COMPARISON BETWEEN OUTCOMES OF OPEN AND ARTHROSCOPIC FIXATION OF TIBIAL SPINE AVULSION FRACTURES

Muhammad Amir Sohail[1], Amna Bashir[2], Mahnoor Amjad[3], Muhammad Bilal Afzal[4], Javed Hassan Raza[5]

How to cite this article

Sohail MA, Bashir A, Amjad M, Afzal MB, Raza JH. Comparison between Outcomes of Open and arthroscopic Fixation of Tibial Spine Avulsion Fractures . J Gandhara Med Dent Sci.2024;11(2):47-50

Date of Submission: 24-01-2024
Date Revised: 19-03-2024
Date Acceptance: 25-03-2024

[1]Assistant Professor, Department of Orthopedic Unit II, Jinnah Hospital, Lahore
[3]Physiotherapist, Department of Orthopedic Unit II, Jinnah Hospital, Lahore
[4]Post Graduate Resident, Department of Orthopedic Unit II, Jinnah Hospital, Lahore
[5]Associate Professor, Department of Orthopedic Unit II, Jinnah Hospital, Lahore

Correspondence

[2]Amna Bashir, Physiotherapist, Department of Orthopedic Unit II, Jinnah Hospital, Lahore
: +92-337-4819412
: amnabashir06@gmail.com

https://doi.org/10.37762/jgmds.11-2.443

ABSTRACT

OBJECTIVES

This study aimed to compare the functional outcomes of fragment reduction and to measure the rate of postoperative complications between arthrotomy (ORIF) and arthroscopy(ARIF) pediatric tibial spine avulsion fractures using the Lysholm knee scoring system (limp, pain swelling, climbing stairs) and IKDC subjective knee evaluation form.

METHODS:

This Comparative Study was conducted at the Department of Orthopedic Surgery, Jinnah Hospital Lahore, between 2021-2022. A total of 42 patients who had tibial spine avulsion fracture with follow-up of 6 months were included. Twenty-one patients were treated with ORIF, and 21 were treated with ARIF. Functional outcomes were assessed using the IKDC score and LYSHOLM score (Follow-up rate was 95 %). Radiographic findings of patients were recorded, and a statistical study was done. The level of significance was set at <0.05.

RESULTS: *The study revealed that out of 42 Participants, 36(85.71%) males and 6 (14.29 %) females participated in the survey with the age range of 8-16 years with a mean age of 12.02± (2.53) years. Out of 42 Participants, 22 (52.4%) had motor vehicle accidents with type 3(38.1%) and 4(54.8%) modified Meyers and Mckeever fracture classification. At the end of the follow-up period, the mean IKDC score was 90.52 + 1.50 (p = 0.00, CI = 95%). The Lysholm score was 90.676.11 compared to the last follow-up (p=0.20, CI = 95%). Compared to ORIF, only 5(11.9%) patients complained of post-op infection or vascular injury.*

CONCLUSION: *This study observed better functional outcomes in arthroscopic reduction and immobilization than in open reduction internal fixation. Arthroscopy for TSAF decreases the risk of arthrofibrosis and minimizes morbidities and better management of symptoms. Compared to OIRF, ARIF showed good content validity for the IKDC and Lysholm scales.*

KEYWORDS: *Fracture, Tibial Spine Fractures, Arthroscopy, Radiographs*

INTRODUCTION

Tibial spine avulsion fractures (TSAF) exhibit bimodal age distribution in both pediatric and adolescent populations. They commonly occur between the ages of 8 to 14. Fracture of the tibial spine is relatively rare. The incidence is 3 per 100,000 pediatric trauma cases yearly.[1] The most common mechanism of injury is pivot-type rotation, similar to the mechanism of ACL rupture in adults, but TSAFs can also occur as a result of direct trauma or hyperextension of the joint.[2,3] The most common activity that results in these fractures is falling from a bicycle, but skiing and motor vehicle accidents are increasingly common risk factors.[4] The early work of Meyers and McKeever led to classifying these fractures into three groups. Type I involves an undisplaced fracture, type II fractures are partially displaced with an intact posterior hinge, and type III fractures are completely displaced. Later, Zariecznjy described a fourth type of fracture, which involves complete displacement from the intercondylar eminence associated with comminution.[5] Different surgical options have been proposed, including open reduction and internal fixation (ORIF), arthroscopic reduction and immobilization, and ARIF.[6] The literature supports conservative management with a knee cast or splint for Type I un-displaced tibial spine fractures and surgical treatment for Type II, if reduction is not anatomical, and Type III and IV fractures.[3] Open surgical techniques have several disadvantages and more complications (soft-tissue damage, higher postoperative pain, longer hospital stay, and delay in rehabilitation). For this reason, arthroscopic techniques are considered the gold standard for treating these lesions: they allow direct visualization of intra-articular injuries, simplified diagnosis, accurate reduction of fracture fragments, treatment of associated soft-tissue injuries, and removal of loose pieces.[7] Controversy

