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Original Research Paper

Orthopaedics

NOVEL SUTURE BRIDGE TECHNIQUE OF ARTHROSCOPIC FIXATION OF NEGLECTED OLD DISPLACED ACL AVULSION FRACTURE FIXATION

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ABSTRACT

INTRODUCTION: ACL avulsion fractures if not properly reduced cause problems like extension block in knee, cartilage erosions and change biomechanics of affected limb. Not many studies have been done on treating old neglected ACL avulsions with suture bridge technique using fiber wire over CC screw. **MATERIALS AND METHODS:** We conducted a study on 30 patients who had old avulsion of anterior tibial eminence fracture and presented to our institute after 8 weeks after injury between 2015 and 2019. All type II type III , type IV ACL avulsion were included in our study and they all underwent arthroscopic suture bridge fixation by the same lead operating surgeon. Our study included using 2 point wide suture bridge fixation over post CC screw and washer with clinical follow up over a period of 6 months. **RESULTS:** Complete range of motion of the knee joint at final follow up was achieved in 26 patients. Three patients had a fixed flexion deformity of 5° and restricted 15° terminal flexion. At the end of final follow up, Anterior drawer's test was negative in 26 patients, while 3 patients revealed grade I laxity. All the patients returned to their pre injury activity level and none of them complained of any giving away sensation of the knee on routine activities. None of the patients suffered from surgical site infections or any such complications. The mean Lysholm score was 93.2 (range 83-98). The mean time for the fracture to unite was 10 weeks (range 6-12 weeks) radiologically and all cases had good bony union. **CONCLUSION:** From this study we can conclude that even though the size of our sample was small we achieved excellent outcome in most of or patients with a good rate of union without sacrificing the native anterior cruciate ligament by avoiding ACL reconstructive procedure. The recent technique of suture bridge fixation using fiber wires over CC screw and washer has major advantages and is a superior method of treating ACL avulsion fractures.

KEYWORDS :

INTRODUCTION

The anterior cruciate ligament gets attached to the proximal tibia via a broad depressed area anteriorly known as the anterior tibial eminence . Avulsion fractures of the tibial spine was first explained by Poncet in 1875, as a common intra-articular knee injury in the pediatric population. The bony ACL avulsion fracture of anterior tibial eminence is more commonly seen in adolescents and young adults[1]. They are caused by forceful hyperextension of the knee or by a direct blow over distal end of femur with the knee flexed commonly occurring with high speed motor vehicle collisions or a high contact sporting activity[1]. They are invariably associated with other injuries, namely "kissing" bone contusions and tears of the medial collateral ligament, meniscus, and posterior cruciate ligament[2] . Broadly the two methods used are either open reduction and internal fixation and second method is arthroscopic fixation. In arthroscopic method there are many methods of fixation like Herbert screw fixation, CC screw fixation, staples fixation, and suture bridge technique .

If displaced ACL avulsion is not properly reduced and fixed it will create many problems, like extension block, articular cartilage erosions, and will revamp the bio kinematics of knee joint which will modify the gait, of patient putting stress on foot,hip and spine. There have been many studies in world literature on treatment of ACL avulsion fractures but not much data is available to describe treatment options available and functional outcome after operation of old neglected tibial spine avulsion fractures. Hence we carried out a study to determine the outcome of old neglected displaced ACL avulsion fractures treated with suture bridge technique using fiber wire over CC screw.

AIMS

The purpose of this study is to study the possibility of reducibility of old (>8weeks) ACL avulsion of anterior tibial eminences fracture and its fixation with suture bridge technique and its complication.

MATERIALS AND METHODS

We conducted a study on 30 patients who had old avulsion of anterior tibial eminence fracture and presented to our institute after 8 weeks after injury between 2015 and 2019

All patients were evaluated with history, symptomatology, clinical examination, xrays and MRI of injured knee and a diagnosis of ACL avulsion fracture was made which were then classified according to Meyers and Mckeeverz grading

In 1959 Meyers and Mckeeverz put forward a classification for anterior tibial eminences ACL fracture as per them they divided it as follows[3]

1. typeI – nondisplaced
2. type II - bird-beak displaced anterior margin with posterior margin still in position in fracture crater
3. type III - fractures completely displaced
4. typeIV - was added later on by zariczny's with complete comminution of bony fragment

All type II type III , type IV ACL avulsion were included in our study and they all underwent arthroscopic suture bridge fixation by the same lead operating surgeon. Our study included using 2 point wide suture bridge fixation over post CC screw and washer with clinical follow up over a period of 6 months

The inclusion criteria was displaced ACL avulsion fracture non union with fragment in the notch, ACL avulsion with extension block, ACL avulsion fracture fibrous non union, (i.e Type II, Type III, Type IV) with minimum completed follow up of 6 months.

