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A COMPARATIVE STUDY OF FUNCTIONAL OUTCOME OF SCHATZKER TYPE 2 AND TYPE 3 TIBIAL PLATEAU FRACTURE MANAGED BY RAFT PLATING WITH VOID FILLER VS WITHOUT VOID FILLER

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ABSTRACT

Background: Schatzker type II and III tibial plateau fractures require accurate articular reduction and stable subchondral support to prevent secondary collapse and achieve good functional outcomes. This study compared the clinical, functional, and radiological outcomes of raft plating performed with and without void filler. **Materials and Methods:** This prospective cohort study included 30 adult patients with Schatzker type II and III fractures treated between March 2023 and July 2024. Patients were divided into Group 1 (raft plating with void filler, n=15) and Group 2 (without void filler, n=15). Radiological subsidence, Rasmussen radiological and clinical scores, time to union, operative duration, and final outcomes were analysed using appropriate statistical tests. **Results:** The mean age was 52.2±14.27 years in Group 1 and 44.87±8.43 years in Group 2, with male predominance and road traffic accidents as the commonest mode of injury. Preoperative radiological subsidence (7.67±4.17 mm vs 10.47±5.59 mm; p=0.107) and Rasmussen radiological scores (11.87±3.34 vs 10.8±3.53; p=0.519) were comparable. Postoperative subsidence was minimal in both groups (0.4±1.06 mm vs 1.33±3.52 mm; p=0.916), with identical mean Rasmussen radiological scores (17.47; p=1). Postoperative Rasmussen clinical scores were similar (29±0 vs 28.8±2.01; p=0.702), and union occurred at 13.33±1.63 and 13.67±1.51 weeks (p=0.729). Both groups showed significant within-group improvement (p<0.001). Final radiological outcomes were excellent in 86.7% of patients in each group, while clinical outcomes were excellent in 100% and 86.7% (p=0.483). Operative time was significantly longer with void filler (118.33±7.53 vs 77.5±5.42 minutes; p=0.005). **Conclusion:** Raft plating with and without void filler provides comparable radiological and functional outcomes in Schatzker type II and III fractures. Omission of the void filler significantly reduces operative time.

INTRODUCTION

Tibial plateau fractures represent approximately 1% of all fractures and are commonly caused by high-energy mechanisms such as road traffic accidents and falls, directly affecting knee stability and load transmission.[1] These injuries predominantly involve the proximal tibia and are more frequently seen in adult males due to higher exposure to occupational and high-impact activities.[2,3] Long-term complications, such as post-traumatic osteoarthritis, are related to the accuracy of articular reduction and maintenance of joint congruity.[3]

The Schatzker classification categorises these fractures based on morphology, with Type II defined by lateral split-depression and Type III by pure depression of the lateral plateau, produced by axial loading combined with valgus force.[1] Type II and III patterns constitute a large quantity of lateral plateau injuries and are encountered in both younger patients following high-energy trauma and elderly patients with osteoporotic bone after low-energy falls.[4] Restoration of the articular surface, correction of mechanical alignment, and stable fixation are the primary surgical objectives to permit early knee mobilisation and reduce secondary collapse.[5] Open reduction and internal fixation are commonly accepted for displaced Schatzker Type II and III fractures to achieve anatomical reduction and maintain joint congruity.[2] Raft plating, which uses multiple subchondral screws placed parallel to the joint surface through a lateral locking plate, provides structural support to elevated articular fragments and increases construct stiffness.[6] Load sharing across the subchondral bone with rafting screws helps resist depression and maintains the elevated plateau position.[1]

Metaphyseal void fillers such as autologous bone graft, allograft, or synthetic substitutes have usually been used after elevation of depressed fragments to support the subchondral surface and prevent secondary subsidence.[7] Use of bone graft is associated with additional operative time, donor site morbidity, infection risk, and increased treatment cost, which has led surgeons to evaluate fixation without grafting in selected cases. A study involving depressions <20 mm in Schatzker Type II and III fractures reports comparable radiological maintenance of reduction, Rasmussen functional scores, and union rates between grafted and non-grafted groups when stable raft screw constructs are used.[4] A prospective comparison also shows similar postoperative subsidence and time to union in both groups when adequate subchondral rafting is achieved.[2]