remains within the literature regarding management. A review concluded that no gold standard treatment had been set out, although the authors did conclude that displaced fractures require operative management.[8,9,10] There is still a debate on the most helpful approach for the fixation of tibial spine avulsion fracture, examining the clinical differences among the various fixation methods. This study aims to compare the outcome of open versus arthroscopic fixation of tibial spine avulsion fractures. Outcome variables will include union, range of motion, weight-bearing, and clinical function outcome assessed with Lysholm Knee score, IKDC scoring, and Laxity of ACL. This study will help generate local statistics regarding both these modalities, which will help decide which modality is more useful and effective for treating tibial spinal avulsion fracture among pediatric and adult patients.

METHODOLOGY:

The Prospective Comparative study was conducted at the Department of Orthopedic Surgery, Jinnah Hospital Lahore**.** The study was completed 12 months after the approval of the study. Each case will be followed up to 6 months. The non-probability convenient sampling technique was used. Sample size of 42 patients (21 in each group) was calculated by using 80% power of the study, 90% confidence interval, and by taking the expected mean value of IKD score in ORIF and ARIF groups as 90.52±1.50 and 90.67±6.11respectively.

$$n = \frac{(Z_{1-\beta} + Z_{1-\alpha/2})^2 + (\delta_1^2 + \delta_2^2)}{(\mu_1 - \mu_2)^2}$$

$Z_{1-\alpha/2}$
Confidence interval= 90%
$Z_{1-\beta}$
power of the study= 80%
μ
Expected mean value of IKD score in ORIF Group = 87.29
μ_2
Expected mean value of IKD score in ARIF Group = 90.52
δ_1 Expected standard deviation of ORIF Group=4.67
δ_2 Expected standard deviation of ARIF Group= 1.50
n Expected sample size in a group= 21
Patients aged (8-16 years) both genders, presenting with injury no more than two weeks. Meyer and Mckeever type II, III, and IV. Exclusion criteria included patients with inadequate follow-up, hybrid fixation, and any chondral injury or associated fracture that could potentially have a significant effect on recovery and outcomes compared with an isolated tibial spine avulsion injury. Ethical approval was obtained from the hospital's ethical review committee before initiating the study. Patients were divided into two groups using a non-probability convenient sampling technique. Patients' demographic and clinical data were noted down. Postoperatively, knee extension braces with compression bandages were applied in all cases. Patients were followed up for an average of 6 months postoperatively. Using a predesigned questionnaire, the patients were monitored, and the outcome variables were documented during every follow-up visit. Ethical Ref No:34/14/01/2021/S2 ERB, Dated:18-02-2021.

RESULTS:

The study revealed that out of 42 Participants, 36(85.71%) males and 6 (14.29 %) females participated in the study with an age range of 8-16 years with a mean age of 12.02± (2.53) years. Out of 42 Participants, 22 (52.4%) had motor vehicle accidents with type 3(38.1%) and 4(54.8%) modified Meyers and Mckeever fracture classification. At the end of the follow-up period, the mean IKDC score progressed from 45.86 ± 4.07 (p=0.02, Cl=95%) to 90.52 ± 1.50 (p = 0.00, CI = 95%). The Lysholm score was improved from 49.75 ± 5.30 (p=0.29, Cl=95%) to 90.67 ± 6.11(p=0.20, CI = 95%) in comparison to the last follow-up. Compared to ORIF, only 5(11.9%) patients complained of post-op infection vascular injury. After two weeks following surgery, no weight bearing was performed. Out of 42 Participants, 39 (92%) started with partial weight bearing 2.07 ± 0.26 (p=0.07) and progressed to full weight bearing (100%) at the end of the follow-up. The post-op knee flexion range was improved from 30.33 ± 2.10 (p=0.003) to 136.4 ± 10.50 (p=0.13) degrees, and the knee extension range was constant. After eight weeks following surgery, ROM was improved with better pain management, and a return to activities in patients with ARIF was observed.

