

## ORIGINAL ARTICLE

# Evaluation of Complex Tibial Plateau Fracture Treated with Ilizavor External Fixator

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## ABSTRACT

**Background:** Complex tibial plateau fractures provide a significant challenge in orthopaedic surgery. The Ilizarov technique addresses common issues in fracture therapy and allows for closed reduction and fixation without significant soft tissue stripping. **Aim of the study:** The purpose of this study was to evaluate the outcomes of treating complicated tibial plateau fractures with the Ilizarov technique in conjunction with minimal internal fixation. **Methods & Materials:** This retrospective study was conducted in the Department of Orthopedic Surgery, Barind Medical College, Rajshahi, TMSS Medical College, Bogura, Cumilla Medical College, Cumilla and East West Medical College, Dhaka, Bangladesh. The study included 30 Schatzker type VI tibial plateau fractures in 29 individuals, whose mean age ranged from 20 to 76 years. Nine fractures were open and twenty-one were closed. Tscherne and Gotzen's classification of soft tissue injury was used for closed fractures, while Gustilo and Anderson's classification was used for open fractures. Rasmussen's method and the Knee Society clinical assessment score were used for radiographic, clinical, and functional evaluations. **Results:** Except for one with varus malunion, all fractures healed. The frame was removed after an average of 16.3 weeks (range 14-24). Only 28 patients (29 fractures) were available for follow-up. The average follow-up period was 27 months (range 16-36). The radiographic reduction of fractures was excellent in 18 cases and good in 12. Using the Knee Society clinical assessment method, 18 knees were classified as exceptional, seven as good, one as fair, and two as poor. Five patients demonstrated clinically significant grade 2+ medial-lateral instability. Only two were symptomatic, although they had no functional limitations. Eleven individuals reported no pain, while the rest 18 experienced mild or intermittent pain. Eight individuals had difficulty walking, and six need walking assistance. There was a strong association ( $P < 0.005$ ) between the existence of accompanying injuries and the final outcome, with the most significant being a concurrent distal femoral fracture. **Conclusion:** This study emphasizes the Ilizarov method's therapeutic success and minimal morbidity rate. The technique is ideally suited to the treatment of difficult tibial plateau fractures in which comminution would necessitate extensive dissection and internal fixation with plates and screws, further compromising the soft tissue.

**Keywords:** Tibial plateau, Ilizarov technique, Radiographic, Internal fixation

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## INTRODUCTION

Complex tibial plateau fractures are a tough surgical issue<sup>[1]</sup>. Challenges include fracture patterns (articular depression, condylar comminution, diaphyseal involvement), soft tissue and ligament injuries, neurovascular injury, and compartment syndrome<sup>[2]</sup>. Failure to reestablish articular congruity and the existence of ligamentous instability are the most important

variables contributing to poor long-term outcomes<sup>[3]</sup>. Success requires restoring articular cartilage, preserving biology, aligning the mechanical axis, restoring joint stability, and maintaining functional motion<sup>[4]</sup>. Nonoperative therapy is ineffective, and internal fixation can lead to problems such as wound breakdown, skin necrosis, deep infections, stiffness, and ankylosis. Surgery may need several debridements,

arthrodesis, or even amputation<sup>[5,6]</sup>. Even with minimally invasive internal fixing procedures, the challenge remains<sup>[7]</sup> Ilizarov external fixation is a promising therapy method for achieving all treatment objectives. Ilizarov offers advantages such as closed or mini-open fracture reduction with less wound complications, early joint motion, functional loading, and weight bearing, as well as the ability to increase reduction and alignment while on a fixator, resulting in a speedier recovery. Knee replacement surgery is less invasive than internal fixation, eliminating the need for major incisions, soft tissue damage, and considerable hardware. For complex tibial plateau fractures, a multi-center prospective randomised trial comparing Ilizarov external fixation and internal fixation found that the latter has a slightly quicker return to function and a shorter hospital stay, while open reduction and internal fixation lead to more complications<sup>[8]</sup>. To assess the results of using the Ilizarov procedure in combination with minimum internal fixation to treat complex tibial plateau fractures, we carried out a retrospective analysis.

## METHODS & MATERIALS

Thirty tibial plateau fractures (Schatzker type VI<sup>[9]</sup>) in 30 patients (27 men and three women) with a mean age of 41.4 (20–76) years were included in the study. There were 21 closed and nine open fractures. Soft tissue injury for the closed fractures was classified according to Tscherne and Gotzen<sup>[10]</sup>, and open fractures were classified according to Gustilo and Anderson<sup>[11]</sup> (Table I). All fractures were the result of high-energy trauma. Twenty patients had associated injuries. The method used was a combination of previously published protocols<sup>[12,13]</sup>. The goal was to correctly decrease the condyles and stabilize the tibial shaft beneath them. Anatomical reduction of the joint surface was a secondary goal, generally achieved using percutaneous or restricted techniques. Longitudinal traction on the fracture table, combined with varus or valgus stresses, helped reduce condylar size. Accurate condylar reduction and compression were made possible by the percutaneous application of large, pointed reduction forceps. Large-caliber K wires were sometimes used to handle bone fragments for reduction. In five cases, bone grafting was performed. After reducing the condyles, counter-opposed Olive. Wires were employed between fragments to compress them. Three to four wires should be at least 14 mm away from the junction line and diverge at least once. Stabilizing the condylar and metaphyseal pieces typically needed a 60° angle. Minimal internal fixing was utilized in 18 fractures (Figure-1). In six cases, a modest incision was made over the primary fracture line or area of comminution to reduce the articular surface.

