



Functional outcome of ACL Avulsion (Tibial Spine) fracture treated with open reduction and fixation in Rural setup

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ABSTRACT:

Introduction: Tibial Spine Fracture (TSF) can be treated conservatively for reduced or nondisplaced fractures and surgically for displaced fractures. In recent years, different surgical techniques, especially arthroscopic techniques, have been described to ensure a stable repair and reduce the risk of complications. However, it entails a long learning period and requires complex tools, skills and equipment, but in a country like India with a large population and low economy, such medical facilities are often out of reach. So the authors decided to measure the functional outcomes of Anterior Cruciate Ligament (ACL) Avulsion fracture (tibial spine Avulsion fractures) treated with open reduction and fixation in rural setup.

Materials and method - study of 12 patients of anterior tibial spine fracture with ACL tibial Avulsion fractures of type 3(a&b) were included. Patients were approached with Medial Para patellar incisions, open arthrotomy and fracture fragments were identified and reduced and fixation was done using Herbert screw. Follow up and evaluation was done using Lysholm knee score with minimum duration of 6 months of follow up.

Results-Results are assessed based on radiological union, Lysholm knee score and ability to return to daily routine, in which Lysholm knee score of 87.2 ± 4.2 , mean radiological union at 15.6 ± 1.7 weeks and return to daily activity at 16.7 ± 2.4 weeks of duration.

Conclusion- Open reduction and internal fixation of anterior tibial spine (anterior cruciate ligament) avulsion provides a satisfactory functional outcome, direct visualization of reduction, and stable osteosynthesis which enables early range of motion. It has a less learning curve and is cost effective.

Keywords: ACL Avulsion, tibial spine Avulsion fracture, open arthrotomy ACL repair, ACL repair with Herbert screw.

INTRODUCTION

A tibial spine fracture (TSF) is an avulsion fracture of the anterior cruciate ligament [1] where it inserts into the tibial eminence. The reported incidence of these types of fractures is approximately 3 per 100,000 people per year [2] but the number of these types of injuries continues to increase as participation in physical activity increases. Typically, TSF is graded on radiographs according to the Meyers and McKeever grading system [3]. Reliable injury measurement schemes are important to guide orthopedic surgeons in determining appropriate treatment for patients and athletes. TSF can be treated conservatively for reduced or nondisplaced fractures and surgically for displaced fractures. Type 3 TSFs typically necessitate surgical treatment [4][5][6]. Non-operative treatment of these cases results in more nonunion, greater residual laxity, and greater loss of range of motion (ROM) [7]. In recent years, different surgical techniques, especially arthroscopic techniques, have been described to ensure a stable repair and reduce the risk of complications [8]. Common problems associated with TSF are arthrofibrosis, residual laxity, nonunion or malunion, and growth arrest of the tibial epiphysis, and arthroscopic treatment of these fractures has a high success rate due to very low morbidity. However, it entails a long learning period and requires complex tools, skills and equipment, but in a country like India with a large population and low economy, such medical facilities are often out of reach [9].

So the authors decided to measure the functional outcomes of ACL Avulsion fracture (tibial spine Avulsion fractures) treated with open reduction and fixation in rural setup and with objective to rule out any complication. As well as to determine the time required to return to occupation/ activity of daily life

MATERIALS AND METHODS

The study was carried out after taking institutional ethics committee approval for patients who were diagnosed with ACL tibial avulsion fracture and who were ready to undergo surgical management after getting a prior informed consent.

Total of 15 patients of anterior tibial spine (ACL avulsion) fractures admitted to our institute between October 2020 to September 2023. All patients examined at ER room with knee injury protocol norm of our institute. We have done study of 12 patients of anterior tibial spine fracture with 6 months of follow up.

INCLUSION CRITERIA of our study includes a.) Age > 18 years b.) Closed injuries c.) Meyers and McKeevers classification type III [3]. While the **EXCLUSION CRITERIA** includes a.) Patients not willing to participate in the study b.) Open injuries c.) Multiple ligaments injuries d.) Paralytic conditions which affects early mobilization e.) Patient with severe comorbidities f.) Grade 3 and above osteoarthritis g.) Proximal tibia fracture

All patients were examined for Laxity, range of motion, clinical knee examination and findings were noted prior to surgery. ACL tibial Avulsion fractures of type 3(a&b) were included, after taking appropriate consents. All patients are examined in ER, hemarthrosis was reduced by knee aspiration, all patients are given spinal anesthesia for surgery.