Patients were checked for the functional outcome of the knee both pre operatively and at follow up using Lhysolm score. The Lysholm score is used for examining specific symptoms in the knee and a total of 100-points are given for symptoms including pain, swelling, locking or instability while walking ,

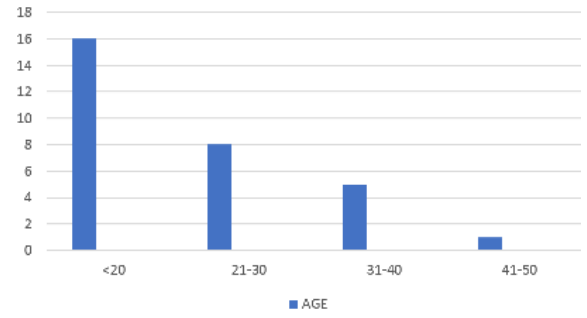
stair climbing, and squatting.

All the patients were operated by arthroscopic suture bridge fixation technique and were followed up at regular intervals after which their final functional outcome was assessed and results analyzed. In the postoperative period patient was started on static and dynamic quadriceps/hamstring and theraband exercises with immediate weight bearing with walker for the first 3 weeks and without walker after 3 weeks.

RESULTS

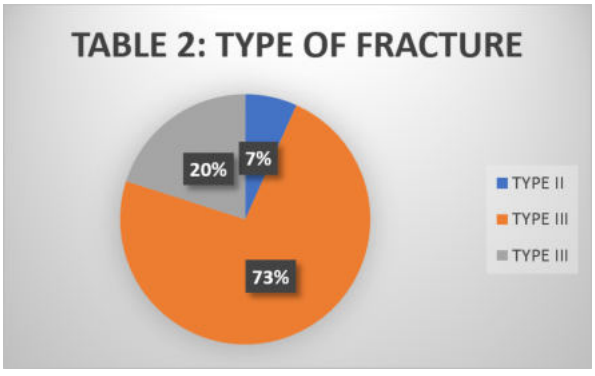
In our study we evaluated and treated 30 patients with old neglected ACL avulsion injuries, 28 patients were male 2 patients were female, the eldest patient in our study was 45yr old male patient with average age 18.5yrs. The most common mode of injury was due to road traffic accident, followed by twisting injury while playing and one of our patients had sustained injury due to slipping in bathroom.

TABLE 1: AGE WISE INCIDENCE OF ACL AVULSION FRACTURE



the average duration was 9 weeks old injury which presented for surgery. The patient with oldest injury presented for surgery and treatment after one and half years of trauma.

The most common type of ACL avulsion fracture was type III (73.3%) followed by type IV (20%) and least common type was type II(6.7%) which presented for surgery.



Thirty patients were analyzed post-operatively and followed up for a mean period of 6 months (range 6-36 months). Complete range of motion of the knee joint at final follow up was achieved in 26 patients. Three patients had a fixed flexion deformity of 5° and restricted 15° terminal flexion. At the end of final follow up, Anterior drawer's test was negative in 26 patients, while 3 patients revealed grade I laxity. All the patients returned to their pre injury activity level and none of them complained of any giving away sensation of the knee on routine activities. None of the patients suffered from surgical site infections or any such complications. The mean Lysholm score was 93.2 (range 83-98). The mean time for the fracture to unite was 10 weeks (range 6-12 weeks) radiologically and all cases had good bony union. One patient in our study was lost to follow up and came to us at a later date with postoperative stiffness along with an attempted MUGA at another hospital which had caused re-avulsion of the bony fragment.

