

Tibial Tubercle Involvement in Tibial Plateau Fractures Reduces Postoperative Range of Motion

Robert Ramiro G Hernandez, David Dallas-Orr, Noah Lyndall, Tyler Lockwood, Shannon Tse, Gillian Soles, Ellen P Fitzpatrick, Mark A Lee, Sean T Campbell, Augustine M Saiz

INTRODUCTION: Tibial plateau fractures (TPF) represent approximately 1% of all fractures. These injuries may also involve the tibial tubercle, which must be stabilized due to its impact on the extensor mechanism. Limited research has been conducted on looking into postoperative TPF outcomes with tubercle involvement. This study aimed to investigate how tibial tubercle involvement (TTI) in TPFs affects postoperative range of motion (ROM) compared to cases without tubercle involvement (WTI). We hypothesized that patients with TTI would have significantly reduced range of motion and that TTI would worsen clinical outcomes at 1 year postoperatively.

METHODS: A retrospective study was conducted of patients who sustained a TPF between 2014-2025 and screened for tubercle involvement. Tibial tubercle involvement was determined through review of radiographic images, CT scans, and operative notes. Postoperative knee ROM was extracted from clinical notes at 6-week and 12-week follow-up visits. Patients that did not have active records of ROM in clinic notes were excluded from the analysis. Independent t-tests were used to compare the flexion and extension ROM between patients with and without tubercle involvement. A chi-square and Fishers exact tests were used accordingly to assess the association between tubercle involvement and postoperative weightbearing status as well as immobilization status.

RESULTS: A total of 162 patients with operatively treated TPF were included in this study. The cohort had an average age of 48.1 years and consisted of 86 (53%) males. The mean Injury Severity Scores of the TTI and WTI groups did not show significant differences (TTI 10.7 ± 9.7 ; WTI 8.7 ± 7.8 ; $p=0.22$). A chi-square test evaluating postoperative weightbearing instructions and immobilization status indicated a significant difference in weightbearing instructions and immobilization status between the TTI and WTI groups ($p = 0.038$; $p = 0.023$) (Table 1). The TTI group demonstrated significantly reduced knee flexion ($71.0^\circ \pm 18.1^\circ$ vs. $105.5^\circ \pm 25.6^\circ$, $p < 0.001$) at 12 weeks postoperatively compared to the WTI group. No significant difference was seen in flexion ROM at 6 weeks ($94.8^\circ \pm 24.1^\circ$ vs. $100.5^\circ \pm 21.8^\circ$, $p = 0.25$) or in extension ROM at either 6 or 12 weeks (Table 2). With an average follow-up time of 1.2 years, no significant differences were found in the rates of reoperation ($p=0.97$), nonunion ($p=0.86$), or infection ($p=0.89$).

DISCUSSION AND CONCLUSION: This study demonstrated that patients with TPFs with tibial tubercle involvement had significantly lower flexion ROM at 12 weeks postoperatively compared to those without tibial tubercle involvement. Additionally, there was a significant difference in postoperative weight bearing status and immobilization measures between groups indicating that immobilization measures had an impact on 12-week flexion ROM. Tibial tubercle involvement in plateau fractures may require different rehabilitation protocols and surgical strategies to maximize patient outcomes. Further investigation and classification of these injuries may be warranted.

Table 1. Comparison of Postoperative Weightbearing and Immobilization Status Between WTI and TTI Cohorts

	No WB (n (%))	Any WB (n (%))	Immobilized (n (%))	Not Immobilized (n (%))
WTI	90 (60)	17 (11)	6 (4)	112 (69)
TTI	42 (28)	2 (1)	8 (5)	37 (23)
Total	132 (87)	19 (14)	14 (9)	149 (91)

Note: Weight-bearing status ($p = 0.038$); Immobilization status ($p = 0.023$); The any weightbearing group consisted of partial weight-bearing, toe-touch weightbearing, and touch-down weight-bearing; TTI: Tibial Tubercle Involved; WB = weight-bearing; WTI: Without Tubercle involvement

Table 2. Comparison of Postoperative Range of Motion Between Tibial Plateau Fractures with and without Tibial Tubercle Involvement

Follow-up	ROM	Tubercle Fracture (Mean \pm SD)	Tubercle Fracture (Mean \pm SD)	p-value
6-week	Flexion ($^\circ$)	100.5 ± 21.8	94.8 ± 24.1	0.25
	Extension ($^\circ$)	4.8 ± 6.9	5.5 ± 5.8	0.55
12-week	Flexion ($^\circ$)	105.5 ± 25.6	71.0 ± 18.1	$< 0.001^*$
	Extension ($^\circ$)	3.2 ± 5.7	2.4 ± 3.5	0.33

Note: * indicates statistical significance at $p \leq 0.05$. Abbreviations: ROM = Range of Motion; SD = Standard Deviation.