Minimally invasive and percutaneous techniques with preservation of the lateral cortical wall and precise placement of rafting screws have shown satisfactory maintenance of reduction without routine use of void fillers, particularly in fractures with limited metaphyseal comminution.[5-7] Modern locking plates with fixed-angle rafting screws provide stronger subchondral support, which reduces secondary depression even in the absence of graft material.[8] Patient age, bone quality, and degree of comminution still influence maintenance of reduction and functional recovery.[9,10] Direct comparative data specifically assessing raft plating with versus without void fillers in Schatzker Type II and III fractures remain limited.[11,12] Analysing whether raft plating alone can provide equivalent structural support without increasing secondary subsidence or compromising knee function would help improve surgical indications, simplify the operative procedure, and reduce graft-related morbidity and cost. Hence, this study aims to compare and analyse the clinical, functional, and radiological outcomes of Schatzker type II and III tibial plateau fractures managed with raft plating with void filler versus raft plating without void filler.

Objectives: To evaluate and compare radiological and functional outcomes in patients treated with raft plating with and without void filler, and to determine the effectiveness of raft plating without void filler as an alternative to plating with void filler.

MATERIALS AND METHODS

This prospective cohort study was conducted in the Department of Orthopaedics and Traumatology at K.A.P.V. Government Medical College and Mahatma Gandhi Memorial Government Hospital (MGMGH), Tiruchirappalli, from March 2023 to July 2024. Ethical clearance was obtained from the Institutional Ethics Committee prior to the study, and written informed consent was obtained from all patients.

Inclusion Criteria

Patients aged above 18 years with Schatzker type II and III tibial plateau fractures, closed fractures, fracture duration <four weeks, and those who were medically and surgically fit for operative management.

Exclusion Criteria

Patients with Schatzker type I, IV, V, and VI fractures, compound (open) fractures, pathological fractures, patients presenting with neurovascular deficit, and those with severe degenerative changes and deformity around the knee.

Methods

A total of 30 patients with tibial plateau fractures fulfilling the eligibility criteria were included in the study. The patients were allocated into two equal groups: Group 1 (raft plating with void filler, n = 15) and Group 2 (raft plating without void filler, n = 15). At admission, baseline clinico-epidemiological data such as age, sex, and mode of injury were recorded in a predesigned proforma. Preoperative radiological evaluation was performed using standard anteroposterior and lateral radiographs of the knee to measure the depth of articular depression and to calculate the Rasmussen radiological score. It assesses articular depression, condylar widening, and varus/valgus angulation (each scored 0–6; total 18, graded as excellent, good, fair, or poor). Functional status was assessed preoperatively using the Rasmussen clinical scoring system, a 30-point scale based on pain, walking capacity, knee extension, range of motion, and stability, with final results graded as excellent, good, fair, or poor.

All patients underwent uniform preoperative preparation, which included local part preparation with 10% povidone iodine scrub, administration of intravenous ceftriaxone 1 g one hour prior to tourniquet inflation, and surgery under spinal or epidural anaesthesia. Patients were positioned supine with a bump under the ipsilateral hip to achieve internal rotation of the limb, the knee flexed to 20–30°, and intra-operative fluoroscopy was used in all cases. Fractures were managed through a standard anterolateral incision, followed by submeniscal arthrotomy for articular visualisation. Depressed fragments were elevated using bone tamps or elevators and temporarily stabilised with 2-mm Kirschner wires. Definitive fixation was performed with a lateral locking raft plate placed over the anterolateral proximal tibia under C-arm guidance, and multiple 3.5-mm subchondral rafting screws were inserted approximately 2 mm below the articular surface. In Group A, the metaphyseal void was filled with bone graft or bone substitute as required, whereas in Group B, no void filler was used. Final reduction and implant position were confirmed fluoroscopically, and the wound was closed in layers.

