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Functional outcomes of postoperative patients with Schatzker tibial plateau fractures V and VI

Funcionalidad de pacientes postoperados de fractura de meseta tibial Schatzker V y VI

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ABSTRACT

Type V and VI proximal tibial fractures, as described by Schatzker, are usually the result of high-energy trauma, such as traffic accidents or falls from height. These injuries are frequently associated with additional damage that complicates treatment and negatively affects functional outcomes. A retrospective, observational, and analytical study was conducted at the "Dr. Gustavo A. Rovirosa Pérez" Regional High Specialty Hospital, including 37 patients over 18 years of age who underwent surgical treatment between January 2023 and January 2025. High-energy mechanisms accounted for 86.5% of cases, and the left limb was the most frequently affected (65%). Schatzker type VI fractures represented 70% of cases, while type V accounted for 29%. Functional outcomes were assessed using the modified Rasmussen scale. Excellent results were observed in 23% of patients and good results in 47%, yielding a 70% rate of favorable functional outcomes. Fracture complexity, obesity, associated injuries, prolonged immobilization, and irregular rehabilitation were identified as factors negatively impacting recovery. These findings emphasize the importance of individualized surgical planning and comprehensive postoperative management to optimize functional results.

Keywords: plateau, tibia, Schatzker classification, functionality, Rasmussen.

RESUMEN

Las fracturas de tibia proximal tipo V y VI, descritas por Schatzker, suelen producirse como consecuencia de traumatismos de alta energía, como accidentes de tráfico o caídas de altura. Estas lesiones se acompañan con frecuencia de daños asociados que complican el tratamiento y condicionan el pronóstico funcional. Con el propósito de conocer nuestra experiencia local, se realizó un estudio retrospectivo, observacional y analítico en el Hospital Regional de Alta Especialidad "Dr. Gustavo A. Rovirosa Pérez", que incluyó a 37 pacientes mayores de 16 años tratados quirúrgicamente entre enero de 2023 y enero de 2025. El mecanismo de alta energía estuvo presente en el 86.5% de los casos y la extremidad izquierda fue la más afectada (65%). El 70% presentó fracturas Schatzker tipo VI y el 29% tipo V. La funcionalidad se evaluó mediante la escala de Rasmussen modificada. Los resultados mostraron que el 23% de los pacientes obtuvo resultados excelentes y el 47% buenos, lo que representa un 70% de desenlaces funcionales favorables. Factores como la complejidad de la fractura, la obesidad, la presencia de lesiones asociadas, la inmovilización prolongada y la rehabilitación irregular influyeron negativamente en la evolución funcional. Estos hallazgos resaltan la importancia de un abordaje quirúrgico individualizado y de un manejo postoperatorio integral para optimizar los resultados funcionales.

Palabras clave: meseta, tibia, clasificación de Schatzker, funcionalidad, Rasmussen.

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INTRODUCTION

Tibial plateau fractures are one of the most complex joint injuries in traumatology, due to their direct involvement of the knee, a fundamental joint for load-bearing and mobility (Biz et al., 2025). Although they represent between 1 and 2% of all fractures, their clinical relevance lies in the functional sequelae and the high frequency of associated complications.

From an anatomical perspective, the lateral tibial plateau is more susceptible to injury because it is narrower and more convex compared to the medial plateau, which is wider and more resistant (Reátiga et al., 2022). Epidemiologically, the incidence of these fractures has increased in recent decades, reaching up to 30 cases per 100,000 inhabitants. In young patients, they are usually related to high-energy trauma, while in older adults, low-energy mechanisms associated with bone fragility predominate (Yokota et al., 2024).

The diagnosis is based on plain radiographs supplemented with computed tomography for proper classification and surgical planning. Magnetic resonance imaging allows for the identification of associated ligamentous and meniscal injuries (Popper et al., 2023; Vo et al., 2024). The surgical treatment aims to restore joint congruity, achieve stable fixation, and allow for early mobilization to reduce the risk of post-traumatic osteoarthritis.

Despite advances in surgical techniques and implants, controversy persists regarding the optimal approach and its impact on final functionality, especially in complex bicondylar fractures. Few studies have evaluated postoperative functional outcomes in patients with Schatzker type V and VI fractures in tertiary hospitals in Latin America. Therefore, the objective of this study was to evaluate postoperative functionality of patients surgically treated at the "Dr. Gustavo A. Rovirosa Pérez" Regional High Specialty Hospital.

METHODOLOGY

A retrospective, observational, and analytical study was conducted on patients treated at the "Dr. Gustavo A. Rovirosa Pérez" Regional High Specialty Hospital between January 2023 and January 2025. The study aimed to evaluate the outcomes of patients diagnosed with Schatzker type V or VI tibial plateau fractures who underwent surgical treatment and received outpatient follow-up. Inclusion criteria were limited to patients aged 16 years and older who had received surgical intervention. Exclusion criteria included patients who did not undergo surgical treatment or those

without adequate follow-up during the study period.