The preassembled frame, consisting of three rings joined by threaded rods, was fastened to the previously inserted olive wires. The distal ring was fastened to a transfixion reference wire that ran parallel to the ankle joint in order to reestablish the tibia's mechanical axis. The intermediate ring was put just distal to any shaft fracture components. A femoral frame was used in five cases to treat a femoral fracture (Figure-2) and two other cases for fracture comminution that required distraction above the knee. Patients began mild activities on the second post-operative day. Weight-bearing was increased as tolerated. For six weeks, patients with severe articular comminution were kept off their feet. Radiographic, clinical, and functional evaluations were conducted using Rasmussen's technique<sup>[14]</sup> and the Knee Society clinical assessment score<sup>[15]</sup>.

## RESULT

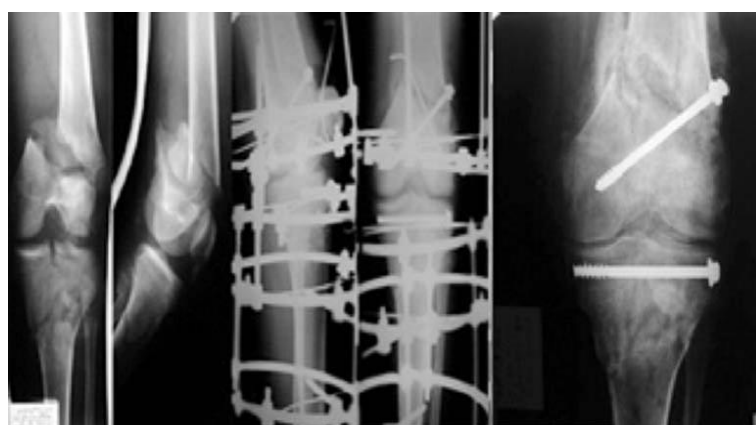
Except for one with varus malunion, all fractures healed. The frame was removed after an average of 16.3 weeks (range 14–24). Only 28 patients (29 fractures) were available for follow-up. The average follow-up period was 27 months (range 16–36). According to Rasmussen's criterion<sup>[14]</sup>, the radiographic reduction of fractures was excellent in 18 cases and good in 12. Using the Knee Society clinical assessment method, 18 knees were classified as exceptional, seven as good, one as fair, and two as poor. The average total range of knee flexion was 112.5° (range: 0–170°), while three individuals had a total arc of motion of less than 60°. In cases treated with knee distraction, the average knee flexion was 83° (range 0–145°), while those with ipsilateral femoral fractures had an average knee flexion of 55°. Five patients demonstrated clinically significant grade 2+ medial-lateral instability. Only two were symptomatic, although they had no functional limitations. Eleven individuals reported no pain, while the rest 18 experienced mild or intermittent pain. Eight individuals had difficulty walking, and six need walking assistance. There was a strong association ( $P < 0.005$ ) between the existence of accompanying injuries and the final outcome, with the most significant being a concurrent distal femoral fracture. However, the magnitude of soft-tissue injury also influenced the outcome. Of the 18 instances treated with extra minimal internal fixation, 12 were graded outstanding, five acceptable, and one fair. Five of ten instances treated without minimal internal fixation were graded outstanding, four good, and one fair. The quality of reduction improved the functional score, as demonstrated in [Table II]. Pin-tract infection was slight and common, but it was treated with local dressings and antibiotics.

**Table – I: Grading of soft-tissue injuries for closed and open fractures**

	Closed fractures (Tscherne–Gotzen)				Open fractures (Gustilo–Anderson)					Total
	0	1	2	3	I	II	IIIA	IIIB	IIIC	
Cases	3	6	9	3	3	2	2	2		30

**Table – II: Relationship between the quality of reduction and the functional outcome**

Functional outcome	Quality of reduction				
	Anatomical	Good	Fair	Poor	Total
Excellent	9	9	-	-	18
Good	7	2	-	-	9
Fair	1	1	-	-	2
Poor	-	-	-	-	-
Total	17	12	-	-	29

**Figure – 1: Closed right tibial fracture in a 41-year-old man treated with closed reduction, minimal internal fixation, and fixation with Ilizarov's apparatus.****Figure – 2: Left distal femoral fracture and ipsilateral tibial plateau fracture in a 20-year-old man treated with minimal internal fixation and cross-knee Ilizarov fixator.**

