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A hospital-based prospective study comparing nonoperative and operative treatment of type 2 tibial spine fractures

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ABSTRACT

Background: Type 2 tibial spine fractures present a therapeutic dilemma because both nonoperative and operative treatment are commonly used, with no universal consensus regarding the optimal approach.
Methods: This prospective hospital-based study included 60 patients with Type 2 tibial spine fractures treated at SMS Medical College, Jaipur, from August 2023 to July 2024. Thirty patients underwent operative fixation and 30 received nonoperative management. Outcomes assessed included complications, knee stability, range of motion, and subsequent surgical interventions.
Results: The operative group demonstrated significantly better knee flexion (132.40±5.29 degrees vs 124.33±6.58 degrees, $p<0.001$) and total arc of motion (132.53±5.36 degrees vs 124.07±6.53 degrees, $p<0.001$). Positive Lachman test was more frequent after nonoperative treatment (20.0% vs 6.7%). Arthrofibrosis occurred only in the operative group, whereas new ACL injury and re-fracture were observed only in the nonoperative group. Subsequent surgery was required in 6.7% of patients in each group.
Conclusions: Operative treatment was associated with better postoperative range of motion and less residual laxity, while nonoperative treatment showed more instability-related complications. Treatment should be individualized according to patient profile and injury characteristics.

Keywords: Arthrofibrosis knee stability, Nonoperative treatment, Operative treatment, Tibial spine fracture, Type 2 tibial spine fracture

INTRODUCTION

Tibial spine fractures are intra-articular avulsion injuries in which the anterior cruciate ligament is detached from its tibial insertion along with a fragment of bone, thereby affecting knee stability and function.[1]

The Meyers and McKeever classification categorizes tibial spine fractures into three major types: type 1 (minimally displaced), type 2 (partially displaced or hinged), and type 3 (completely displaced).[3]

Although type 1 fractures are generally treated conservatively and type 3 fractures are usually managed operatively, the ideal management of type 2 fractures remains controversial because both treatment strategies are used in practice.[2,4]

Because the tibial spine serves as the attachment site for the anterior cruciate ligament, inadequate healing may compromise functional knee stability and may lead to laxity, recurrent injury, and long-term functional impairment.[1,5,6]

The present study was undertaken to compare nonoperative and operative treatment of type 2 tibial spine fractures with respect to complications, knee stability, range of motion, and need for subsequent intervention.

METHODS

This prospective hospital-based interventional study was conducted in the Department of Orthopaedics, SMS Medical College and Attached Hospitals, Jaipur, from August 2023 to July 2024, after approval from the Institutional Ethics Committee (Approval No. 762/MC/EC/2023 dated 05/07/2023). Written informed consent was obtained from all participants or their guardians, as applicable.

A total of 60 patients with type 2 tibial spine fractures were enrolled. Patients aged 6 to 45 years with no prior tibial spine or anterior cruciate ligament injury were eligible. Patients with associated femoral or tibial fractures, or with concomitant grade 2 or 3 injuries of the medial collateral ligament, lateral collateral ligament, or posterior cruciate ligament, were excluded.

Participants were divided into two equal groups according to the treatment received. Group A comprised 30 patients treated operatively by open or arthroscopic fixation. Group B comprised 30 patients treated nonoperatively with immobilization in brace or cast, physical therapy, and activity modification.

The primary outcome was overall complication rate, including new tibial spine fracture, new anterior cruciate ligament injury, non-union, superficial infection, persistent pain, and arthrofibrosis. Arthrofibrosis was defined as loss of 10 degrees or more of extension or 25 degrees or more of flexion compared with the contralateral limb.

Secondary outcomes included ligamentous laxity assessed by Lachman test, final range of motion (flexion, extension, and total arc), and subsequent surgeries such as reoperation for re-fracture, new ACL tear, instability-related procedures, or implant removal.