Operative technique

All patients were approached with Medial Para patellar incision of about 8-10 cm. Open arthrotomy was performed and fractured fragment was identified & Debridement of fragment and area of its original "bed" 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 or K wire. Later depending on size of fragment guide pin and Herbert screw was passed. Appropriate sized 4.5mm Herbert screw was placed then. Prior to closure once again, stability tests and range of motion were examined and noted. Examination at this point confirms that no hardware impinges articular area or block the range of motion along with stability of fixation. Intra-operative images were taken ensuring the reduction and anterior laxity of knee was evaluated. Wound closure was done in layers in standard manner. Post operatively knee extension braces with compression bandages were applied in all cases.

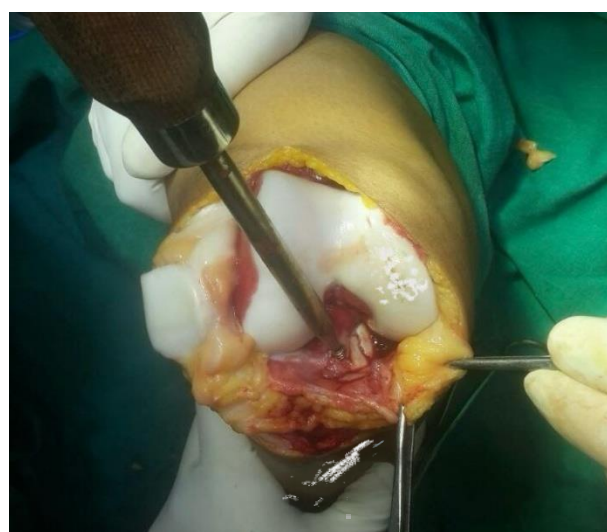
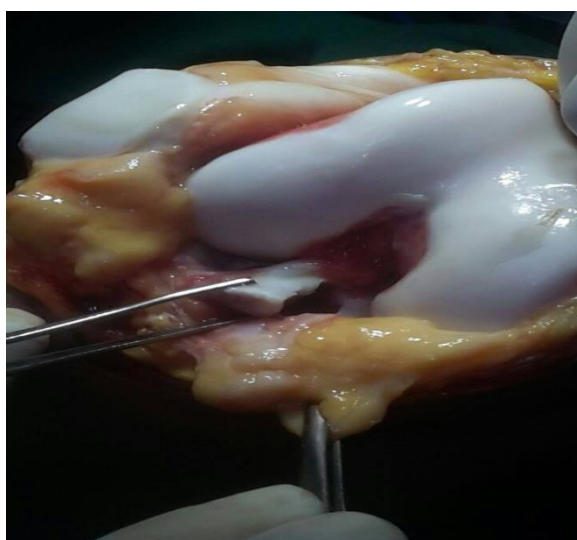


Image 1 showing tibial spine Avulsion fracture hooded with forceps
Image 2 showing tibial spine Avulsion fracture fixation with herbet's screw

POSTOPERATIVE Rehabilitation PROTOCOL:

- **Immediate post op-**
- Patient's knee will be immobilized in long knee brace immediately post operatively.
- Patient will be taught active toe movement, ankle pump, static quadriceps and Vastusmedialisobliquus strengthening exercise.

- **1st post operative day-**
Straight leg raise, static Quadriceps, ankle pump exercises started. Knee is allowed to flex till 30 degree. High sitting knee strengthening was given. All anti-gravity muscles are strengthened.
- **2nd post operativeday-**
Patient started full weight bearing walking with hinge knee brace. Rest all exercises are continued.
- **14th post operative day-**
Suture removal will be done on 14th day.
- **Duration of follow up:**
4 weeks, 6 weeks, 12 weeks,24 weeks.
During follow-up clinical and radiological examination will be done with X-rays and clinical and functional outcome is assessed with Lysholm knee score[10].

FOLLOW-UP AND EVALUATION:

Any discharge, gapping (sign of infections),post op infections, screw back out, Knee bending.

