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Anterior tibial spine (ACL avulsion) fracture treated with open reduction and fixation with screw: surgical technique, functional and clinico-radiological outcomes

Rajesh V. Chawda*, Vijay J. Patel, Dhaval M. Ninama, Harsh N. Patel

Department of orthopaedics, NHL municipal medical college, Ahmedabad, Gujarat, India

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***Correspondence:**
Dr. Rajesh V. Chawda,
E-mail: rvchawda@gmail.com

ABSTRACT

Background: The anterior tibial spine fracture occurs almost at a same frequency both in adolescents and in adults. These injuries are often overlooked at emergency room. Stable internal fixation requires to gain optimum function of ACL by securing its length and nascent tension. We treated anterior tibial spine (ACL avulsion) fracture patient with open reduction and screw fixation.
Methods: Study of Ten patients of anterior tibial spine (ACL avulsion) fracture, with minimum of 06 months and maximum of 18 months follow up. Classification of anterior tibial spine (ACL avulsion) a fracture done by Meyer and Mckeever. All patients operated with open reduction and internal fixation with screw via medial parapatellar approach. Functional and clinical outcome measured with Lysholm knee score at final follow up.
Results: We studied 10 patients with anterior tibial spine (ACL avulsion) fractrure where mean age of patient was 36.4 years. Mean radiological healing was 10.6 weeks in anterior tibial spine (ACL avulsion) fracture. We observed mean motion of knee 133 degree in anterior tibial spine (ACL avulsion) fracture. Mean Lysholm score at final follow up was 86.8.
Conclusions: Open reduction for anterior tibial spine (ACL) fracture provides direct visualization with easy application of screws ultimately confers stable osteosynthesis enables to start early range of motion and further rehabilitation protocol. Open reduction internal fixation is comparative less technically demanding, less expansive and gives excellent to good results as compared to other techniques.

Keywords: Anterior tibial spine, ACL avulsion, Lysholm, Open reduction

INTRODUCTION

Anterior cruciate avulsion fractures relatively an uncommon injury which incidence has been rising with sporting injuries and road traffic accidents. The avulsion of tibial attachment of anterior cruciate ligament frequently known as tibial spine of intercondylar eminence fracture.[1]

Most consistent features of these injuries are hemarthrosis, restricted and painful range of motion. Many a times it has been seen with concomitant proximal tibial fractures as well as posterior cruciate avulsion injury and meniscal injuries. Incidence in children of these injuries reported around 3 per 100000 populations per year.[2]

Avulsion fracture of anterior cruciate ligament most commonly resulted from sports where hyperextension and rotational injuries are common (skiing, football etc.) and in high velocity trauma by motor vehicle accidents.

Isolated tibial spine avulsion injuries are often overlooked.[3] Careful examination with proper treatment plan is necessary to achieve an expected outcome. Hindrances in these injuries often lead to extension lag with restriction of knee movement and may present with instability too. These all factors ultimately compromise the normal joint biomechanics which lead to early degenerative arthrosis of joint.

Treatment modalities have been evolving decades by decades with newer techniques. The vast treatment modes comprises from conservative management with cast or brace to operative fixation like arthroscopic fixation, suture pull out technique with fiber wire or metal wire, open reduction and screw fixation.

Recent era most of these injuries addressed by arthroscopic fixation and suture pull out technique whenever feasible. Many a time's larger fragments and inadequate reduction by arthroscopic aid demands open reduction necessarily. Even In a developing nations due to lack of resources, longer learning curves, costlier surgical process constrained arthroscopic treatment where open reduction and screw fixation should be considered. In our study we presented functional outcomes of 10 cases of anterior tibial spine (ACL avulsion) fractures managed with open reduction and screw fixation.

METHODS

We assessed 10 patients of anterior tibial spine (ACL avulsion) fractures admitted to our institute between January 2016 to May 2018. All patients examined at ER room with knee injury protocol norm of our institute. Patients checked for other concomitant injuries and ordered necessary radiographic examinations. Aspiration of hemarthrosis and extension splint were given primarily in all cases.

Our inclusion criteria were:

- Age >18 years.
- Meyer and Mckeever classification type II, III A and IIIB, IV.
- Closed injuries.
- Concomitant proximal tibial condyle fractures.

Our exclusion criteria were:

- Open injuries.
- Multiple ligaments injuries.
- Previously operated knees for any reasons.

All fractures were classified by Mckeever and Meyer classification system.[4] Type 4 injury refers to comminution and rotation along with displacement described by Zaricznyj in literature.[5] Mechanism of injury and choice of fixation had been taken after thorough clinical as well as radiological examination. Patients were taken for surgery as earliest after anesthetic clearance.

