

Management of Complex Tibial Plateau Fractures Using the Ilizarov External Fixator

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Abstract

Background: High-energy bicondylar tibial plateau fractures are challenging because of articular comminution, metaphyseal bone loss, and associated soft-tissue compromise. Circular external fixation using the Ilizarov technique provides stable fixation with minimal soft-tissue disruption.

Methods: A prospective study was conducted on twenty patients with Schatzker type V and VI tibial plateau fractures treated using the Ilizarov external fixator. Closed or minimally invasive reduction was achieved using ligamentotaxis, followed by frame application. Early knee range-of-motion exercises were initiated, and progressive weight bearing was allowed. Functional outcomes were evaluated using Rasmussen's functional scoring system.

Results: Fracture union was achieved in all patients (100%). The mean time to union was 18 weeks (range, 16–20 weeks). According to Rasmussen's criteria, 80% of patients achieved good to excellent functional outcomes. Superficial pin-tract infection was the most common complication; no deep infection, malalignment, implant failure, or nonunion was observed.

Conclusions: Ilizarov external fixation is a reliable and effective treatment option for complex tibial plateau fractures, particularly in high-energy injuries with compromised soft tissues.

Key words: Tibial plateau fracture, Ilizarov external fixator, Schatzker type V and VI, Ligamentotaxis, Circular external fixation, High-energy fractures

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Introduction

Tibial plateau fractures account for approximately 1–2% of all fractures and include a broad spectrum of injury patterns. High-energy fractures, particularly Schatzker type V and VI injuries, are frequently associated with severe comminution,¹ metaphyseal bone loss, and soft-tissue compromise. The goals of treatment include restoration of articular congruity, maintenance of mechanical alignment, stable fixation, and early mobilization to prevent knee stiffness & post-traumatic arthritis^{2,3}.

Although open reduction and internal fixation (ORIF) has traditionally been advocated, it is associated with a substantial risk of wound complications in high-energy injuries. Circular external fixation using the Ilizarov technique offers stable fixation through ligamentotaxis while preserving the soft-tissue envelope.^{3,4}

Materials and Methods

This prospective study included twenty patients with Schatzker type V and VI tibial plateau fractures treated at a tertiary orthopaedic center. Patients with vascular injuries or those requiring flap coverage were excluded.

All patients underwent closed or minimally invasive reduction using ligamentotaxis followed by application of an Ilizarov circular external fixator.^{3,4} Early postoperative knee range-of-motion exercises were encouraged. Progressive weight bearing was allowed based on clinical and radiological evidence of fracture union. Patients were followed for a minimum period of six months.

Functional outcomes were assessed using Rasmussen's functional scoring criteria, and radiological union was evaluated with serial radiographs.

Table 1. Patient Demographics and Injury Characteristics

Variable	Value
Number of patients	20
Age range (years)	25–65
Mean age (years)	42
Sex (Male : Female)	14 : 6
Side involved (Right : Left)	12 : 8
Mechanism of injury	High-energy trauma (road traffic accidents, fall from height)
Schatzker classification	Type V 9 patients (45%)
	Type VI – <11 patients (55%)

Associated soft-tissue injury Present in majority of cases

Table II. Treatment Protocol

Parameter	Description
Reduction technique	Closed / minimally invasive reduction
Fixation method	Ilizarov circular external fixator
Principle applied	Ligamentotaxis
Knee mobilization	Early postoperative range-of-motion exercises
Weight bearing	Gradual, guided by radiological union
Minimum follow-up	6 months
Functional assessment	Rasmussen's functional scoring criteria

Results

All fractures achieved radiological union, resulting in a 100% union rate. The mean duration to union was 18 weeks (range, 16–20 weeks). According to Rasmussen's functional scoring system, 9 patients (45%) had excellent outcomes, 7 patients (35%) had good outcomes, and 4 patients (20%) had fair outcomes. Overall, 80% of patients achieved good to excellent functional results.

The most common complication was superficial pin-tract infection, which was managed successfully with local care and oral antibiotics. No cases of deep infection, malalignment, implant failure, or nonunion were observed.

Table III. Radiological and Functional Outcomes

Outcome Measure	Result
Fracture union rate	100%
Mean time to union	18 weeks
Range of union time	16–20 weeks
Rasmussen score – Excellent	9 patients (45%)
Rasmussen score – Good	7 patients (35%)
Rasmussen score – Fair	4 patients (20%)
Good to excellent outcome	80%

Table IV. Complications

Complication	No. of Patients	Percentage
Superficial pin-tract infection	6	30%
Deep infection	0	0%
Malalignment	0	0%
Implant failure	0	0%
Nonunion	0	0%

Discussion

The management of complex tibial plateau fractures remains controversial, particularly in high-energy injuries with compromised soft tissues. The principal finding of the present study is that Ilizarov external fixation resulted in a 100% union rate with satisfactory functional outcomes and a low complication profile.

Open reduction and internal fixation of bicondylar tibial plateau fractures has been associated with a high incidence of wound complications. Young and Barrack reported wound complication rates of up

to 23% following internal fixation of high-energy tibial plateau fractures.⁶ Extensive surgical exposure and soft-tissue stripping are major contributing factors to infection and wound breakdown.⁶

In contrast, circular external fixation minimizes soft-tissue disruption and preserves periosteal blood supply. Dendrinos et al. reported reliable fracture union and favorable functional outcomes using the Ilizarov technique for high-energy tibial plateau fractures.³ Similarly, Catagni et al. emphasized the advantages of ligamentotaxis-based reduction and early mobilization achieved with circular fixation.⁴

The three-column concept of tibial plateau fractures described by Luo et al. has improved understanding of posterior column involvement.⁵ The modular nature of the Ilizarov frame allows stabilization of all columns without the need for extensive posterior surgical exposure.

Pin-tract infection was the most common complication in the present study; however, all cases were superficial and resolved with conservative management. Importantly, no deep infections or mechanical failures were encountered.

The limitations of this study include a relatively small sample size and short follow-up duration. Long-term follow-up is required to evaluate the incidence of post-traumatic osteoarthritis and long-term functional outcomes.¹

Conclusions

Ilizarov external fixation provides a stable, minimally invasive, and biologically friendly solution for the management of complex tibial plateau fractures. It is particularly advantageous in high-energy injuries with significant soft-tissue compromise, allowing early mobilization and achieving satisfactory functional and radiological outcomes.

References

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