The sample size was non-probabilistic and consisted of 37 patients, selected based on the inclusion and exclusion criteria. Data for the study were gathered through a comprehensive review of both physical and electronic medical records of the patients. Additionally, telephone interviews were conducted with patients to obtain further relevant data, such as subjective reports on functionality and pain levels, ensuring a more complete dataset.

To assess patients' functional outcomes, the modified Rasmussen scale was utilized. This scale is a well-established tool for evaluating patients' functional recovery in tibial plateau fractures. It includes a series of assessments related to pain, gait, extension, range of motion, stability, and quadriceps strength, providing a comprehensive evaluation of functional recovery following surgical treatment.

The statistical analysis employed in the study was primarily descriptive. For the analysis of qualitative variables, the results were presented as frequencies and percentages, which allowed for a clear depiction of the demographic and clinical characteristics of the study participants.

The study was conducted in accordance with institutional ethical standards and was approved by the institutional ethics committee. Given its retrospective nature, the study was exempt from the requirement for informed consent, as per the guidelines established in NOM-004-SSA3 (2012), a regulation that governs the ethical aspects of medical research in Mexico. This regulatory framework ensures that retrospective studies, like the one conducted here, are ethically permissible without the need for individual patient consent.

RESULTS AND DISCUSSION

Thirty-seven patients with surgically treated Schatzker V and VI tibial plateau fractures were analyzed. Eighty-six percent were male, and 14% were female (Table 1). High-energy injury was the cause in the vast majority of cases (86%), and the left limb was most frequently affected (65%). Regarding fracture type, 70% were Schatzker VI and 29% Schatzker V (Table 2).

Regarding baseline conditions, 76% of patients had no chronic comorbidities; however, overweight and obesity were present in more than 80% of the sample, which was identified as a factor that negatively influenced functional recovery.

Table 1. Patients with Schatzker V and VI tibial plateau fractures according to sociodemographic characteristics

Sociodemographic characteristics	Frequency	Percentage
Sex		
Male	32	86.5
Female	5	13.5
Level of education		
Illiterate	1	2.7
Primary	12	32.4
Secondary	14	37.8
High school	8	21.6
University	2	5.4

Table 2. Patients with Schatzker V and VI tibial plateau fractures, according to the characteristics of the injury

Characteristics of the injury	Frequency	Percentage
Injured limbs		
Right	13	35
Left	24	65
Mechanism of injury		
Low energy	5	14
High energy	32	86
Schatzker classification		
Schatzker V	11	29
Schatzker VI	26	70
Associated injuries		
Exposed	9	24
Other fractures	5	14
Neurovascular injury	1	3
None	22	60

The most frequent surgical approach was double-plate placement (35%), followed by screws plus plate (27%) and single plate placement (24%). Most patients underwent surgery after 10 days of hospitalization, and a single surgical approach was used in 87% of cases. In the postoperative follow-up, 57% of patients remained immobilized for less than 6 weeks, and 66% received formal rehabilitation. The most frequent complications included osteoarthritis (17%) and exposure of osteosynthetic material (13%).

Eighty-one percent of patients were immobilized with a Jones bandage and splint upon

admission; 16% required a first surgical procedure for external fixation. Sixty-eight percent underwent surgery after 10 days of hospitalization, 19% between 5 and 10 days, and only 14% before 5 days. A single approach was used in 87% of patients, a double approach in 5%, and a percutaneous approach in 8%. A double plate was used in 35% of patients, while compression screws were placed and protected with a plate in 27%, a single implant was preferred in 24%, and an external fixator was used as the definitive treatment in 8% (Table 3).

Table 3. Preoperative approach in patients with Schatzker V and VI tibial plateau fractures

Preoperative management	Frequency	Percentage
Initial management		
None	1	2.7
Splint	30	81
External fixator	6	16
Time to surgery		
< 5 days	5	14
5-10 days	7	19
> 10 days	25	68
Surgical approach		
Single approach	32	87
Double approach	2	5
Percutaneous	3	8
Surgical management		
Single plate	9	24
Double plate	13	35
Screw + plate	10	27
External fixator	3	8
External fixator + other implant	2	5

Functionality, assessed using the Rasmussen scale, showed that 23.3% of patients achieved an excellent result and 47% a good result; overall, 70% had favorable outcomes. In contrast, 13% had fair results, and 17% had poor results. Twenty-seven patients with Schatzker V and VI tibial plateau fractures underwent a single surgical approach. Of these, 12 had a good outcome, 7 an excellent outcome, 5 a poor outcome, and 3 a fair outcome, according to the Rasmussen scale. Two patients underwent a double approach, with a good outcome in one patient and a fair outcome in the other. One patient underwent a percutaneous approach, with a good outcome according to the Rasmussen scale. There was no follow-up for 7 patients (Figure 1).

