby bringing these two sutures (four strands) through the two different tunnels (drill holes) in the anteromedial aspect of the proximal tibia. Tension was given to the sutures by Assistant and at the same time through arthroscopy, Surgeon confirms reduction and appropriate tension on ACL. Maintaining tension on the sutures, the knee is brought through a full range of motion and stability of reduction was checked. These sutures were then tied with appropriate tension over the tibial bony bridge present between two drill holes.¹³ Stable and satisfactory fracture reduction and ACL tension was confirmed through final arthroscopic

examination. The arthroscopy portals and anteromedial tibial incision were closed in standard fashion, and a sterile dressing was applied.

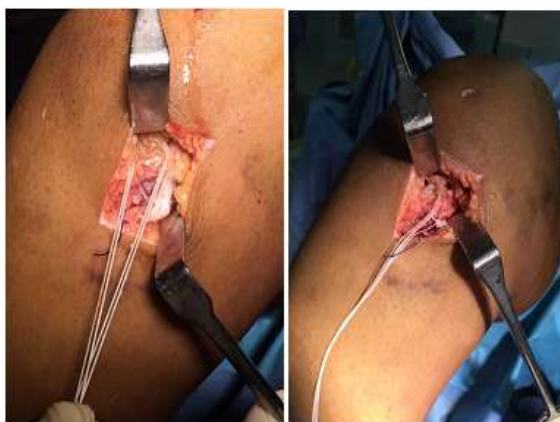


Fig. 2 E & F: Intra-operative photographs showing retrieval of sutures through tibial tunnels and tying of sutures over bony bridge between two tunnels



Fig. 2 G & H: Post-operative Antero-posterior and Lateral Radiographs showing fixation of comminuted avulsion fracture of ACL

Post-operatively knees were immobilized in long leg knee brace. After 3 days, Brace was removed intermittently and gradual passive and active knee range of movement exercises were started. Up to first two weeks range of motion exercises were performed from 0° to 45° . From 2 to 4 weeks range of motion exercises were allowed up to 90° and up to 120° till 6 weeks and full range of motion thereafter. Patient were allowed partial weight bearing with crutches for the first 4 weeks and then full weight bearing.¹⁴ Long leg knee brace was continued till 4 weeks post operatively. All patients were discharged on 4th to 6th post-operative day and thereafter called for follow up in outpatient department on 12th post-operative day and thereafter every 2 weeks for first two months and after every 6 months thereafter. Radiographs were taken at 1st month, 2nd month and 6th month follow up visits. At each

follow up visit knee functional outcome was assessed with to the Knee Society Scoring system.

Results

23 patients with comminuted avulsion fracture of Anterior Cruciate Ligament were studied retrospectively. 16 were males and 7 were females. The age of the patients ranged from 16 to 29 years with an average of 23.5 years. The follow up period averaged 27 months (range 12 to 39 months). The mechanisms of injury was sports related in 14 patients and fall from cycle and bike in 9 patients. Along with comminuted avulsion fracture of ACL, concomitant injuries to Medial collateral ligament and medial and lateral meniscus was present in 13 patients.



- A= Patients with comminuted avulsion fractures of ACL = 43.5%
- B= Patients with comminuted avulsion fractures of ACL with meniscal injuries = 34.8%
- C= Patients with comminuted avulsion fractures of ACL with Grade I MCL sprain and meniscal injuries = 21.7%

Fig. 3: Percentage of concomitant injuries present with comminuted avulsion fractures of ACL

Post-operatively 17 patients had full range of motion by 8 weeks. The remaining 6 patients had a range of 5° to 110° at the 8 week. This was improved to 5° to 125° till 12 weeks of follow up. 19 patients had a negative Lachman test postoperatively, and 4 patients had a grade I Lachman, but with a firm end point. 2 patients had deep vein thrombosis on 3rd and 5th post-operative day. These patients were treated with low molecular weight heparin injections subcutaneously for 1 week followed by oral anticoagulants and physiotherapy. There were no complications like non-union, septic arthritis, pulmonary embolism. Injured knee was improved in all patients (P value < 0.001) postoperatively. The average knee society score at final follow up was 91 points and the final functional score was 89 points. At an average of 27 months' follow-up (range, 12 to 39 months), all of the patients were satisfied with their outcome and returned to their pre-injury functional activity.

Discussion

Fixation of comminuted avulsion fractures of ACL is challenging. This injury is known to be associated with other intra-articular injuries commonly meniscal injuries.¹⁴ 45% of Poor results in previous studies of similar kind were attributed to non-addressing of associated injuries.¹⁵ Soft tissue entrapment, which occurs in 65-100% of these fractures, must be addressed for adequate reduction.^{16,17} Meniscal injuries can be treated at the same time through Arthroscopy. They cannot be treated as effectively as that of Arthroscopy if done by open arthrotomy. Soft tissue entrapment can be easily resolved through arthroscopy with probe. Arthroscopic techniques for fixation of avulsion fractures of ACL include fixation with metal screw, staple, Kirschner wires, and suture.¹⁸⁻²⁶ Fixation with screw, staple or Kirschner wire often becomes impossible as small fragments may further shatter while fixing with implant. Suture techniques offer enough stability to ensure early motion and rehabilitation.^{12,13} Hence our team in Arthroscopy unit has decided to treat all such fractures with Arthroscopic suture fixation technique.

Our study results demonstrate satisfactory outcomes in all patients. Four patients had grade I Lachman test postoperatively despite good reduction of the avulsed fracture. Reason for this could be stretching of ACL before the occurrence of fracture. Recent studies have shown that in moderately long-term follow-up, minor degrees of sagittal plane laxity is asymptomatic and does not hamper functional outcome.^{27,28} This may be due to intact secondary knee restraints uninjured at the time of the fracture. Complications in the form of DVT occurred in two patients but they were treated successfully and full function was achieved in these patients also.

This technique has several advantages

1. Suture techniques offer enough stability to achieve union and good function.
2. Soft tissue entrapment, which occurs in 65-100% of these fractures, and associated meniscal injuries can be addressed effectively at the same setting.
3. There are no implant in the knee and therefore no need for second surgical procedure to remove hardware.
4. There is also no risk of intra-articular penetration, loosening, migration of metal when using sutures for fixation.
5. Arthroscopy has many advantages over open reduction and fixation techniques such as minimal scar, less morbidity and less chances of infection as compared to open reduction and fixation techniques.

Disadvantages

1. Arthroscopic skill in suture passing is a prerequisite for this technique.
2. Instruments such as Accupass suture passer and Ice tong suture retriever are required for this technique.

Hence advantages are more than disadvantages and therefore we believe that this technique of Arthroscopic suture fixation is better technique for achieving good functional outcome.

Conclusion

Arthroscopic suture fixation of comminuted avulsion fractures of ACL gives acceptable results and reduces implant related complications.

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