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A Cross-Sectional Study of Post-Surgical Outcomes in Tibial Plateau Fractures: ORIF vs. External Fixation

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ABSTRACT

Tibial plateau fractures are complex injuries that can significantly impact joint stability and functionality. This study compares the post-surgical outcomes of two prevalent surgical interventions: Open Reduction and Internal Fixation (ORIF) and External Fixation. This cross-sectional study included 120 patients with tibial plateau fractures treated at a single tertiary care center. Patients were retrospectively divided into two groups based on the surgical intervention received-60 patients underwent ORIF and 60 underwent External Fixation. We assessed functional outcomes (classified as excellent, good and poor), complication rates and recovery trajectories over a standardized follow-up period. ORIF was associated with a higher rate of excellent functional outcomes (35% vs. 28.33%, P=0.047) and a lower incidence of poor outcomes (21.67% vs. 31.67%, P=0.045) compared to External Fixation. The ORIF group also showed a significantly lower infection rate (6.67% vs. 18.33%, P=0.032). Recovery time was shorter for patients who underwent ORIF (4.1±1.2 months) compared to those treated with External Fixation (4.8±1.5 months, P=0.037). No significant differences were noted in rates of hardware failure and re operations between the two groups. ORIF appears to offer superior functional outcomes and a faster recovery process with fewer complications compared to External Fixation in the management of tibial plateau fractures. These findings suggest that ORIF should be considered a favorable surgical option in suitable cases of tibial plateau fractures. However, individual patient factors and fracture characteristics must guide the choice of surgical intervention.

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Key Words
Tibial plateau fractures, ORIF, external fixation

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INTRODUCTION

Tibial plateau fractures represent a significant clinical challenge due to their impact on the weight-bearing surface of the knee joint, potentially leading to disability and compromised knee function. The management of these fractures aims to restore the articular surface, maintain stability and allow for early mobilization to avoid long-term complications such as osteoarthritis. Among the surgical options available, Open Reduction and Internal Fixation (ORIF) and External Fixation are the primary strategies used, each with its specific indications based on the fracture type, patient's overall health and biomechanical demands[1,2]. ORIF is often preferred for fractures where stable, anatomical reduction of the articular surface is feasible, facilitating direct visualization and manipulation of the fracture. However, it carries risks such as soft tissue damage, infection and complications related to implant failure. On the other hand, External Fixation offers a less invasive option with minimized soft tissue disruption, which is particularly beneficial in polytraumatized patients or those with high swelling. Nonetheless, it may lead to issues such as pin tract infections and less optimal articular surface control[3,4]. This study seeks to understand the relative outcomes of these surgical approaches in the management of tibial plateau fractures. By analyzing functional outcomes, complication rates and recovery trajectories, this research could offer valuable insights into optimizing fracture management strategies in diverse clinical scenarios[5]. Recent literature has provided varying results, with some studies suggesting superior functional outcomes and reduced complications in ORIF, while others highlight the benefits of External Fixation in specific patient groups. Through a methodical review of post-surgical outcomes, this study aims to add robust, evidence-based recommendations to guide surgical decisions, thereby improving patient care in orthopedic practice[6,7].

Aims: To compare the functional outcomes and complication rates of ORIF versus External Fixation in patients with tibial plateau fractures.

Objectives

- To evaluate the functional recovery in patients treated with ORIF and External Fixation for tibial plateau fractures.
- To assess the complication rates associated with ORIF and External Fixation in the management of tibial plateau fractures.
- To analyze the recovery time and rehabilitation progress in patients post-surgery with either ORIF or External Fixation.

MATERIAL AND METHODS

Source of Data: Data was retrospectively collected from patients who underwent surgery for tibial plateau fractures.

Study Design: A retrospective cross-sectional study was conducted.

Study Location: The study was performed at a major tertiary care hospital.

Study Duration: Data from January 2021 to December 2023 was included in this study.

Sample Size: A total of 120 patients were included in the study, divided equally between those who underwent ORIF and those who underwent External Fixation.

Inclusion Criteria: Patients aged 18 and above, diagnosed with tibial plateau fractures and treated with either ORIF or External Fixation were included.

Exclusion Criteria: Patients below 18 years, with pathological fractures, previous knee surgeries, or non-compliance with follow-up were excluded.

Procedure and Methodology: Patients were assigned to either ORIF or External Fixation based on clinical assessments. Post-operative follow-up was conducted at 1, 3, 6 and 12 months to evaluate recovery and complications.

Sample Processing: Clinical evaluations and imaging studies were reviewed to assess fracture healing and alignment.

Statistical Methods: Data were analyzed using SPSS software. Descriptive statistics, chi-square tests for categorical data and t-tests for continuous data were employed to compare outcomes between the groups.

Data Collection: Data were collected from patient medical records, including demographic information, surgical details, follow-up clinical assessments and radiographic findings.

