Double suture fixation of displaced anterior cruciate tibial bony avulsion in children

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Abstract:

Background- Discontinuity of anterior cruciate ligament fibres secondary to avulsion fractures of tibial spine has been well described in children between 8-13 years. The classification and treatment of displaced intercondylar eminence fractures is controversial. Mayer and McKeever’s classification is the one most often used.

Methods-Five children with tibial spine avulsion treated by this method are selected for study. Author has described modified direct suture with No.5 ethibond. Two sutures are taken, one through ACL around the fragment and second through fragment directly with the epiphysis by the strong suture needle, as described in the manuscript.

Results- Follow up period ranges from 3-12 months. All patients regained full range of movements with no subjective laxity, except scar of incision, not much apprehensions were raised by the patients.

Conclusion- Tibial spine injuries should be diagnosed promptly. Though arthroscopic option appears quite attractive, results are good even with open method by author modified method of suture placement.

Key words: ACL Avulsion, children, Tibial eminence, Ethibond suture

Introduction

Discontinuity of anterior cruciate ligament fibres secondary to avulsion fractures of tibial spine has been well described in children though the classification and treatment of displaced intercondylar eminence fractures is controversial. The synonyms for this fracture are tibial eminence fractures, ACL avulsion fractures. These injuries are commonly seen in children aged between 8-13 years and usually are sports related. Though this injury was first documented by Poncet in 1895, it was only in 1959 that Meyers and McKeever described classification and surgical management for type II [1,2,3]. The cause for increased incidence in children is thought to be because of relative weakness of incompletely ossified tibial eminence compared to native ACL fibres [4]. Other hypothesis is greater elasticity of ligaments over bone in children [5]. Mayer and MC Keever’s [2] is the most often used and originally had three types with type 4 added later by Zariczynj [6]. CT scan is useful in better assessment of fracture anatomy and degree of comminution [6]. MRI is useful in outlining the non osseous concomitant injuries like meniscal injury, cartilage injury and other ligamentous injury [7,8].

Chief goals of treatment are anatomical reduction of displaced fragment after removing any block for reduction like bone fragments, blood clots, intermeniscal ligament or meniscus. Adequate rigid fixation which allows early range of motion exercises. Eliminate the extension block and impingement due to displaced fragments [9,10].

Material & Methods

Five patients (Type II -3 , type III-2) of age group 7-12 were selected for study. Three patients underwent MRI while two underwent only plane radiographs. After anesthesia fitness patients were operated under spinal/ general anesthesia. Tourniquet was applied.

Operative procedure: Anterior midline incision was taken and anteriomedial arthrotomy was done. Haemarthrosis was drained and Intercondylar eminence fractured fragment visualised. The crater in tibia was cleaned of clots and small bony fragments. No.5 ethibond was taken and directly needle was passed through tibial epiphysis to exit in the lateral edge of crater. The needle was passed through base of anterior cruciate ligament close to bone from lateral to medial side (Fig 1-2). The needle was then passed inside out through medial edge of crater to exit on anterior surface of tibial epiphysis (Fig.3). Reduction of the fragment was done under anterior horn of medial meniscus and both ends of outside suture are pulled to hold the piece in crater. (Fig.4a-d).

It was found that in spite of pulling the threads the anterior end remains lifted up, which was pushed with artery forceps and held in positio. One more no 5 ethibond was taken and directly needle was passed through tibial epiphysis to exit in the lateral edge of crater. The needle was passed through base of anterior cruciate ligament close to bone from lateral to medial side (Fig 1-2). The needle was then passed inside out through medial edge of crater to exit on anterior surface of tibial epiphysis (Fig.3). Reduction of the fragment was done under anterior horn of medial meniscus and both ends of outside suture are pulled to hold the piece in crater. (Fig.4a-d).

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exiting out through tibial epiphysis. First the anterior suture is tied while assistant holds the posterior suture (Fig. 5 a-c). Then the posterior suture was tied which fixes the fragment tightly. The knee is passé through full range of motion to confirm the fixation (Fig. 6 a-c). Sutured in layers over radivac drain. Pressure bandage given. Postoperatively knee brace was given, Partial weight bearing was allowed for three weeks then full weight was allowed. Knee movements were started active and passive with the aim to achieve 1-30 degree flexion at end of one week, 0-60 degrees at end of two weeks, 0-90 degrees at end of three weeks. Then closed chain exercises are allowed up to six weeks. At this juncture one check x ray was taken and then after confirmation of position full weight bearing and full movements of knee and all exercises is allowed. Patient is followed at three months then at every three months upto one year, Follow up ranges from three months to one year. Results are assessed in terms of range of movements, subjective laxity, objective laxity with anterior drawer and Lachman test and pain.