TABLE 3: LHYSOLMS SCORE BEFORE AND AFTER OPERATION

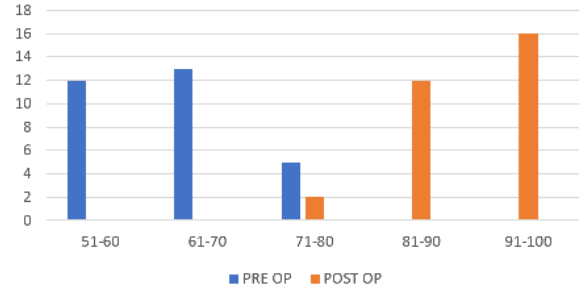
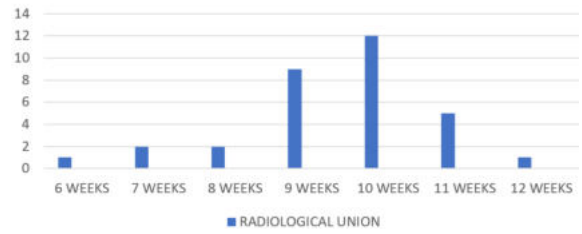


TABLE 4: TIME FOR RADIOLOGICAL UNION



SURGICAL TECHNIQUE

FIG 1 : Pre op MRI showing ACL avulsion fracture

Spinal anaesthesia was given to all our patient under AAP. The patient was given supine position with affected leg by he side of operating table with tourniquet applied at mid thigh level we never used side post for the procedure after taking all precautions and performing all aseptic precautions we started procedure with anterolateral diagnostic portal and anteromedial working portal , the scopy portal was switched as on when required through haemarthrosis was washed out and aggressive retropatellar pad of fat was removed until anterior margin of fracture crater was visualized completely and clearly with interposed inter meniscal ligament underneath of avulsed bony fragment was freed that will help for reduction of fracture fragment .

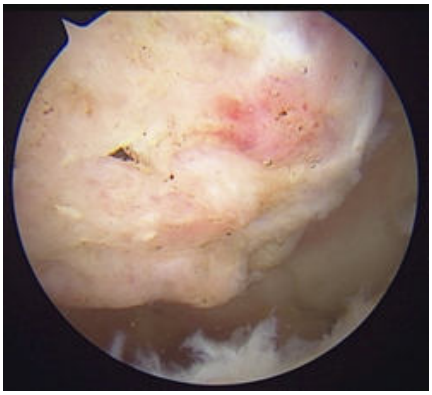


FIG 2: Old avulsed ACL fragment

The old avulsed fragment was mobilized by clearing all fibrous tissue around ACL avulse fragment and from the crater, the crater was freshened with burr and sometime 5mm

sharp osteotome was also used to remove some irregular bony bump in the crater and crater was deepened for at least 2 to 3mm, the undersurface of avulse fragment was also freshened to bleeding surface

Once the ACL avulsed fragment was mobilized, reducubility of ACL avulsed fragment in the crater was accessed and once reduction was achieved the we proceed with suture management of ACL avulsion fragment .No.2 fiber wire was loaded in self self-retrieving suturing devices like minipass of smith and nephew . One suture loop was passed from anteromedial portal in the anteromedial to posterolateral direction and entire ACL was grasped in the device and suture was passed and synched at the base of ACL over the fragment, similarly no.2 fiber wire was passed from anterolateral portal from anterolateral direction to posteromedial direction with the help of minipass and suture was passed through the substance of ACL and suture was synched through the same portal

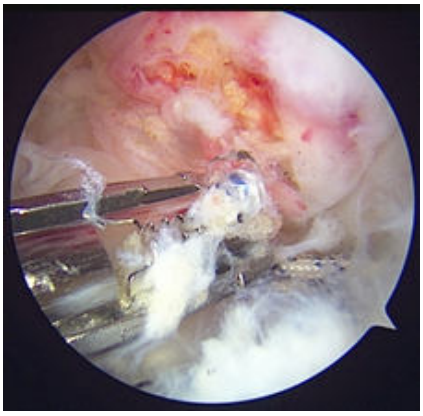


FIG 3: suture passing device (Minipass)

Two tunnels were reamed at the corner of fracture crater I.e one tunnel was at the anteromedial corner and other tunnel was in the anterolateral corner of the crater .tunnel was reamed with ACL zig with the angle of zig adjusted at 55 degree on both side I.e anteromedial and anterolateral corner.

