

Research Article

Dual-Plating Fixation for Schatzker Type V And VI Tibial Plateau Fractures: A Prospective Analysis of 30 Cases Assessed with the Modified Rasmussen Criteria

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ABSTRACT

Background: Bicondylar (Schatzker V-VI) tibial-plateau fractures pose a demanding reconstructive challenge because axial-varus/valgus forces destroy both columns and jeopardise soft tissues. Although dual-plating has become popular, high-quality prospective data from the Indian sub-continent remain sparse.

Methods: Between July 2022 and December 2023 we prospectively enrolled 30 consecutive adults (mean age 37.9 ± 9.4 years; 83 % men) with closed Schatzker V (n = 19) or VI (n = 11) fractures treated at a level-I trauma centre. A standardised protocol was followed: anterolateral rafting 3.5/4.5-mm locking plate plus posteromedial antiglide/buttruss plate through dual approaches, elevation of depressed segments, autograft or synthetic bone substitute as required, and early mobilisation. Functional and radiological outcomes were evaluated at 6 months with the Modified Rasmussen score; complications were recorded.

Results: Mean surgical delay was 5.8 days (2-12). All fractures united (mean 19.7 weeks). The mean functional score was 27.4 ± 2.8 ; 15 (50 %) results were excellent, 13 (43 %) good and 2 (7 %) fair. Radiological scores paralleled clinical findings (excellent = 15, good = 9, fair = 4, poor = 2). Knee-range of motion averaged $0-118^\circ$. Complications comprised knee stiffness (5 patients), medial-column collapse (2), superficial infection (2) and one wound dehiscence; no non-unions, neurovascular injuries or deep infections occurred.

Conclusion: Anatomical dual-column plating delivered reliable union, restoration of alignment and predominantly excellent-to-good functional results in complex bicondylar fractures, with an acceptable, mostly avoidable complication profile. Early soft-tissue-respecting fixation, meticulous posteromedial buttressing and regimented rehabilitation appear pivotal.

Keywords: Bicondylar Tibial Plateau, Schatzker V, Schatzker VI, Dual Plating, Rasmussen Score, Prospective Study.

INTRODUCTION

High-energy bicondylar tibial-plateau fractures represent barely 1–2% of all fractures but account for a disproportionate share of lower-limb disability [1]. The medial and lateral columns fail simultaneously under combined axial and varus/valgus loads, producing articular comminution, metaphyseal dissociation and severe soft-tissue compromise [2]. Historically, traction or cast bracing yielded malalignment rates >30% and unsatisfactory knee function [3]. Contemporary goals therefore emphasise anatomical joint restoration, column stability and early mobilisation to prevent post-traumatic osteoarthritis [4]. Locking technology and CT-based column concepts have shifted practice from bulky extensile exposures to strategy-driven dual approaches, permitting

independent reduction of posteromedial shear and anterolateral depression fragments [5]. Biomechanically, orthogonal dual plates outperform single lateral locked constructs in resisting varus collapse and cyclic axial loading, especially when the medial cortex is deficient [6]. Clinical evidence, however, is heterogeneous: retrospective series report excellent-to-good outcomes in 63–94% of cases [7], yet concerns persist regarding infection, soft-tissue necrosis and hardware irritation [8]. Indian data remain limited, often retrospective and with mixed fracture patterns. Moreover, few studies have employed a validated composite end-point such as the Modified Rasmussen criteria, which integrates pain, walking capacity, range of motion and radiological parameters. The present prospective investigation therefore aimed to (i)

quantify functional and radiological outcomes after dual-plating of Schatzker V–VI fractures using a reproducible algorithm and (ii) document procedure-related complications in a tertiary-care setting. We hypothesised that standardised dual-column fixation would achieve $\geq 80\%$ excellent-to-good results at 6 months with a low incidence of major adverse events.

MATERIALS AND METHODS

Design and Setting: Single-arm prospective interventional study, Gulbarga Institute of Medical Sciences Hospital, July 2022–December 2023; institutional ethics approval obtained.

