

FUNCTIONAL OUTCOME OF SCREW FIXATION IN MEYERS AND MCKEEVER TYPE 3 ANTERIOR TIBIAL SPINE FRACTURES

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DOI: <https://doi.org/10.5281/zenodo.17008250>

Keywords

Anterior tibial spine fracture, Lysholm score, screw fixation, functional outcome, BMI, knee injury, Meyers and McKeever classification.

Article History

Received: 05 June, 2025

Accepted: 07 July, 2025

Published: 14 July, 2025

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Abstract

Objective: To evaluate the short-term functional outcome of open reduction and internal screw fixation in patients with Meyers and McKeever type 3 anterior tibial spine fractures using the modified Lysholm knee scoring system.

Study Design:

Prospective cohort study.

Place & Duration of Study: Conducted at the Orthopedic Unit of Ghurki Trust Teaching Hospital, Lahore, from December 01, 2024, to May 31, 2025.

Methodology: A total of 60 patients aged 16 to 60 years with closed Meyers and McKeever type III anterior tibial spine fractures were enrolled in the study. The diagnosis was confirmed using 3D CT scans. All patients underwent open reduction and internal fixation with screws under spinal anesthesia, performed via a midline arthrotomy using a medial para-patellar approach. The functional outcome was evaluated two months post-operatively using the modified Lysholm score. Data were analyzed using SPSS version 20, with independent samples t-tests and oneway ANOVA applied for comparisons across gender, BMI, and age groups. A p-value ≤ 0.05 was considered statistically significant.

Results: Of the 60 patients, 96.7% were male and 3.3% were female. The mean age was 26.58 ± 9.39 years, and the mean BMI was 23.54 ± 3.79 kg/m². The overall mean Lysholm score at two months post-operatively was 90.37 ± 9.99 , indicating good functional recovery. No statistically significant differences were observed in Lysholm scores between genders ($p = .204$) or age groups (not tested with a single p-value). However, BMI groups did show a difference, although not statistically significant ($p = .149$), with patients having a normal BMI (≤ 25) showing slightly higher Lysholm scores than overweight patients (> 25).

Conclusion: Open reduction and internal screw fixation provide favorable short-term functional outcomes in Meyers and McKeever type 3 anterior tibial spine fractures. BMI was found to significantly influence recovery, while gender and age did not show a statistically significant impact.

INTRODUCTION

Among the knee pathologies that present in the emergency room (ER) is tibial spine fracture. It is a frequently noticed injury in the younger population group. The incidence is about 3 in every 1,00,000 children, constituting 2% to 5% traumatic cases of pediatric knee effusion.¹ Anterior tibial spine is the site of tibial attachment of the anterior cruciate ligament (ACL). Hence, these fractures lead to chronic instability of the knee alongside the acute sequel of the trauma. The mechanism of injury of the anterior tibial spine fracture is usually indirect trauma. External rotation of the abducted femur on the planted tibia causes the injury.² The tibial eminence is the attachment of both the cruciate ligaments of the knee. Patients usually present soon after the trauma, and thus clinical diagnosis is based on the initial presence of pain and effusion secondary to hemarthrosis, alongside the persistent complaint of knee instability. The diagnosis is confirmed by radiological analysis of the joint. X-ray is the first investigation that usually depicts the injury, and a CT scan confirms it by delineating the affected joint's detailed anatomy and helps in preoperative planning. However, MRI is used to rule out any ligamentous or meniscal injury alongside the tibial spine fracture.³

The most widely accepted classification system for anterior tibial spine fractures is the one presented by Meyers and McKeever in 1959. As per the system, type 1 represents minimal displacement of the anterior margin, and type 2 depicts considerable displacement of the anterior margin, where the posterior margin is still in contact with the tibial plateau. However, the 3 are completely displaced fractures. The treatment protocols are based on the aforementioned classification system. Types 1 and 2 are treated in cast, whereas type 3 requires open reeducation and internal fixation of the spine with screws.⁴ The approaches for fixation include both arthrotomy and arthroscopy. Both techniques have shown good radiological and functional outcomes, each with pros and cons. Open fixation is the conventional way to manage the fracture, and satisfactory long-term clinical and radiological outcomes are well established. However, it is associated with higher perioperative pain. Similarly, biochemical results have shown that the use of both

sutures and screws has more or less similar fixation strength in the long term.⁵

Gigante A. et al studied the outcome of screw fixation in 3 cases of tibial spine fractures. They stated that 2 months postoperatively, the Lysholm knee score was 88.67 ± 7.64 and the mean International Knee Documentation Committee (IKDC) score was 66.27 ± 3.81 . These results signify that the screw fixation is associated with good functional recovery over the short term as well.⁶

Unfortunately, minimal research has been done on the procedure's efficacy in our society. Hence, the rationale of this study is to look into the effectiveness of screw fixation in anterior tibial spine fractures. This will help fill the gap in the knowledge regarding the procedure and, hence, will help formulate guidelines regarding the management of the condition.

So this study aimed to determine the functional outcome of Meyers and McKeever type 3 anterior tibial spine fracture cases undergoing open screw fixation at Ghurki Trust Teaching Hospital, Lahore.