Table 1: Patient Outcomes

Parameter	Initial Value	Final Value
Mean IKDC Score	45.86 ± 4.07	90.52 ± 1.50
Lysholm Score	49.75 ± 5.30	90.67 ± 6.11
Post-op Knee Flexion	30.33 ± 2.10	136.4 ± 10.50

Table 2: Comparison between ORIF and ARIF

Parameter	ORIF	ARIF
Post-op Infection	05 (11.9%)	N/A
Vascular Injury	N/A	N/A
Weight Bearing (Partial)	N/A	39 (92%)
Weight Bearing (Full)	N/A	42 (100%)
Return to Activities	N/A	Yes

Table 3: Post-op Complications

	Post-op Infection	Vascular Injury	Anterior Knee Pain
N	42	42	42
Mean	1.88	1.88	1.17
Median	2.00	2.00	1.00
Std. Deviation	0.328	0.328	0.377

DISCUSSION

Arthroscopic treatment reduces complications like soft-tissue lesions, post-operative pain, and length of hospitalization compared to open surgery, but clinical outcomes and radiographic results do not seem to differ.[11,12] A recent study in 2020 by Pailhé et al. evaluated the therapeutic results of ARIF to ORIF in tibial eminence fractures.[13] Results revealed that IKD score and extension exhibited significant differences between groups, although time to return to sports (weeks), Lysholm score, and flexion did not IKDC score at the last follow-up of 68.8 ± 11.8 months was 20.2 points ± 8.9 ($p = 0.028$). In contrast to our study, the Pedi-IKDC score showed good content of validity and progress to 90.52 ± 1.50 (p = 0.00, CI = 95%) at the end of follow-up months. Lysholm's score improved to 90.67 ± 6.11(p=0.20, CI = 95%) in arthroscopic procedure and earlier return to activity and better pain management. With the advent of arthroscopy and magnetic resonance imaging, it is now known that associated soft tissue injury is common with tibial spine avulsion fractures. These include meniscal injury, ACL injury, and chondral injury.[14] Diagnosis and treatment of these injuries are of utmost importance for successful outcomes. Arthroscopy allows for identifying and treating these soft tissue injuries and the reduction and fixation of displaced Type II, III, and IV fractures, in contrast to our study, where 21 patients out of 41 were treated with arthroscopy, which demonstrated better functional outcomes with less rate of complications. Only 5 (12%) had post-op infection. Only 3(7.1%) can perform mild functional activities without limitations before knee injury 0.63 ± 9.31. The patient showed maximum activity participation in the 24th week of the following.[15] A systematic review comparing suture versus screw fixation outcomes found a 6.3% rate of postoperative contracture after arthroscopic suture fixation based on their defined criteria of a 10-degree extension deficit or a 25-degree flexion loss.14 Similarly, a previous study found an 8.3% prevalence of arthrofibrosis in children and adolescents after ACL reconstruction. 31 ± 0.97.15. Compared to our study, the range of motion of knee flexion from the 4th-week follow-up was 31.52 ± 2.89, with a significance level (p=0.003) improved to 131.7 ± 6.22 at the 24th week. The mean value of knee extension at the 8th week of follow-up was 2.83 ± 0.59 and remained constant throughout the period, and there was no obvious extension lag and contracture deformity observed in patients with arthroscopy.[16,17,18]

CONCLUSIONS

This study observed better functional outcomes in arthroscopic reduction and immobilization than in open reduction internal fixation. Arthroscopy for TSAF decreases risk of arthofibrosis and minimizes morbidities and better management of symptoms. Compared to OIRF, ARIF showed good content validity for the IKDC and Lysholm scales.