After appropriate consents, all patients were given spinal anesthesia. Clinical knee examination had been carried out in each case prior to surgery. Laxity and range of motion with stress tests findings were noted. We did not evaluate any patient with arthroscopy prior to open reduction. All patients were operated with or without tourniquet used.

Surgical technique

All patients were approached with Medial Para patellar incisions of about 4-5 cm. fractured fragment was identified. Debridement of fragment and area of its original "seats" with small scoop was done. Thorough joint lavage with normal saline was given and joint was inspected for meniscal damage, chondral injury as well as any free fragment of fractures. After that provisional reduction had been achieved with small c reduction clamp (Figure 1). Later depending on size of fragment guide pin of cannulated screw was passed. Appropriate sized screw was placed then (Figure 2). Prior to closure once again, stability tests and range of motions were examined and noted. Examination at this point confers that no hardware impinges articular area or block the range of motion along with stability of fixation. Wound closure was done in layers in standard manner. Post operatively knee extension braces with compression bandages were applied in all cases.

Figure 1: Intraoperative image of image intensifier showing reduction done with c-clamp.

Static quadriceps, straight leg raising and ankle toe movement exercises initiated from first postoperative day in all patients. Intravenous antibiotics for 48 hours followed by oral antibiotics for 7 days. Non weight bearing mobilisation also allowed from postoperative day 1. Suture removal done at 2 weeks with gradual knee range of motion started up to 40 degrees which would be increased up to 90 degree at 3rd week. Weight bearing allowed at 6 week after assessing radiographic healing. Brace was removed and knee ROM and muscle strengthening along with their band exercises advocated till 12 weeks. Later on 6 monthly follow up were assessed with Lysholm knee score.

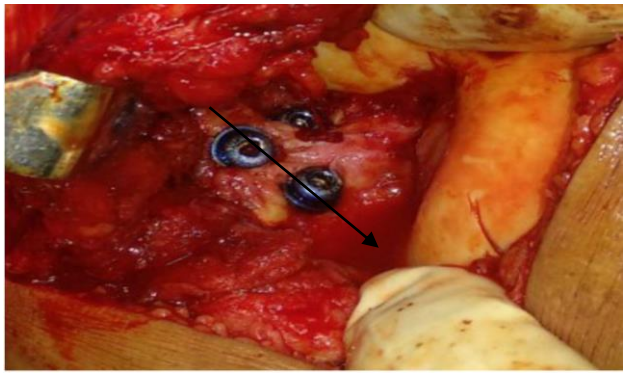

Figure 2: Intraoperative clinical reduction (black arrow shows reduction with screws).

RESULTS

We evaluated 10 patients with anterior tibial spine (ACL avulsion) fractures where 8 patients were male and 2 were female. Mean age was 36.4 years. Patient with minimum age was 22 years and maximum age was 65 years. Frequent involvement was noted of age group 20-40 years in our study. Mean duration between injury and surgery were 2.5 days ranging from 1 day to 8 days.

There were about 6 cases of road traffic accident (60%) followed by 2 cases of sports injury (20%) and 2 cases of fall down and skid injury (20%) (Table 1).

Meyers and Mckeever classification was used in the study where type II cases were 6 (60%) and type III were 4 (20%) noted. We noted sporting injuries had a higher grade of classification with a younger age involvement (Figure 3).

We fixed all avulsion fractures with 4.0 mm or 6.5 mm cannulated cancellous screws made up of either titanium or stainless steel, screw size depends on a fragment size and presence of comminution. All patients were followed up minimum for 6 months and maximum for 18 months after surgery. We noted mean radiological healing range was 8-14 weeks with mean 10.6 weeks. We observed postoperative mean range of motion was 133^{o} at final follow up. In one case we noted 10 degree of extension lag at 6 month of follow up (Table 2).

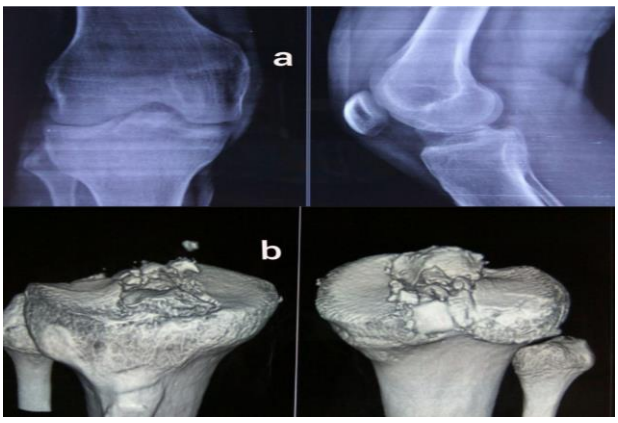

Figure 3: Clinical case; (a) preoperative x ray; (b) preoperative CT scan; (c) postoperative x ray; (d) clinical range of motion at final follow up.