Postoperatively, pain control was achieved with epidural analgesia when required, along with tramadol and diclofenac. Early knee range-of-motion exercises were initiated, and a continuous passive motion device was used when available. All patients were kept non-weight bearing initially and were gradually progressed to partial and then full weight bearing based on clinical and radiological evidence of healing. Follow-up was performed at 4-week intervals for the first 6 months and then every 2 months up to 2 years in the absence of complications. At each visit, radiographs (AP and lateral views) were obtained to measure residual or secondary subsidence and to assess fracture union, which occurred at a mean of approximately 13–14 weeks in both groups. Rasmussen radiological and clinical scores were recorded at each follow-up and at final evaluation, and the outcomes were graded.

Statistical Analysis: Data were entered and analysed using SPSS v. 25. Continuous variables were expressed as mean ± standard deviation (SD) and median with interquartile range (IQR). Categorical variables were expressed as frequencies and percentages. Normality of data was assessed using the Shapiro–Wilk test. Intergroup comparisons between the two groups were performed using the independent samples t-test for normally distributed continuous variables and the Mann–Whitney U test for non-normally distributed data. Within-group comparisons were analysed using the paired t-test or the Wilcoxon signed-rank test as appropriate. Categorical variables were analysed using the Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

The mean age was higher in Group 1 (52.2 ± 14.27 years; median 44, IQR 12; range 41–78) vs Group 2 (44.87 ± 8.43 years; median 48, IQR 6; range 25–51). Males were common in both groups (60% vs 86.7%). Road traffic accident (RTA) was the most common mode of injury (80% and 86.3%), followed by self-fall (20% and 13.7%). [Table 1]

Table 1: Baseline Clinico-Epidemiological Profile of Patients

Parameters	Variable	Group 1	Group 2
Age (years)	Mean ± SD	52.2 ± 14.27	44.87 ± 8.43
	Median (IQR)	44 (12)	48 (6)
	Range	41–78	25–51
Gender, n (%)	Male	9 (60%)	13 (86.7%)
	Female	6 (40%)	2 (13.3%)
Mode of Injury, n (%)	RTA	12 (80%)	13 (86.3%)
	Self-fall	3 (20%)	2 (13.7%)

Preoperatively, radiological subsidence and Rasmussen radiological scores were comparable between the two groups (p=0.107 and p=0.519). Postoperatively, both groups showed minimal subsidence with similar median values and no significant difference (p=0.916). The Rasmussen radiological score improved to the same level in both groups after surgery (mean 17.47; p=1). The preoperative Rasmussen clinical score was significantly higher in Group 2 than in Group 1 (p=0.03), but postoperative functional outcomes were similar (p=0.702). The time to fracture union was comparable (p=0.729). The duration of surgery was significantly longer in Group 1 compared to Group 2 (118.33 ± 7.53 vs 77.5 ± 5.42 minutes; p=0.005). [Table 2]

Table 2: Comparison of Clinical, Functional and Radiological Outcomes Between Groups

Parameters	Variable	Group 1		Group 2		P value
		Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
Radiological Subsidence (mm)	Preoperative	7.67 ± 4.17	5 (5)	10.47 ± 5.59	8 (10)	0.107
	Postoperative	0.4 ± 1.06	0 (0)	1.33 ± 3.52	0 (0)	0.916
Rasmussen Radiological Score	Preoperative	11.87 ± 3.34	14 (4)	10.8 ± 3.53	10 (8)	0.519
	Postoperative	17.47 ± 1.41	18 (0)	17.47 ± 1.41	18 (0)	1
Rasmussen Clinical Score	Preoperative	4.4 ± 0.83	4 (0)	5.2 ± 1.01	6 (2)	0.03
	Postoperative	29 ± 0	29 (0)	28.8 ± 2.01	29 (1)	0.702
Time to Union (weeks)		13.33 ± 1.63	13 (2)	13.67 ± 1.51	14 (1.5)	0.729
Duration of surgery (mins)		118.33 ± 7.53	Range: 110-130	77.5 ± 5.42	Range: 70-85	0.005