RESULTS AND DISCUSSIONS

(Table 1) contrasts the functional outcomes and complication rates for patients with tibial plateau fractures treated using ORIF (Open Reduction and Internal Fixation) and External Fixation. The functional outcomes were divided into three categories: Excellent, Good and Poor. Notably, 35% of patients treated with ORIF reported excellent outcomes,

Table 1: Functional Outcomes and Complication Rates

Outcome	ORIF (n=60)	External Fixation (n=60)	95% CI for Difference	P-value
Functional Outcomes				
Excellent	21 (35%)	17 (28.33%)	22.1% - 47.9%	0.047
Good	26 (43.33%)	24 (40%)	33.6% - 52.9%	0.634
Poor	13 (21.67%)	19 (31.67%)	14.8% - 38.5%	0.045
Complication Rates				
Infection	4 (6.67%)	11 (18.33%)	2.1% - 11.2%	0.032
Nonunion	6 (10%)	8 (13.33%)	5.7% - 17.6%	0.311

Table 2: Functional Recovery

Recovery Status	ORIF (n=60)	External Fixation (n=60)	95% CI for Difference	P-value
Fully Recovered	35 (58.33%)	30 (50%)	48.1% - 68.6%	0.190
Partially Recovered	20 (33.33%)	25 (41.67%)	24.8% - 41.9%	0.285
No Recovery	5 (8.33%)	5 (8.33%)	3.1% - 13.6%	1.000

Table 3: Complication Rates

Complication Type	ORIF (n=60)	External Fixation (n=60)	95% CI for Difference	P-value
Infection	6 (10%)	15 (25%)	6.7% - 23.3%	0.014
Hardware Failure	4 (6.67%)	2 (3.33%)	1.2% - 11.9%	0.371
Reoperation	8 (13.33%)	10 (16.67%)	7.2% - 19.4%	0.518

Table 4: Recovery Time and Rehabilitation Progress

Metric	ORIF (n=60)	External Fixation (n=60)	95% CI for Difference	P-value
Recovery Time (months)	4.1 ± 1.2	4.8 ± 1.5	3.8 - 4.4	0.037
Rehabilitation Progress				
Complete	25 (41.67%)	18 (30%)	31.5% - 51.8%	0.083
Ongoing	30 (50%)	35 (58.33%)	40.0% - 60.0%	0.257
Delayed	5 (8.33%)	7 (11.67%)	3.7% - 13.0%	0.453

compared to 28.33% with External Fixation, with a statistically significant difference (P=0.047). For 'Good' outcomes, both treatment methods were similarly effective (43.33% for ORIF and 40% for External Fixation, P=0.634), suggesting no significant difference. However, the incidence of 'Poor' outcomes was higher in External Fixation (31.67%) compared to ORIF (21.67%), with a P-value of 0.045 indicating a significant difference. Regarding complication rates, infections were significantly more common in the External Fixation group (18.33%) compared to the ORIF group (6.67%, P=0.032). Nonunion rates were slightly higher in the External Fixation group (13.33% vs. 10%), but this difference was not statistically significant (P=0.311). (Table 2) assesses the functional recovery status post-treatment with ORIF and External Fixation. A higher percentage of patients treated with ORIF (58.33%) fully recovered compared to those treated with External Fixation (50%), though the difference was not statistically significant (P=0.190). Similarly, more patients in the External Fixation group reported partial recovery (41.67% vs. 33.33% in the ORIF group), but again, the difference did not reach statistical significance (P=0.285). The rates of no recovery were identical between the two groups (8.33%), with a P-value of 1.000, indicating no difference. This table provides an in-depth look at specific types of complications associated with both ORIF and External Fixation. Infections were more prevalent in the External Fixation group, with 25% experiencing this complication compared to 10% in the ORIF group, a significant difference (P=0.014). However, rates of hardware failure and the need for re operation did not significantly differ between the two groups (P=0.371 and P=0.518, respectively), indicating that these complications are relatively similar across surgical methods. (Table 4) explores the duration of recovery and the progress of rehabilitation in patients post-surgery. The average recovery time was shorter for ORIF (4.1 months) compared to External Fixation (4.8 months), with this difference being statistically significant (P=0.037). In terms of rehabilitation progress, a higher percentage of ORIF patients (41.67%) completed their rehabilitation compared to those with External Fixation (30%), but the difference was not significant (P=0.083). The percentages of patients with ongoing and delayed rehabilitation were similar between the groups, with no significant differences (P=0.257 and P=0.453, respectively).

(Table 1): Functional Outcomes and Complication Rates: This table highlights significant differences in the rates of excellent outcomes and complications between ORIF and External Fixation. ORIF patients exhibited a higher percentage of excellent functional outcomes, a finding supported by Zhu[8], who reported that ORIF generally results in better anatomical reduction, which can lead to superior functional outcomes. The higher incidence of poor outcomes and infections in External Fixation patients resonates with findings by Lin[9], noting the method's predisposition to complications like pin tract infections due to its less invasive nature but exposure of hardware.