Material & Methods

This prospective cohort study was conducted at the Orthopedic Unit of Ghurki Trust Teaching Hospital, Lahore, from December 01, 2024, to May 31, 2025. Ethical approval was obtained from the Institutional Ethical Review Committee before the commencement of the study. A total of 60 patients were included, with the sample size calculated using the WHO sample size calculator at a 95% confidence level and 13% margin of error, based on a known Lysholm score of 92.10 ± 4.59 .⁷ A non-probability consecutive sampling technique was employed for patient selection. Patients aged between 16 and 60 years of both genders presenting with closed anterior tibial spine type 3 fractures were included in the study. Fractures were confirmed on a 3D CT scan as breaks involving both the anterior and posterior cortex of the tibial spine. Patients were excluded if they had associated meniscal or ligamentous injuries, compartment syndrome, fractures with knee dislocation, were unfit for surgery, or were likely to be lost to follow-up. Written informed consent was obtained from each participant after explaining the study's purpose, procedures, and potential risks.

Relevant demographic data, including name, age, gender, contact information, and clinical details, were recorded using a pre-designed proforma. All selected patients underwent open reduction and internal fixation of the anterior tibial spine fracture under spinal anesthesia. Patients were positioned supine on a radiolucent operating table, and a medial arthrotomy was performed to access the fracture site. The fragment was reduced and fixed using a screw.

Postoperatively, patients were followed for two months. Functional outcomes were evaluated using the modified Lysholm score, which includes eight parameters: limp, support requirement, locking, instability, pain, joint swelling, stair climbing, and squatting. The score ranges from 0 to 100, with higher scores indicating better knee function. The

Results

Table 1. Descriptive Statistics of Study Participants (N = 60)

Variable	Mean $\pm$ SD	Min-Max	Frequency (n)	Percentage (%)
Gender				
Male			58	96.7
Female			2	3.3
Age (years)	26.58 $\pm$ 9.39	16 - 60		
Age Group				
≤ 20 years				
21-30 years			44	73.3
31-40 years			11	18.3
> 40 years			5	8.3
BMI (kg/m²)	23.54 $\pm$ 3.79	15.10 - 30.0		
BMI Group	1.27 $\pm$ 0.45	1 - 2		
Normal (≤ 25)			37	61.7
Overweight (> 25)			23	38.3
Pre-operative Activity Level				
Recreational sports			1	1.7
No recreational activity			59	98.3
Lysholm Score	90.37 $\pm$ 9.99	22-95		

healthcare provider assessed the score through clinical examination and patient-reported feedback. All collected data were analyzed using SPSS version 20. Mean and standard deviation were calculated for continuous variables such as age, height, and body mass index. At the same time, frequencies and percentages were computed for categorical variables like gender and preoperative functional status. The Lysholm scores were stratified by age, BMI, and preoperative status to assess effect modification. The normality of data was checked using Kolmogorov's test. Post-stratification analysis was performed using the Student's *t*-test and one-way ANOVA, and a *p*-value of ≤ 0.05 was considered statistically significant.

The study included 60 patients, with a predominance of male participants (96.7%), while only 3.3% were female. The mean age of the participants was 26.58 $\pm$ 9.39 years, ranging from 16 to 60 years. The largest proportion of participants (73.3%) fell within the 21-30 year age group, followed by 18.3% in the 31-40 year range, and only 8.3% were older than 40 years. The mean BMI was 23.54 $\pm$ 3.79 kg/m², suggesting that most participants had a

healthy weight. In terms of BMI classification, 61.7% had a normal BMI (≤ 25), while 38.3% were overweight (> 25).

With regard to pre-operative activity level, the vast majority of patients (98.3%) reported no participation in recreational sports, while only 1.7% reported engaging in such activity. This indicates that most participants had low baseline physical activity before surgery.

Table 2. Comparison of Lysholm Scores by Gender, BMI Group, and Age Group (N = 60)

Grouping Variable	Group	Mean $\pm$ SD	p-value
Gender	Male	90.67 $\pm$ 9.89	.204
	Female	81.50 $\pm$ 12.02	
BMI Group	≤ 25 (Normal)	91.84 $\pm$ 3.91	.149
	> 25 (Overweight)	88.00 $\pm$ 15.27	
Age Group			
	21–30 years	89.80 $\pm$ 11.48	
	31–40 years	92.45 $\pm$ 2.77	
	> 40 years	90.37 $\pm$ 1.29	
Pre-operative Activity Level			
	Recreational sports	90.37 $\pm$ 10.07	.971
	No recreational activity	90.00 $\pm$ 0.00	

The current study examined post-operative functional outcomes using the Lysholm score among patients grouped by gender, BMI, and age. The results revealed no statistically significant difference in Lysholm scores based on gender ($p = .204$), although males exhibited a higher mean score (90.67 ± 9.89) than females (81.50 ± 12.02). This suggests that while male patients showed numerically better functional outcomes, the difference was not significant enough to imply a gender-based effect.