FIG 4: tunnel at anteromedial corner

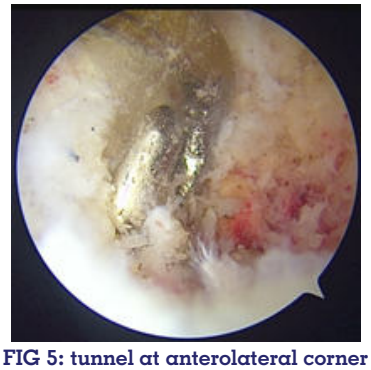


FIG 5: tunnel at anterolateral corner

The sutures in the A/M portal were shuttled into A/L portal and vice versa, so the sutures are criss crossed over the top of ACL avulsed bony fragment. Sutures were shuttled through the tunnel after adjusting the intra articular suture position over the ACL avulsed fragment .ACL Avulsed fragment was reduced over the crater accurately by manipulating the fragment with the help of probe and adjusting the position of suture over the fragment and then reduction was achieved by pulling the sutures in downward direction maintaining the tension on sutures 1.5 to 2mm k wire was used to temporarily fix the fragment from high A/M aspect of patellar tendon in downward direction

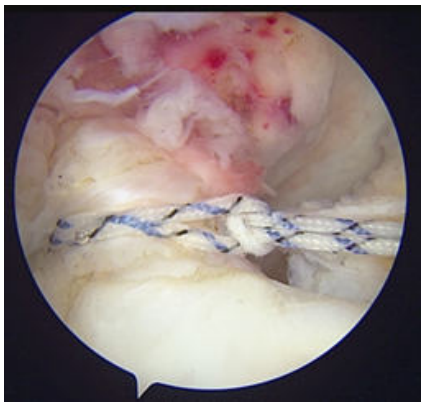


FIG 6:fiber wire synched on osteo-ligamentous junction

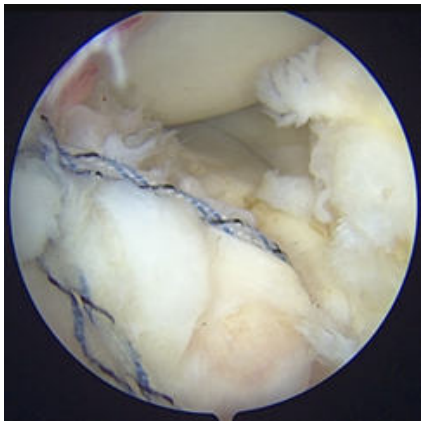


FIG 7: Criss crossing of sutures over avulsed fragment

2cm incision was taken on A/M aspect of tibia 3 to 4cm below the tibial tuberosity, cc screw with washer was inserted on A/M surface of tibia from A/M to lateral direction, average length of screw was 35mm then sutures were tide over the cc screw underneath the washer under the tension. Before final tightening of screw k wire was removed and tightening of screw k wire was removed and tightening of cc screw over washer was achieved

FIG 8: post op X ray 1

FIG 9: post op Xray 2

DISCUSSION

ACL avulsion fractures are common injuries occurring in young active individuals. They are more commonly seen in children as the bone fails earlier to stress as compared to ligaments. In our study the average age group of study subjects was 18 years which was correlating with the studies conducted worldwide. It was found that majority of our subjects were males probably because they were more involved in outdoor activities and contact sports putting them at higher risk of such injuries than females. Plus females have been known to have more ligament laxity than males due to the effect of oestogen which increases the stress bearing capacity of the ligaments and reduces the chances of bony avulsions.

ACL avulsion fractures can be addressed by either conservative or operative methods. The decision to operate is taken depending upon the amount of displacement and concomitant ligament laxity[3]. The aim of surgery was to bring back anatomical joint congruity. It was seen that in all type II, III, and IV fractures, patients had extension block and articular cartilage erosion due to the avulsed fragment impinging in the intercondylar notch as well as the medial femoral condyle. It was also observed that few of our patients had pain in the foot and ankle while walking because of the extension lag causing an alteration in the biomechanical axis of the affected limb and putting undue stress on the foot and ankle. Hence anatomical reduction and fixation was of utmost importance. The surgical options available are either open reduction and internal fixation or arthroscopic reduction and fixation. Arthroscopic fixation has major advantages of causing lesser morbidity and postoperative stiffness, complete visualization of articular erosions due to the displaced bony fragment and allowing overall evaluation of the joint for associated injuries. The most common fixation methods include CC screw with washer, percutaneous wires, staplers and non-absorbable sutures or anchors.