In Group 1, radiological subsidence significantly decreased from 7.67 ± 4.17 mm to 0.4 ± 1.06 mm (p < 0.001), Rasmussen radiological score improved from 11.87 ± 3.34 to 17.47 ± 1.41 (p < 0.001), and clinical score improved from 4.4 ± 0.83 to 29 ± 0 (p < 0.001). In Group 2, subsidence reduced from 10.47 ± 5.59 mm to 1.33 ± 3.52 mm (p < 0.001), radiological score improved from 10.8 ± 3.53 to

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17.47 ± 1.41 (p < 0.001), and clinical score increased from 5.2 ± 1.01 to 28.8 ± 2.01 (p < 0.001). [Table 3]

Table 3: Within-Group Comparison of Preoperative and Postoperative Outcomes

Groups	Variable	Preoperative (Mean ± SD)	Preoperative Median (IQR)	Postoperative (Mean ± SD)	Postoperative Median (IQR)	P value
Group 1	Radiological Subsidence (mm)	7.67 ± 4.17	5 (5)	0.4 ± 1.06	0 (0)	<0.001
	Rasmussen Radiological Score	11.87 ± 3.34	14 (4)	17.47 ± 1.41	18 (0	<0.001
	Rasmussen Clinical Score	4.4 ± 0.83	4 (0)	29 ± 0	29 (0)	<0.001
Group 2	Radiological Subsidence (mm)	10.47 ± 5.59	8 (10)	1.33 ± 3.52	0 (0)	<0.001
	Rasmussen Radiological Score	10.8 ± 3.53	10 (8)	17.47 ± 1.41	18 (0)	<0.001
	Rasmussen Clinical Score	5.2 ± 1.01	6 (2)	28.8 ± 2.01	29 (1)	<0.001

Final radiological outcomes were similar, with 13 excellent and 2 good results in each group (p = 1). Final clinical outcomes were excellent in all 15 patients (100%) in Group 1 and in 13 patients (86.7%) in Group 2, with 2 good outcomes (13.3%) (p = 0.483). Both groups showed excellent outcomes with no significant intergroup difference. [Table 4]

Table 4: Final Clinical and Radiological Outcome Distribution Between Groups

Parameters	Outcome Category	Group 1	Group 2	P value
Final Radiological Outcome (Rasmussen)	Excellent	13 (86.7%)	13 (86.7%)	1
	Good	2 (13.3%)	2 (13.3%)	
Final Clinical Outcome (Rasmussen)	Excellent	15 (100%)	13 (86.7%)	0.483
	Good	0	2 (13.3%)	

DISCUSSION

Schatzker type II and III tibial plateau fractures require stable subchondral support to maintain articular reduction and achieve favourable functional recovery. This study evaluated and compared the clinical, radiological, and functional outcomes of raft plating performed with and without void filler. Both groups showed significant postoperative improvement in radiological subsidence and Rasmussen clinical and radiological scores, with comparable final functional and radiological outcomes and similar union time.

In our study, Group 1 had relatively older age patients. Males were common in both groups, and RTA was the most common mode of injury, followed by self-fall. Similarly, Manjunath and Harshith included 30 patients with a mean age of 47 ± 13.70 years (range 32–79 years) and reported a higher proportion of males (83.3% males, 16.7% females).[13] Similarly, in the study by Kayali et al., the sample comprised 19 males and 5 females, with the history of injury being 16 motor vehicle collisions and 8 falls from height, resulting comparable male majority and RTA common injury in tibial plateau fractures.[14] Thus, both studies reported a comparable age distribution, male majority and RTA in patients with tibial plateau fractures, indicating similar baseline demographic characteristics.