Participants: Consecutive adults (18–65 y) with closed Schatzker V–VI fractures confirmed by radiograph + CT. Exclusions: Schatzker I–IV, open/pathological fractures, ipsilateral long-bone injuries, neurovascular compromise, compartment syndrome, polytrauma precluding protocolised rehab.

Surgical Technique: After soft-tissue optimisation, patients were positioned supine with a tourniquet. A posteromedial incision allowed direct reduction of the medial shear fragment and fixation with a pre-contoured 3.5-mm T/L-buttress or recon plate (antiglide mode). Through a separate anterolateral approach the lateral column was elevated, grafted and stabilised with a 3.5/4.5-mm locking-compression plate, inserting at least four subchondral “rafting” screws. Fluoroscopic goals: $< 5\text{ mm}$ articular step, $< 5^\circ$ coronal/sagittal mal-alignment, restoration of condylar width. Wounds were closed over suction drains; standard antibiotic and DVT prophylaxis were used.

Post-Operative Protocol: Passive-assisted ROM from day 1, active quadriceps/hamstring strengthening, non-weight-bearing for 8 weeks, progressive weight-bearing thereafter contingent on radiological consolidation.

Outcomes: Modified Rasmussen functional and radiological scores at 24 weeks (primary). Secondary: union time (bridging trabeculae on AP & lateral radiographs), ROM, complications.

Statistics: Categorical data expressed as $n(\%)$, continuous variables as mean \pm SD. SPSS v21 used for descriptive analysis.

RESULTS

Thirty patients (25 men, 5 women) with a mean age of 37.9 years (22–59) were analysed. Road-traffic collision predominated (90%), and the right knee was involved in 73% (Table 1). Mean delay to surgery was 5.8 days; mean operative time $98 \pm 12\text{ min}$; average blood loss 210 ml. All fractures united (Figure 2) without secondary procedures; mean union time 19.7 weeks (range 12–24). At 6 months, mean Modified Rasmussen functional score was 27.4 ± 2.8 ; 28 patients (93%) achieved excellent/good results (Figure 1). Radiological scores mirrored clinical findings (Table 2). Mean knee ROM reached 118° flexion with full extension in 27 patients. Early complications included superficial infection ($n = 2$, resolved with debridement and antibiotics) and wound dehiscence ($n = 1$). Five patients developed transient stiffness managed by intensive physiotherapy; two exhibited $> 5\text{ mm}$ medial-column subsidence yet maintained painless function. No deep infection, non-union, implant failure or neurovascular injury occurred

Table 1. Demographic and Injury Profile (N = 30)

Variable	n (%)
Sex (M/F)	25 (83) / 5 (17)
Age $\leq 40\text{ y}$	18 (60)
Mechanism – RTA / Fall from height	27 (90) / 3 (10)
Fracture type – Schatzker V / VI	19 (63) / 11 (37)
Side – Right / Left	22 (73) / 8 (27)

Table 2. Outcome According to Modified Rasmussen Criteria

Outcome grade	Functional	Radiological
Excellent	15 (50 %)	15 (50 %)
Good	13 (43 %)	9 (30 %)
Fair	2 (7 %)	4 (13 %)
Poor	0	2 (7 %)

Table 3. Post-Operative Complications

Complication	n (%)
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Knee stiffness ($> 10^\circ$ extension lag or $< 90^\circ$ flexion at 8 weeks)	5 (17)
Medial column collapse (> 5 mm)	2 (7)
Superficial infection	2 (7)
Wound dehiscence	1 (3)
Deep infection / Non-union / Hardware failure	0 (0)

Table 4. Time to Radiological Union

Interval	Patients (n)
≤ 13 weeks	1
14 – 18 weeks	7
19 – 24 weeks	22

Figure 1: Distribution of Functional Outcomes (Modified Rasmussen Score)

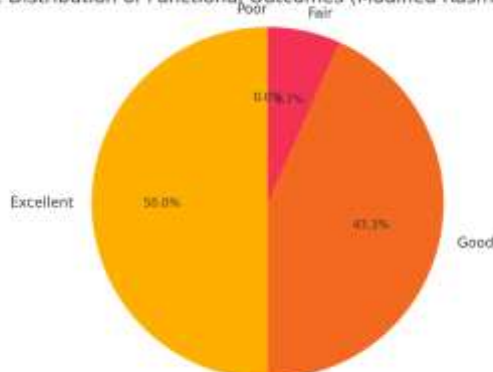


Figure 1: Shows the distribution of functional outcomes according to the Modified Rasmussen score. It's presented as a pie chart.