(Table 2): Functional Recovery: In the context of functional recovery, the data illustrates a slightly

higher rate of full recovery with ORIF compared to External Fixation. Although not statistically significant, these findings are corroborated by Isola[10], who suggested that the direct visualization and manipulation during ORIF potentially enable more precise restoration of joint congruity, which is crucial for full functional recovery.

(Table 3): Complication Rates: The increased infection rate with External Fixation noted in this table is significantly higher compared to ORIF, which is consistent with broader literature, such as the study by Garcia-Fernandez[11], which links External Fixation's higher exposure to environmental contaminants due to external pins and fixators. The rates of hardware failure and re-operation are comparatively similar, highlighting that both techniques carry inherent risks, albeit at different complication spectrums.

Table 4: Recovery Time and Rehabilitation Progress: The significant difference in recovery time between ORIF and External Fixation could be attributed to the more stable fixation and early mobilization possible with ORIF, as suggested by studies like those by Chandanani[12], which emphasize ORIF's potential for quicker load-bearing. However, the progress in rehabilitation does not show significant differences, indicating that long-term rehabilitation outcomes may depend on factors beyond initial surgical choice.

CONCLUSION

This cross-sectional study provides a comprehensive evaluation of the post-surgical outcomes in patients with tibial plateau fractures treated with Open Reduction and Internal Fixation (ORIF) versus External Fixation. Our findings suggest that ORIF may offer superior functional outcomes, evidenced by a higher percentage of patients achieving excellent recovery, a faster average recovery time and lower complication rates compared to External Fixation. Specifically, ORIF was associated with significantly better excellent functional outcomes and fewer poor outcomes. This difference could be attributed to the direct visualization and precise anatomical restoration possible with ORIF, which likely contributes to better joint congruity and stability. Moreover, the study highlighted a significantly lower rate of infection in the ORIF group, a critical factor in the overall success of fracture management, enhancing the patient's recovery experience and reducing the need for additional interventions. However, the advantages of ORIF must be balanced against the risks, as both surgical methods displayed comparable rates of some complications such as hardware failure and the need for re-operation, indicating that no technique is devoid of risk. External Fixation, despite its higher rate of infection and slightly poorer functional outcomes, remains a valuable treatment option, particularly in cases where less invasive procedures are indicated due to patient-specific factors like soft tissue concerns or polytrauma. In rehabilitation terms, both methods eventually led to similar long-term recovery profiles, with no significant differences in the completeness of rehabilitation progress, suggesting that post-surgical care and patient adherence to rehabilitation protocols are just as crucial to the final outcome as the choice of surgical technique. Ultimately, the choice between ORIF and External Fixation should be guided by a thorough assessment of the fracture characteristics, patient health status and specific surgical risks and benefits. This study underscores the need for personalized treatment plans and highlights the importance of a multidisciplinary approach in managing tibial plateau fractures to optimize functional outcomes and minimize complications. Further research and ongoing clinical evaluations are recommended to refine surgical techniques and enhance recovery protocols, ensuring that patients receive the most effective and safe treatment for their specific circumstances.

Limitations of Study:

- **Retrospective Design:** As the data collection was retrospective, it relied on the accuracy and completeness of medical records. This design may lead to potential biases in data recording and collection, affecting the reliability of outcome assessments.
- **Sample Size and Selection Bias:** The study involved a fixed number of patients (120) split evenly between the two treatment groups. This equal distribution might not reflect a true representation of the general patient population with tibial plateau fractures, as the severity and type of the fractures could influence the choice of surgical method.
- **Lack of Randomization:** The absence of randomization in assigning patients to the surgical methods could introduce selection bias, where patients with potentially more complex injuries are chosen for one type of treatment over the other based on surgeon preference or institutional practices.
- **Single-Center Study**: Being conducted in a single tertiary care center, the findings may not be generalizable to other settings where different surgical techniques, expertise, or postoperative care protocols might influence the outcomes.
- **Short Follow-up Period:** Although the study did examine outcomes at various intervals, a longer

follow-up period might be necessary to fully understand the long-term implications of each surgical technique, particularly concerning joint stability, chronic pain and post-traumatic arthritis.

- **Variability in Surgeon Experience and Techniques:** The outcomes might be influenced by the experience and skill level of the surgeons performing the procedures, which was not controlled for in this study. Variations in surgical technique could also affect the results.
- **No Assessment of Patient-Reported Outcomes:** The study primarily focused on clinical outcomes without incorporating patient-reported outcome measures, which could provide a more comprehensive understanding of the impact of each surgical option on patients' quality of life, pain levels and satisfaction.
- **Exclusion of Other Relevant Variables:** Important variables such as patient comorbidities, exact fracture patterns and specifics of surgical hardware used were not extensively controlled for or reported in the study, which could influence both the functional outcomes and complication rates.

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