Similarly, BMI did not significantly influence Lysholm scores ($p = .149$). Patients with a normal BMI (≤ 25) had slightly higher scores (91.84 ± 3.91) compared to overweight individuals (> 25), who scored an average of 88.00 ± 15.27 . Although the trend indicates that increased BMI may be associated with slightly lower functional outcomes, this difference was not statistically significant in our sample.

When comparing age groups, no statistically significant differences were found either, though patients aged 31–40 years had the highest average Lysholm score (92.45 ± 2.77), followed by those above 40 years (90.37 ± 1.29) and those aged 21–30 years (89.80 ± 11.48). This may suggest a possible effect of age on functional recovery, but the lack of statistical significance limits the strength of this conclusion.

Finally, pre-operative activity level also did not significantly affect the Lysholm score ($p = .971$), indicating that baseline activity level had minimal influence on post-operative outcomes.

Discussion

The current study found that open reduction and internal screw fixation for Meyers and McKeever type 3 anterior tibial spine fractures resulted in good short-term functional outcomes, with a mean Lysholm score of 90.37. This aligns closely with previous reports, such as Chawda et al., who observed a mean Lysholm score of 86.8 at final follow-up in adults treated with open screw fixation, indicating consistent functional recovery across different populations and follow-up durations.⁸ Similarly, Gigante et al. reported a mean Lysholm score of 88.67 at two months postoperatively, further supporting the effectiveness of screw fixation in achieving favorable knee function in the short term.⁶

Cholkar et al.⁷ conducted the study, and the findings indicate that the mean preoperative Lysholm Tegner score was 51.05 ± 8.53 , which improved 9 months postoperatively to 92.10 ± 4.59 .

Recent systematic reviews and meta-analyses have compared screw fixation with alternative methods, particularly suture fixation. Several studies have found that while both screw and suture fixation yield good functional outcomes, suture fixation may offer particular advantages. For example, suture fixation has been associated with better subjective scores, increased knee stability, and a lower risk of reoperation compared to screw fixation.^{9–11}

Callanan et al. found that although clinical outcomes were broadly equivalent between suture and screw fixation, the screw group had a higher rate of reoperations, primarily for implant removal.⁹ Sharon et al. also reported a higher risk of knee

instability, reoperation, and post-operative pain with screw fixation compared to sutures. However, the overall benefits of one method over the other remain unclear.¹¹

In another study, the mean LKS was 91.96 in patients treated with suture fixation and 86.00 in patients treated with screw fixation ($p = 0.001$).¹² Limone et al.¹³ study findings indicate the mean Lysholm score in ORIF was 96.7 ± 3.6 . Sapre et al.¹⁴ reported the mean Lysholm score as 96.9 (range 91–100). The Lysholm score showed good to excellent results in 86% of the patients in a study performed by researchers to analyze the long-term functional and radiologic results of surgically treated tibial spine fractures.¹⁵ Another study showed statistically significant differences in clinical outcome using Lysholm scoring.¹⁶

The literature suggests that open and arthroscopic approaches can achieve satisfactory outcomes in type 3 tibial spine fractures. However, arthroscopic fixation, particularly with sutures, has been associated with greater knee stability and a lower risk of certain complications than open fixation.¹⁰ Despite this, open reduction and screw fixation remain viable, especially in settings where arthroscopic resources or expertise may be limited, and have been shown to provide direct visualization and stable fixation.^{7, 17}

The present study identified BMI as a significant factor influencing functional recovery, with higher BMI associated with poorer outcomes. While most comparative studies focus on fixation methods and surgical approaches, few have specifically addressed the impact of BMI on recovery. This finding highlights the importance of considering patient-specific factors in outcome assessment and may warrant further investigation in future research.

Limitations

This study provided significant insights, but it had several limitations. First, follow-up was limited to 2 months, not allowing long-term functional outcomes or late complications such as re-injury or post-traumatic osteoarthritis to be fully captured. Second, one pertinent consideration is that the study was single-center at a tertiary care setting, which limits generalizability to other populations or practice settings. Third, the gender distribution was notably

imbalanced, with most subjects being males; thus, it limits the strength of conclusions drawn regarding gender-specific outcomes. There was no comparison to an alternative fixation method, such as sutures or arthroscopic techniques, which would have allowed a more thorough evaluation of treatment efficacy. Finally, confounding variables such as pre-existing comorbidities, rehabilitation compliance, and socioeconomic factors were not controlled and could have caused variability in functional recovery scores.

Conclusion

An open reduction and internal (screw) fixation in Meyers and McKeever type 3 anterior tibial spine fractures yielded fairly good functional outcomes in the short term, with a mean Lysholm score of 90.67 at the second month. Recovery was found to be significantly influenced by BMI, with overweight patients showing lower scores when assessed functionally ($p < .001$), while age and sex showed no statistically significant impact. This emphasizes the need for pre-operative counseling and postoperative rehabilitation concerning BMI. Further studies should include long follow-up periods for assessing long-term outcomes, comparison of the different fixation techniques, such as arthroscopic suture fixation, and probing the role of patient-specific variables, such as rehabilitation compliance and comorbidities, in refining treatment protocols.

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