Most of the studies fixed the fragments using fiber wires over endo button or bone or suture disc. These techniques will only reduce and pull the fragments into the crater without offering much compression. In our study all the avulsed fractures were fixed using a new method of suture bridge technique tying fiber wires over CC screw and underneath washer which will not only reduce and pull the fragments into the crater but also ensure extra compression with tightening of the CC screw over the washer. The benefits of this technique were no prominent hardware, no risk of intra articular damage to cartilage due to hardware and no physeal damage as tunnels were positioned in the epiphysis only sparing the physis with ACL zig adjusted at 45degree angle. This method gives a rigid fixation allowing early ROM with more pull-out strength and as the fiber wire is synched at the osteo ligamentous junction it provided good tightness to ligaments even in old neglected ACL avulsion injuries. Hunter and Willis[4] reported a 44% reoperation rate in patients treated with cannulated screws. Bong et al[5] in his study studied the biomechanics of suture and screw fixation for tibial spine fractures in cadavers and concluded that suture fixation was better than cannulated screw fixation. In our study of 30 patients all operated with suture bridge technique excellent results were seen in 26 patients and satisfactory results in 3 patients with a mean Lysolm score of 92.6. these results were comparable to studies conducted worldwide. Song *et al*[6] treated ACL avulsion fractures using sutures and anchors and achieved a Lysholm score of 89.5. Ahn *et al*[2] used suture fixation technique and got a Lysholm score of 95.6. Robert *et al* achieved a 94.2 Lysholm score of using screws and suture alone. Seon *et al*[7] in his study using screw and suture fixation reported a Lysholm score of 91.7 and 92.7, respectively. Kim *et al* operated five cases using bio absorbable suture anchors and achieved good results. Tsukada *et al*.[8] found that there was significantly greater anterior translation after cyclic loading in fractures stabilized with pullout suture fixation compared with antegrade screw fixation whereas in our study in only 4 patients had grade 1 ligament laxity which was not found to be significant. In a procine model, Eggers *et al*.[9] concluded that under cyclic loading, suture fixation had better strength then screw fixation. No significant difference in outcomes was seen by Hunter and Willis[4] in regards to the type of fixation, whereas Seon *et al*.[7] reported that both the screws and suture fixation technique gave relatively good result in terms of stability and functional outcome.

The main complication encountered in our study was that the patients had initially tried conservative management for the fracture using braces for fracture immobilization. These fractures were neglected for a period of 8-12 weeks and hence the patient had not mobilized the limb sufficiently causing significant quadriceps wasting along with 20 degrees of extension lag. The ACL ligament had also lost its tightness and underwent residual laxity due to loss of attachment to the tibial bone. These complications were tackled using thick suture placement within the fibers of ACL ligament for a good fixation, along with deepening the crater by 5-8 mm and drilling holes at the anteromedial and anterolateral positions of the crater and applying the sutures in a criss-cross manner over the avulsed fragment to reduce chances of anterior tilting or displacement of fracture. The position of the tunnel determined the position of the sutures over the fragment. When the suture lines were placed in the middle to posterior position the fracture fragment had a tendency of displacing upwards thereby reducing the tension of the ligament. The muscle wasting was addressed with rigorous rehabilitation protocols in which partial weight bearing was started immediately and aggressive physiotherapy of the knee done 4 weeks post operation.

CONCLUSION

From this study we can conclude that even though the size of our sample was small we achieved excellent outcome in most of or patients with a good rate of union without sacrificing the native anterior cruciate ligament by avoiding ACL reconstructive procedure. This study enlightens the fact that even old neglected avulsion fractures can be reduced accurately and have good end results providing hope to a huge number of patients who in a country like India present to the orthopedic surgeons late after trying and failing in a number of traditional methods and home remedies. The recent technique of suture bridge fixation using fiber wires over CC screw and washer has major advantages and is a superior method of treating ACL avulsion fractures.

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