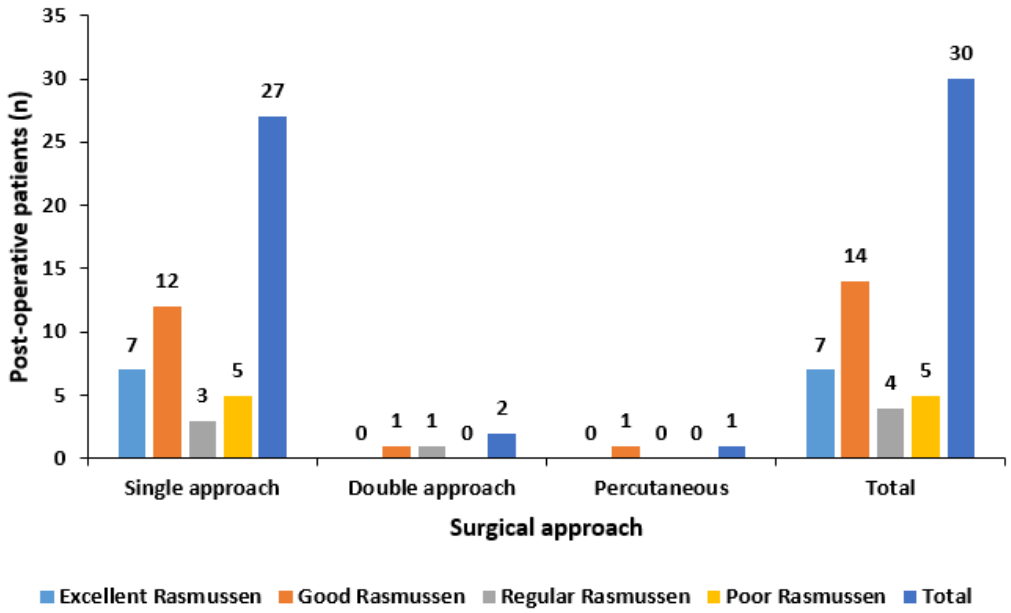

Figure 1. Functionality of post-operative patients with Schatzker V and VI tibial plateau fractures, according to the Rasmussen scale for each surgical approach used.

Analysis of associated factors revealed that double-plate placement was linked to better functional outcomes, especially when combined with rehabilitation and short periods of immobilization. Conversely, obesity, overweight, and comorbidities such as diabetes and hypertension were associated with less favorable outcomes.

Of the 30 patients who underwent postoperative treatment for Schatzker V and VI tibial plateau fractures and were followed up, 12 received double plating. Of these, 7 had a good outcome according to the Rasmussen classification, 2 excellent, 2 fair, and 1 poor. Nine patients underwent osteosynthesis using compression screws with plate protection, achieving an excellent outcome, 3 poor, 2 good, and 1 fair according to the Rasmussen classification. Six patients underwent osteosynthesis with a single plate, 3 of them had a good outcome, 1 excellent, 1 fair, and 1 poor, according to the Rasmussen classification. One patient was managed with an external fixator, who had a good outcome. Two patients were managed with a plate and external fixator and a screw with external fixator, with excellent and good outcomes, respectively.