Table 1: Demographic distribution of patients.

Si no.	Age	sex	Classification	Mode of injury
1	30	Male	II	RTA
2	29	Male	III	Sports
3	23	Male	II	Fall down
4	34	Male	II	RTA
5	22	female	III	RTA
6	36	Male	II	RTA
7	55	Male	II	Fall down
8	25	Male	III	Sports
9	45	Female	III	RTA
10	65	Male	II	RTA

We noted one case with superficial infection which was treated by local debridement and oral antibiotics for 10 days which was healed by dressings. We treated one patient with type II anterior tibial spine avulsion fracture with screws which also had lateral condyle tibia fracture treated with screws with good functional outcome at final follow up. Mean Lysholm score was 86.8 in our study (Table 3). We noticed excellent results in 3 patients (30%), good results 6 patients (60%) and fair results in patient (10%).We did not notice postoperative laxity to any case in our study at final follow up.

Table 2: Distribution of functional parameters among cases.

Si no.	Radiological healing duration	ROM at final follow up	Lysholm knee score
1	12	0-135	89
2	10	0-140	86
3	09	0-130	87
4	10	0-125	84
5	11	0-135	88
6	08	0-140	94
7	11	0-130	85
8	09	0-140	93
9	12	0-135	90
10	14	10-120	72

Table 3: Analysis of functional outcome by Lysholm score.

Si no.	Lysholm score (%)	No. of patients with percentage
1	Excellent >90	03 (30)
2	Good 84-90	06 (60)
3	Fair 65-83	01 (10)
4	Poor <65	00

DISCUSSION

Most of anterior tibial spine (ACL avulsion) injuries managed by conservative means with excellent results. Open reduction and fixation required in significantly displaced fractures. Fractures of anterior tibial spine associated with ligaments injury usually have unsatisfactory outcome.[4] Recent literature reviewed that frequency of these injuries are almost similar in adults as compared with skeletally immature patients.[6-10] Anterior tibial spine fractures usually leads to discontinuity of substance of anterior cruciate ligament. To restore optimum function of knee, it necessary to have a competent ACL. Therefore to treat avulsion injuries of ACL with adequate stable fixation to achieve early mobilization. To restore articular congruity, to achieve stable osteosynthesis and to attain early rehabilitation protocol is mainstay of treatment. An untreated injury often leads to knee instability and loss of various degree of extension range of knee.

Various methods to address these injuries mentioned in literatures. Although there has been controversial debate about choice of fixation. Arthroscopic fixation has been rising to treat these injuries. It has its own drawbacks like expansive treatment, longer learning curve, inability to address complete reduction in some instances, soft tissue entrapment between fragments. Tethering of the fragment by an attached anterior horn of the lateral meniscus prevented reduction, on a contrary open reduction allows direct visualization of fragment geometry and its reduction with ease of implant placement. Well evident that it is difficult to place the screws when fragment was small or presence of comminution. Hence recent studies showed suture pull out technique with fiber wire gives better strength.[11]

Open reduction also an advantage of lesser technical expertise as compared to arthroscopic fixation, lesser operating time, less expansive technique, poor resources and it can be used even in remote areas with basic orthopaedic theatre facilities. Even though many studies noted screw fixation requires hardware removal in case of blocking extension and impingement. In our study we did not encounter with this problem. Loss of knee extension directly related with duration of postoperative knee immobilisation. Longer duration leads to much loss to knee range especially extension.[12] We believe that one should start knee range from 2nd week along with isometric exercises. We faced extension lag in one of our cases. All of our patients have obtained there pre-fracture level activity at final follow up. Limitations of our study are small number of cases with relatively shorter follow up. Moreover clinical translations of this technique require larger number of cases and longer follow up. Comparative study with other techniques is needed to decide possible best treatment.

CONCLUSION

Open reduction and internal fixation of anterior tibial spine (anterior cruciate ligament) avulsion with screws provides ease of application of screws, direct visualization of reduction, stable osteosynthesis which enables early range of motion prevents immobilization related complications like stiffness and limitation of range of motion. Moreover it is relatively easier to learn and cost effective modality which provides equally good results with other available modalities.

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