4 WEEKS:- Lysholm score , knee bending up to 0-30,hinge knee brace was removed andX-ray

6 WEEKS:- Knee Movements , Lysholmscore system , knee bending up to 90 andX-ray

12 WEEKS:-Lysholm knee score andX-ray

24 WEEKS (ASSESSMENT AT FINAL FOLLOW UP)

Image 3 showing post op X-ray

**RESULTS**

Results are based on lysholm knee score. Although we have taken 15 patients 2 patient lost to follow up and 1 suffered RTA, so all 3 of them were excluded from study. However, out of remaining 12, 9 are males and 3 are females aging from 18 to 44 years.

Image 4 showing post op rehabilitation



Table 1: Demographic details of the participants

S. No	Gender	Age	Side	Mode of injury
1	Male	18	Right	Sports
2	Male	24	Right	Road traffic accident
3	Male	38	Right	Road traffic accident
4	Male	30	Left	Road traffic accident
5	Male	25	Right	Road traffic accident
6	Male	30	Right	Road traffic accident
7	Male	28	Right	Sports
8	Male	23	Left	Fall down
9	Male	36	Right	Road traffic accident
10	Female	38	Right	Road traffic accident
11	Female	44	Left	Fall down
12	Female	32	Right	Fall down

Table 2: showing results of Lysholm knee score and Range of motion at the time of final follow-up

Classification	Lysholm knee score	Range of motion at final follow up	Union	Complication
3a	90	0-130	14weeks	None
3a	90	0-120	14.4weeks	None
3b	80	10-120	17 weeks	None
3a	90	0-130	16 weeks	None
3b	85	0-120	15 weeks	None
3a	90	0-120	16.5 weeks	None
3a	90	0-120	14 weeks	None
3a	95	0-120	15.7weeks	None
3b	85	0-120	16.2 weeks	None
3a	90	10-120	17 weeks	None
3a	70	10-110	Non union	Non union Re-surgery

				Union achieved by 27weeks
3a	85	0-120	16 weeks	None

Mean age of patients are 32 years, Mode of injury was RTA in 7 patients, fall down in 3 and sports injury in 2, side of injury is 9 on right side and 3 on left side. All patients are operated within 3 weeks of injury with average delay of 4 days. Radiological examination was taken prior to surgeries suggesting grade 3a and 3b injuries. Mean follow up period of 6.5 months ranging from 4 to 8 months, objective clinical evaluation using Lachman test, anterior drawer test was used, knee ROM was checked and functional outcome done using Lysholm knee scoring system. Ability to return to daily pursuit and radiological union was also evaluated. Lysholm score was excellent 7 patients and good in 5 patients. Lachman was negative in all the patients in final follow up. The range of motion in 10 patients achieved 0 to 120 degree and 1 patient got knee range from 20 to 120 degree. Among complications 2 patients had knee stiffness which was corrected with physiotherapy. However there were no wound complications but 1 patient got non union for which they got re-operated. None of the patient had knee length discrepancy.

DISCUSSION

Choosing the appropriate repair method for lower socioeconomic groups requires consideration of special factors such as (a) economic feasibility, (b) the patient's ability to return to work as soon as possible, and (c) to be performed at a simple setup by a surgeon with basic orthopaedic instruments, training and skills (d) if not done well, surgical complications may occur. The most common methods used are screw fixation and suture fixation, and both have achieved satisfactory results. Compared with arthroscopy, complications include screw impingement, screw recoil, and wound dehiscence.

McLennan et al [11] first proposed the benefits of arthroscopic treatment of intercondylar tibial fractures in 1982, with a low incidence rate. Since then, arthroscopic treatment has become increasingly common. However, arthroscopic treatment also has some disadvantages, such as expensive treatment, a long learning curve, and the need for heavy equipment and tools. For some sectors of the population, this remains out of reach. Additionally, in some cases, it can result in an inability to achieve anatomic reduction and soft tissue becomes trapped between the fracture fragments. In contrast, open reduction can be performed in basic bone centers, does not require arthroscopic techniques or resources, and is less expensive. Therefore, it has more practical importance in developing countries like India. It has other advantages, such as allowing direct visualization of the fracture, ensuring anatomical reduction, and allowing easy and precise insertion. In older fractures, open surgery allows us to better evaluate and repair the edges of the fracture, thus promoting fracture healing.