CONFLICT OF INTEREST: None

FUNDING SOURCES: None

REFERENCES

1. Adams AJ, Talathi NS, Gandhi JS, Patel NM, Ganley TJ. Tibial spine fractures in children: Evaluation, management, and future directions. J Knee Surg [Internet]. 2018;31(5):374-81.
2. Bogunovic L, Tarabichi M, Harris D, Wright R. Treatment of tibial eminence fractures: a systematic review. J Knee Surg [Internet]. 2015;28(3):255-62.
3. Green D, Tuca E Luderowski E Gausden M, Goodbody C, Konin G. A new, MRI-based classification system for tibial spine fractures changes clinical treatment recommendations when compared to Myers and Mckeever Knee Surg Sports Traumatol Arthrosc. Knee Surg Sports Traumatol Arthrosc. 2019;27.
4. Rajanish R, Jaseel M, Murugan C, Kumaran CM. Arthroscopic tibial spine fracture fixation: novel techniques. J Orthop. 2018;15.
5. Rhodes JT, Cannamela PC, Cruz AI, Mayo M, Styhl AC, Richmond CG, et al. Incidence of meniscal entrapment and associated knee injuries in tibial spine avulsions. J Pediatr Orthop [Internet]. 2018;38(2):e38-42.
6. Cps S, Acharya K, Rao S, Pandey V. Arthroscopic suture pull-out fixation of displaced tibial spine avulsion fracture. J Knee Surg [Internet]. 2016;30(01):28-35.
7. Li J, Yu Y, Liu C, Su X, Liao W, Li Z. Arthroscopic fixation of tibial eminence fractures: A biomechanical comparative study of screw, suture, and suture anchor. Arthroscopy [Internet]. 2018;34(5):1608-16.
8. Tuca M, Bernal N, Luderowski E, Green DW. Tibial spine avulsion fractures: treatment update: Treatment update. Curr Opin Pediatr [Internet]. 2019;31(1):103–11.
9. Fox JC, Saper MG. Arthroscopic suture fixation of comminuted tibial eminence fractures: Hybrid all-epiphyseal bone tunnel and knotless anchor technique. Arthrosc Tech [Internet]. 2019;8(11):e1283-8.
10. Mitchell JJ, Sjostrom R, Mansour AA, Irion B, Hotchkiss M, Terhune EB, et al. Incidence of meniscal injury and chondral pathology in anterior tibial spine fractures of children. J Pediatr Orthop [Internet]. 2015;35(2):130-5.
11. Vannabouathong C, Ayeni OR, Bhandari M. A narrative review on avulsion fractures of the upper and lower limbs. Clin Med Insights Arthritis Musculoskelet Disord [Internet]. 2018;11:1179544118809050.
12. Osti L, Buda M, Soldati F, Del Buono A, Osti R, Maffulli N. Arthroscopic treatment of tibial eminence fracture: a systematic review of different fixation methods. Br Med Bull [Internet]. 2016;118(1):73-90.
13. Pailhé R, Bauer T, Flecher X, Bonnevialle N, Roussignol X, Saragaglia D, et al. Better functional outcomes for ORIF in tibial eminence fracture treatment: a national comparative multicentric study of ORIF vs ARIF. Knee Surg Sports Traumatol Arthrosc [Internet]. 2020;28(2):653-7.

14. Shimberg JL, Aoyama JT, Leska TM, Ganley TJ, Fabricant PD, Patel NM, et al. Tibial Spine Research Interest Group, Green DW. Tibial spine fractures: how much are we missing without pretreatment advanced imaging? A multicenter study. The American Journal of Sports Medicine. 2020;48(13):3208-13.
15. Shimberg JL, Leska TM, Cruz AI Jr, Patel NM, Ellis HB Jr, Ganley TJ Jr, et al. A multicenter comparison of open versus arthroscopic fixation for pediatric tibial spine fractures. Orthop J Sports Med [Internet]. 2022;10(5_suppl2):2325967121S0041.
16. R R, Jaseel M, Murugan C, Kumaran CM. Arthroscopic tibial spine fracture fixation: Novel techniques. J Orthop [Internet]. 2018;15(2):372-4.
17. Russu OM, Pop TS, Ciorcila E, Gergely I, Zuh S-G, Trâmbițaș C, et al. Arthroscopic repair in tibial spine avulsion fractures using polyethylene terephthalate suture: Good to excellent results in pediatric patients. J Pers Med [Internet]. 2021;11(5):434.
18. Scrimshire AB, Gawad M, Davies R, George H. Management and outcomes of isolated paediatric tibial spine fractures. Injury [Internet]. 2018;49(2):437-42.

CONTRIBUTORS

1. ***Muhammad Amir Sohail*** *- Concept & Design; Drafting Manucript; Critcal Revision; Supervsion; Final Approval*
2. ***Amna Bashir*** *- Concept & Design; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision*
3. ***Mahnoor Amjad*** *- Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript*
4. ***Muhammad Bilal Afzal*** *- Concept & Design; Drafting Manucript; Critcal Revision; Supervsion*
5. ***Javed Hassan Raza*** *- Concept & Design; Critcal Revision; Supervsion; Final Approval*