Data were entered into Microsoft Excel and analyzed using SPSS software. Continuous variables were expressed as mean +- standard deviation and compared using Student's t-test. Categorical variables were compared using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The mean age of participants was comparable between the operative group (24.97±8.76 years) and the nonoperative group (24.10±8.34 years) (p=0.765). Male patients predominated in both groups. Falls while playing were the most common mechanism of injury, followed by road traffic accidents (Table 1).

Table 1: Demographic and injury characteristics of the study population.

Parameter	Operative group	Nonoperative group	P value
Mean age (years)	24.97±8.76	24.10±8.34	0.765
Gender (male/female)	26/4	25/5	1.000
Fall while playing, N (%)	18 (60.0)	17 (56.7)	-
Road traffic accident, N (%)	9 (30.0)	8 (26.7)	0.926
Slipping, N (%)	3 (10.0)	5 (16.6)	-

Table 2: Comparison of knee range of motion.

Motion parameter	Operative group	Nonoperative group	P value
Flexion (degrees)	132.40±5.29	124.33±6.58	<0.001
Extension (degrees)	0.13±0.51	0.27±0.58	0.126
Total arc of motion (degrees)	132.53±5.36	124.07±6.53	<0.001

Table 3: Post-treatment knee stability and ligamentous laxity.

Lachman test	Operative group, N (%)	Nonoperative group, N (%)	P value
Positive	2 (6.7)	6 (20.0)	0.253
Negative	28 (93.3)	24 (80.0)	

Operative treatment resulted in significantly better postoperative knee flexion and total arc of motion. Extension was similar in both groups and the difference was not statistically significant (Table 2).

Positive Lachman test was observed more often after nonoperative treatment (20.0%) than after operative treatment (6.7%), suggesting greater residual laxity in the conservatively managed group, although the difference did not reach statistical significance (p=0.253) (Table 3).

Arthrofibrosis occurred only in the operative group. In contrast, all new ACL injuries and re-fractures occurred in the nonoperative group. The overall complication rate was higher in the nonoperative group (20.0% vs 13.3%), but the difference was not statistically significant (p=0.678).

Subsequent surgery was required in 6.7% of patients in each group (Table 4).

Table 4: Complications and subsequent surgeries.

Complication	Operative group, N (%)	Nonoperative group, N (%)	P value
Arthrofibrosis	2 (6.7)	0	-
New ACL injury	0	3 (10.0)	-
Re-fracture	0	2 (6.7)	-
Superficial infection	1 (3.3)	0	-
Persistent pain	1 (3.3)	1 (3.3)	-
Total complications	4 (13.3)	6 (20.0)	0.678
Subsequent surgery	2 (6.7)	2 (6.7)	1.000

DISCUSSION

In the present study, both groups were demographically comparable, with similar age distribution, sex distribution, and mechanisms of injury. This reduced the likelihood that baseline differences influenced the observed treatment outcomes.

The operative group achieved significantly better knee flexion and total arc of motion than the nonoperative group. These findings suggest that anatomic reduction and fixation may improve postoperative functional recovery, which is consistent with previous reports.[8-10]

Residual laxity assessed by Lachman test was more frequent in the nonoperative group. Although the difference was not statistically significant, the trend is clinically relevant and is in keeping with published evidence showing better anterior stability after fixation.[12,13]

Operative treatment was associated with arthrofibrosis in a small number of patients, highlighting the need for meticulous rehabilitation and early mobilization. By contrast, new ACL injury and re-fracture occurred only after nonoperative treatment, suggesting a greater risk of residual instability or incomplete healing with conservative care.[6,14]

Taken together, these findings indicate that operative management may provide superior stability and range of motion in type 2 tibial spine fractures, whereas nonoperative treatment may still be considered selectively in carefully chosen patients.

CONCLUSION

Operative management of type 2 tibial spine fractures was associated with better postoperative knee flexion, better total arc of motion, and less residual laxity than nonoperative management. Although arthrofibrosis was observed only in the operative group, nonoperative management showed more instability-related complications, including new ACL injury and re-fracture. Operative treatment appears preferable for many patients with type 2 tibial spine fractures, especially when restoration of stability and function is a priority. Treatment, however, should be individualized according to age, activity level, and injury characteristics.

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