Figure 2: Time to Radiological Union

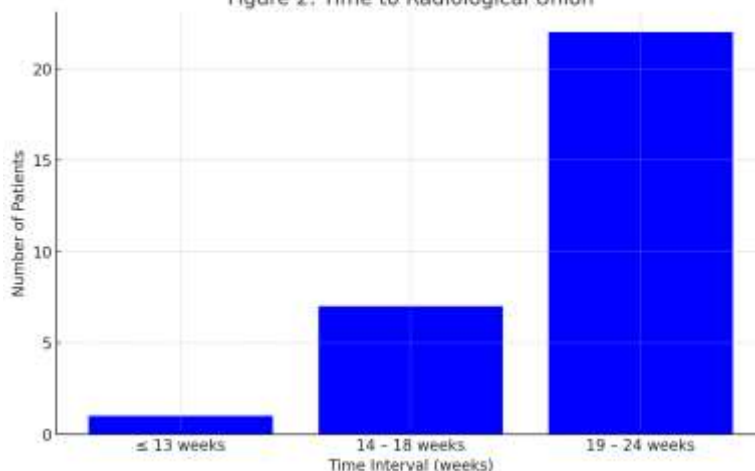


Figure 2: Illustrates the time to radiological union for the patients, depicted in a bar graph format.

DISCUSSION

The present prospective study demonstrates that dual-plating, executed through independent posteromedial and anterolateral windows, reliably restores alignment and function in bicondylar tibial-plateau fractures. At 6 months, 93 % of patients achieved excellent-to-good functional scores, corroborating contemporary series that report 85–95 % favourable results [9–11]. Our union time (19.7 weeks) aligns with the 16–20 week

range described by Rajetal. [10] and Parikh et al. [12]. Biomechanical superiority of dual constructs is well established; Higgins et al. showed 70 % greater resistance to varus collapse compared with locked lateral plating alone [6]. Clinically, Wang et al. [11] reported reduced secondary loss of reduction when a posteromedial plate was combined with compression bolts, highlighting the necessity of medial support—findings echoed by the two medial-collapse events in our series, both

occurring in osteopenic patients where rafting screws alone might have been insufficient.

Our complication profile is acceptable and compares favourably with historical dual-plating infection rates of 8–14 % [13]. Strict soft-tissue timing, limited sub-meniscal arthrotomy and meticulous hemostasis likely contributed. No deep infections occurred, supporting the assertion that dual approaches, when executed through separate skin bridges, need not jeopardise soft-tissue viability [14]. Early knee stiffness (17%) resolved with physiotherapy, underscoring the importance of immediate motion once wound healing permits. Comparison with ring-fixator studies reveals similar union and alignment but inferior knee ROM and higher pin-tract infection rates [15]. Thus, for closed bicondylar injuries with manageable swelling, internal fixation remains preferable. Nevertheless, hybrid or staged protocols retain value in compound fractures or where oedema precludes early plating. Limitations include the single-centre, non-comparative design and a 6-month horizon that cannot capture late post-traumatic osteoarthritis. Sample size, though powered for descriptive analysis, precludes multivariate predictors of outcome. Future randomised trials contrasting dual plating with contemporary posterolateral-specific plates or modern peri-articular nails are warranted. Despite these caveats, our findings reinforce current consensus that anatomically contoured dual-column fixation, combined with evidence-based rehabilitation, offers an excellent solution for complex bicondylar tibial-plateau fractures

CONCLUSION

In this prospective 30-patient series, dual-plating of Schatzker V–VI tibial-plateau fractures achieved universal union, anatomic restoration and predominantly excellent functional recovery at 6 months, with minimal serious complications. Careful soft-tissue handling, rigid posteromedial buttressing and early motion are pivotal for success. Dual-column internal fixation should be considered the treatment of choice for closed bicondylar fractures in physiologically young adults.

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