In this study we have mean age group of 31 ± 13 years in which males are more compared to females (9 males and 3 females) which is similar to study by Rajesh Goel et al, mode of injury in our study is RTA which is similar to studies by Rajesh Goel and Rajesh v Chawda [12] compared to study done by Vikram spare et al [13] on tibial Avulsion fracture studies post operative full weight bearing walking was started on pod 2 in our study while they have started till first week.

Knee ROM was started since 4 ± 2 weeks and based on size of the fracture fragment and stability of fixation and full weight bearing walking is started on post operative day 2 with knee extension brace, Radiological union is seen at 15.6 ± 1.7 . Patient had complete functional recovery and return to daily pursuit between 16.7 ± 2.4 in our study we found out the Lysholm knee score ranging from 80 to 90 (87.2 ± 4.2) was excellent compared to other studies done by Dr Rajesh et al. [14]

None of our patients had limb length discrepancies as compared to study by dr. Rajesh Goel et al. Mean follow up period was 6.5 months ranging from 4 to 8 months compared to study by dr. Rajesh v Chawda [12], we have only used Herbert screw as implant so complications like screw back outs are not observed in our study.

Wound dehiscence and other healing complications are not seen in our study however 1 of our patient had screw backout and other had non union for which they got re-operated.

As per the results of this study, people belonging to low socioeconomic strata as well as those residing in rural setup where adequate infrastructure is lacking or devoid of arthroscopic setup this technique give promising outcomes and will be beneficial due to early rehabilitation and minimal complications, leading to early return to daily routine/occupation/sports. Also, as there is direct visualization of the fracture fragment, its reduction and stability under naked eye, surgeons feel more comfortable and satisfied using this technique

Limitation of this study is as this is a single implant, single setup study done by single surgeon hence it is biased, multiple implants and large group of patient if included gives better results

CONCLUSION

Open reduction and internal fixation of anterior tibial spine (anterior cruciate ligament) avulsion provides a satisfactory functional outcome, direct visualization of reduction, and stable osteosynthesis which enables early range of motion. It has a less learning curve and cost effective and can be performed by almost all certified orthopedic surgeons irrespective of any further training.

REFERENCES:

1. C.coyle, s. Jagernauth, M. Ramachandran Tibial eminence fractures a systemic review
2. Skak SV, Jensen TT, paulsen TD, sturup j. Epidemiology of knee injuries in children. Acta orthopscand. 1987;58:78-81
3. Meyers MH, McKeever FM. Fracture of the Intercondylar Eminence of the tibia. *J Bone Joint Surg Am.* 1959;41:209–22.
4. M.tuca, N. Bernal, E. Luderowski, D.W. Green tibial spine Avulsion fracture treatment curropinpediatr, 31(1) (2019 feb).pp. 103-111.
5. E.J. Strauss, D.J. Kaplan, M.E. Weinberg, J. Egol, L.M. Jazrawi arthroscopic management of tibial spine Avulsion fracture: orthopsurg. 26(10) (2018 -may 15). Pp. 360-367.
6. L. Bogunovic, M. Tarabichi, D. Harris, R. Wright Treatment of tibial eminence fracture: a systemic review *J knee surg*, 28 (2014), pp. 255-262.
7. I. Gans, T.J. Ganley Tibial eminence fractures: a review and algorithm for treatment: univ Pa Orthop J. 23 (2013), pp 1-4.
8. Chawda Rev et al. *Int J Res orthop.* 2019 mar ;5(2):340-344.
9. Damianosalvato et al in journal of isakos volume 8 December 2023.
10. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *ClinOrthopRelat Res.* 1985;(198):43–49.
11. McLennan JG. The role of arthroscopic surgery in the treatment of fractures of the intercondylar eminence of the tibia. *J Bone Joint Surg Br.* 1982;64:477–8
12. dr. Rajesh Goel et al and dr. Dinesh Kumar Bharwa studies published in international journal of innovative science and reasearch technology volume 8 issue 5 may 2023
13. dr. Vikram spare and Vaibhavbagaria on tibial spine Avulsion fracture
14. Rajesh V Chawda research on anterior tibial spine(ACL avulsion) fracture treated with open reduction and fixation with screw.international journal of research in orthopaedics march 2019