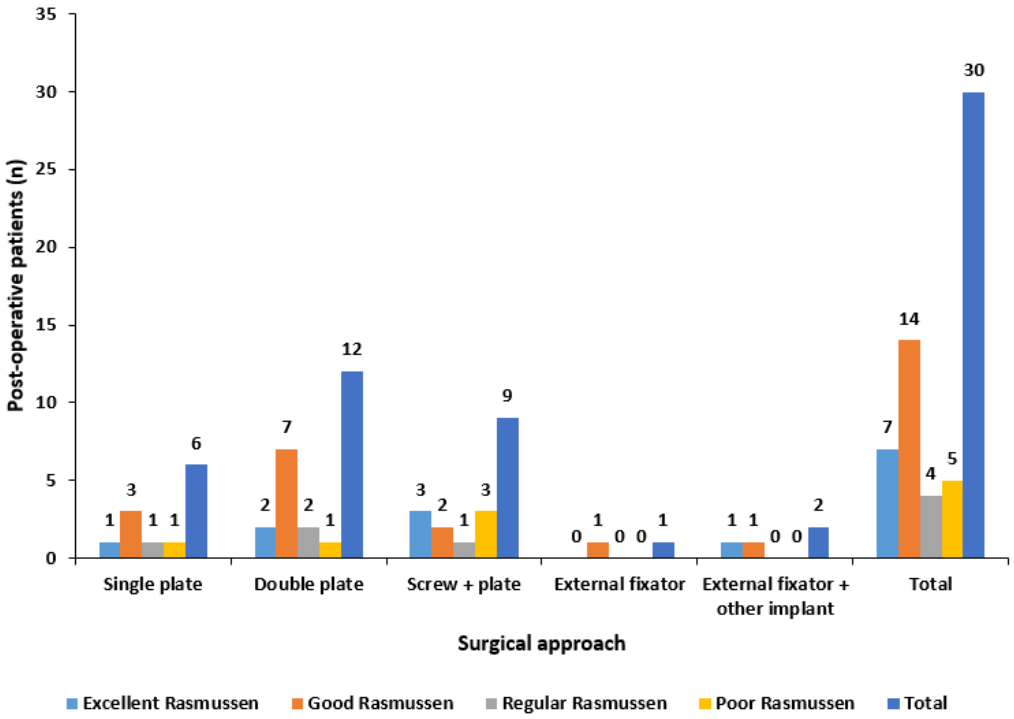

Figure 2. Functionality of post-operative patients with Schatzker V and VI tibial plateau fractures, according to the Rasmussen scale for each implant used.

Rohra et al. (2016) followed 34 patients with Schatzker type V and VI tibial plateau fractures treated with double plating, reporting that 85% achieved excellent functional outcomes and 15% good outcomes at three years of follow-up. Their findings suggest that double plating provides stable fixation and is associated with highly satisfactory outcomes in complex fractures, although they did not specify the surgical approach used.

Of the 37 patients included, 30 completed follow-ups. Twelve were treated with double plating, of whom 2 achieved excellent results, 7 good results, and 3 fair or poor results. In contrast, the six patients treated with single plating had a lower proportion of favorable outcomes: only 1 excellent, 3 good, and 2 fair or poor. Although the outcomes confirm that double plating remains an effective alternative, the proportion of excellent results was considerably lower than in previous studies (Rohra et al., 2016).

From a clinical perspective, the results of this study suggest that the final functional outcome in bicondylar tibial plateau fractures does not depend solely on the type of implant used,

but rather on a combination of biomechanical and biological factors. In agreement with the meta-analysis by Chang et al. (2016), no significant functional differences were identified between single- and double-plate fixation, reinforcing the importance of prioritizing adequate stability with minimal soft tissue trauma.

The preference for single-plate approaches and the surgical delay observed in most patients may have negatively influenced the proportion of excellent outcomes by limiting early initiation of mobilization. This suggests that the timing of surgery and the damage control strategy are key determinants of functional prognosis.

Furthermore, prolonged immobilization and inconsistent rehabilitation were associated with worse functional outcomes, which is consistent with findings reported by Hake and Goulet (2016) and Buckley et al. (2017), who highlight early mobilization as a key element in preventing joint stiffness and optimizing recovery.

In practical terms, these results support the need to individualize the surgical approach, considering the fracture complexity, soft tissue condition, and patient's overall health, as well as to implement early and structured rehabilitation protocols, to maximize functional outcomes in Schatzker type V and VI fractures.

CONCLUSIONS

Schatzker V and VI tibial plateau fractures occurred predominantly in young men following high-energy trauma. Surgical treatment yielded favorable functional outcomes in most patients. Double-plate fixation showed a trend toward better functional results, especially when combined with early mobilization and structured rehabilitation. Final functionality depends on multiple factors; therefore, individualized and multidisciplinary management is recommended.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: Jorge E. Flores and Carlos E. Castro. **Data curation:** Paola Santos, Mónica A. Martínez, Jorge E. Flores, and Carlos E. Castro. **Formal analysis:** Paola Santos, Luis E. Gutiérrez, and Verónica G. Carrera. **Investigation:** Paola Santos, Mónica A. Martínez, Jorge

E. Flores, and Carlos E. Castro. **Methodology:** Paola Santos, Mónica A. Martínez, Jorge E. Flores, and Carlos E. Castro. **Project administration:** Luis E. Gutiérrez and Verónica G. Carrera. **Resources:** Luis E. Gutiérrez and Verónica G. Carrera. **Software:** Verónica G. Carrera. **Supervision:** Luis E. Gutiérrez and Verónica G. Carrera. **Validation:** Luis E. Gutiérrez and Verónica G. Carrera. **Visualization:** Luis E. Gutiérrez and Verónica G. Carrera. **Writing – original draft:** Paola Santos, Mónica A. Martínez, Jorge E. Flores, and Carlos E. Castro. **Writing – review & editing:** Luis E. Gutiérrez and Verónica G. Carrera.

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