**Results**

Average age of patient was 9.2 years. Three were males and two females. Cause of injury was vehicular accident in two and injury during sports in three, There were no associated injuries. Two patients were operated within 48 hours, one on 5th day and one on 7th day. There were no postoperative infections. Full movements were achieved in all five patients at end of three months. The follow up is three months in two patients, nine months in one and one year in one All patients had no subjective...
instability at three months and at their last follow up. Residual laxity objectively seen in two patients at their last follow up. Four patients had no pain at the end of three months. One patient had pain in terminal flexion which subsided with analgesics by six month follow up.

**Discussion**

The classification and treatment of displaced intercondylar eminence fracture is controversial. Meyers and McKeever classification does not take into account of size of fragment but gives only idea of degree of displacement. True avulsion fractures of anterior cruciate ligament often have small fragment and are difficult to reduce by extension because there is little or no contact with femoral condyles. Eminence fractures, often large fragments with wings of articular cartilage, are pushed down by femoral condyles by extending knee. Oostvogel et al [11] advocates operative treatment only for type three fractures. All other types were immobilized for six weeks unless gentle extension was not possible. In type II fractures after aspiration of knee, and extension of knee if acceptable reduction is achieved, then conservative treatment is continued. Loss of reduction is very common and needs closed monitoring [12]. If there is persistent superior displacement on lateral radiograph, then it is preferable to go for internal fixation. In type III fractures operative treatment is justified. It has evolved from conservative treatment to open reduction and internal fixation to arthroscopic reduction and internal fixation. Various methods of fixation which include retrograde wires [6], Screws [13], antegrade screws [14], sutures [15,16,17,18] suture anchors [19], k wire and tension band wiring [20], Suture bridge [21]. Most authors find it important to avoid crossing epihysyal plate [22], however transepiphyseal screw has been described [23]. Arthroscopic fixation with a intrafocal screw has been described.

Looking at so many views regarding fixation of fracture, it is clear that no method is perfect and has pros and cons with it. There are only few comparative studies in literature to recommend which is the best technique. Seon and Park [24] did a comparative study of screw fixation and suture fixation of tibial spine fractures and concluded that there is no significant difference in terms of clinical outcome and stability. Bong and coworkers [25] in their biomechanical study of screw versus fiber wire fixation concluded that fiber wire fixation was significantly stronger than cannulated cancellous screws fixation. Biomechanical comparison four different methods of fixation was done by Mahar and colleagues [26] on immature bovine knees and they concluded that two single armed no.2 ethibond sutures, bioabsorbable nails, single bioabsorbable screw, or a single metal screw did not have any significant advantage over other. Tsukada [27] and co workers did a biomechanical comparative study of antegrade screw fixation, retrograde screw fixation and pull out suture fixation. They compared initial fixation strength in response to cyclic tensile load and found that antegrade screw is most effective in providing internal fixation strength.

After going through literature and personal experience of open screw fixation and wire loop fixation, author modified the method as described above. As the two No 2 ethibond sutures were having comparable strength to screws, author thought of using two No 5 ethibond sutures which will definite increase strength of fixation. For arthroscopic technique, one need to make two 2.7 mm drill holes. Author has apprehension of making drill holes in epiphysis sparing physis as well. The suture is passed directly with the strong needle with No 5 ethibond thus avoiding drilling. The arthroscopic technique is quite technically demanding and costly and gazette oriented. Author works in peripheral setups and found open technique very easy and with less learning curve. The method of having second suture in anterior part of piece that is intraosseous suture which will keep anterior part of piece well in place reversing the natural displacing force. This is difficult arthroscopically but very easy by medial arthrotomy with knee flexed completely. Though the level of evidence is level V for this suture, author is very much convinced about fixation method. Though transphyseal fixation is advised by Goudarzi [23] in seven avulsions with screws and wires, he stresses importance of early removal at six weeks. Author is of opinion of not crossing physis, passing suture through epihysis takes care of problem. And there is no need of implant removal. Previously prolonged immobilization induced arthofibrosis led to knee stiffness [28]. Earlier rehabilitation is crucial as it encourages a faster recovery and prevents development of secondary complications [29]. Author’s modified method of suturing allows early rehabilitation. No patient developed restriction of motion. Though residual laxity is seen in two patients objectively, clinically they were asymptomatic. Literature also confirms this fact. Few authors advised countersinking of the fragment [30] to decrease residual laxity, however this was not followed by us.

Hardware prominence in screw fixation group leading to notch impingement and extension loss is common. Author’s method of suture placement method avoids this problem. Though growth disturbance after fixation of this fracture is uncommon; literature and Author recommends physis sparing fixation method in immature skeleton [31]. The cosmetic problem in young patients especially girls as the scar is big. This is only problem which worries the patient and parents.

Conclusion: Tibial spine injuries should be diagnosed
promptly. Though arthroscopic option appears quite attractive, results are good even with open method by authors modified method of suture placement.

References


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