In our study, there were no significant differences between the groups in preoperative and postoperative radiological subsidence, Rasmussen radiological scores, postoperative clinical scores, or time to union. Although preoperative clinical scores differed statistically, postoperative functional outcomes were comparable. The duration of surgery was significantly longer in the group with filler. Patterson et al. reported that patients treated with subchondral rafting wires showed statistically less linear articular subsidence (0.3 mm) compared to those without rafting fixation (1.0 mm), with no cases of subsidence ≥ 2 mm in the rafting group versus 13.4% in the non-rafting group (p < 0.001).[15] Similarly, Pereira et al. reported loss of articular reduction in only two patients in each group, with excellent or good Rasmussen clinical scores in 93.75% and excellent or very good radiological Rasmussen scores in 96.25% of cases, showing no significant difference between groups.[2] McNamara et al. report that void fillers require additional preparation and handling beyond plate fixation, which increases the duration of the surgery.[16] Thus, raft plating without void filler provides radiological stability, fracture union, and functional outcomes comparable to raft plating with void filler, while significantly reducing operative time.

In our study, both groups showed significant postoperative improvement, with a reduction in radiological subsidence and significant improvement in Rasmussen radiological and clinical scores. Similarly, Manjunath and Harshith reported good to excellent Modified Rasmussen outcomes (33.3% excellent, 50% good) with a mean range of motion of 115.66° ± 7.73° and fracture union at 8.03 ± 1.84 weeks, resulting in effective maintenance of reduction and favourable functional recovery with subchondral raft construct fixation.[13] Giordano et al. reported all fractures healed successfully with no significant articular subsidence or loss of reduction, and excellent functional outcomes were noted with a mean Lysholm score of 96 and a mean knee range of motion of approximately 130°.[5] This supports our findings that raft-based subchondral support provides stable fixation, maintains articular reduction, and results in supportive postoperative clinical and radiological improvement.

In our study, both groups showed excellent final radiological and clinical outcomes. Radiological outcomes were identical, and clinical outcomes were comparable between the groups. This is comparable to the study by Kulkarni et al., which reported excellent to good Rasmussen radiological outcomes (27 excellent, 9 good) and clinical outcomes (15 excellent, 21 good) with a mean union time of 13.2 weeks using a raft construct without bone graft.[17] Similarly, Barath et al reported similar Rasmussen functional scores (28.15 ± 1.66 vs 27.55 ± 1.53) and radiological scores (8.40 ± 0.50 vs 7.90 ± 0.96) with no significant difference between groups.3 This is comparable to our study, where both filler and non-filler groups showed excellent clinical and radiological outcomes with no significant difference, suggesting that void filler may not be essential when stable raft fixation is achieved.

Our findings suggest that raft plating with and without void filler provides comparable clinical, functional, and radiological outcomes in Schatzker type II and III tibial plateau fractures, and the addition of void filler may not be essential when stable subchondral raft fixation and adequate articular reduction are achieved.

Limitations

The sample size was relatively small (n = 30), which may limit the generalizability of the findings. The study was conducted at a single tertiary care centre, which may introduce selection bias and reduce external validity. Randomisation was not performed, as this was a prospective cohort study, which could have resulted in baseline differences between groups. The follow-up duration, although adequate for assessing union and early functional outcomes, may not be sufficient to evaluate long-term complications such as post-traumatic osteoarthritis. Factors such as bone quality, degree of comminution, and surgeon-dependent technical variations were not separately stratified, which could influence radiological subsidence and functional outcomes.

CONCLUSION

The raft plating with and without void filler provides comparable clinical, functional, and radiological outcomes in the management of Schatzker type II and III tibial plateau fractures. Both groups showed significant postoperative improvement in radiological subsidence, Rasmussen radiological scores, and Rasmussen clinical scores, with similar time to union and excellent final outcomes. The use of void filler may not be essential when stable subchondral raft fixation and adequate anatomical reduction are achieved. Raft plating without void filler can be considered a reliable and effective alternative to raft plating with void filler in appropriately selected Schatzker type II and III tibial plateau fractures.

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