## DISCUSSION

The treatment of intraarticular fractures in the tibial plateau is fundamentally complicated<sup>[16,17]</sup>. Articular congruity must be restored, and soft tissues must be treated with care, just as bone<sup>[18,12]</sup>. Not all fractures can be reduced with ligamentotaxis alone, and a limited open reduction with minor periosteal stripping is sometimes required<sup>[19]</sup>. Because internal fixation will not be used, the Ilizarov fixation provides for a more flexible choice of incision. In 26 percent of 50 complex plateau fractures treated with Ilizarov fixation, Morandi and Pearse<sup>[20]</sup> observed elevation and bone grafting. Marsh et al.<sup>[21]</sup> were able to decrease 16 of 21 plateau fractures treated with halfpin fixation, whether closed, percutaneously, or through open wounds. In this study, closed reduction was successfully accomplished in 24 cases. In our investigation, six instances required minimal open reduction

by a 5- to 6-cm incision, whereas five needed bone grafting to sustain the raised articular surface. This ratio was much lower than those reported by Watson and Coufal<sup>[11]</sup> (79% open reduction and 57% grafting), Weiner et al.<sup>[22]</sup> (60% open reduction), and Dendrinos et al.<sup>[23]</sup> (50% open reduction). In 18 plateau fractures (60%), little internal fixation was performed using percutaneously inserted lag screws. This differs from Weiner et al.<sup>[22]</sup>, who employed screw fixation in all of their intraarticular fractures, and Dendrinos et al.<sup>[4]</sup>, who only used external fixation wires and no screws. Our group's average fixation length was only slightly longer than that reported by Kumar and Whittle<sup>[12]</sup> (24.7 weeks), which included four cases of delayed/non-union. With their elimination, this period was reduced to 16 weeks, which is consistent with the mean time to union reported in previous samples<sup>[13,22]</sup>. Using Rasmussen criteria for radiographic

assessment, we achieved excellent to good decrease in all of our cases, which outperformed all comparable series<sup>[13,22]</sup>. While Morandi and Pearse<sup>[20]</sup> noted 113°, Guadinez et al.<sup>[24]</sup> recorded a mean range of movement (ROM) of 85°. According to Zecher et al.<sup>[25]</sup>, every patient they treated achieved at least 90°. Despite the inclusion of three cases of knee stiffness, our study had a higher average knee range of motion than comparable studies. Using the Knee Society assessment method, our study's average knee score was 87.7, functional score was 87.2, and knee rating was 87.4. Mikulak et al.<sup>[26]</sup> found a mean knee score of 78.5, a mean functional score of 81.9, and an average knee rating of 80.2 in 24 patients. Kumar and Whittle<sup>[12]</sup> found a mean knee score of 83 and a mean functional score of 69 in 45 individuals (79%) with anatomical decrease. In nine patients (21%) with nonanatomical reduction, the average knee score was 52, although the average functional score was just 19. Several publications have found characteristics that increase the likelihood of a successful outcome<sup>[20,22]</sup>. The majority of the reports contain only low- or very few high-energy fractures. There is limited published information on the outcomes of treating high-energy fractures. The differences in osseous and soft-tissue injury patterns between these two categories indicate that the result and treatment required may differ. In the current investigation, two variables had a direct relationship with the final ROM: knee distraction and the concomitant distal femoral fracture. Polytrauma patients had only fair and poor outcomes, primarily those with concurrent ipsilateral femoral fractures. This was also the case in Mikulak et al.<sup>[26]</sup>, and it is consistent with the findings of Lobenhoffer et al.<sup>[27]</sup>. The severity of soft-tissue injury was also a strong predictor of functional outcome. In our study, open injuries accounted for 45% of poor results. Mallik et al.<sup>[28]</sup> discovered infection worsening four of five bicondylar fractures treated with plates, whereas Young and Barrack<sup>[29]</sup> identified deep infection in seven of eight fractures treated with double plates. Given its deadly nature, one of the management goals must be to keep infection to an absolute minimum. In the current study, pin-tract infection had no effect on the end outcome<sup>[28,22]</sup>. Some writers have indicated that anatomical restoration of the plateau surfaces is critical for preventing subsequent osteoarthritis<sup>[9,29]</sup>. Others have reported good functional outcomes after conservative treatment or surgical treatment that did not completely restore the anatomy<sup>[16,17,13,22]</sup>. One cause for these divergent viewpoints is a lack of a consistent classification and evaluation procedure. Furthermore, the criteria for an acceptable result may not have been severe enough to detect differences between the fracture and therapy groups. It is unclear if the inferior results were due to the degree of the initial articular damage or the quality of articular reduction.

**Limitation of the study:** The study has small sample sizes and a single focus area. The study's findings might therefore not accurately represent the whole picture.

## CONCLUSION & RECOMMENDATION

With just a slight difference in knee ratings between patients with anatomical and nonanatomical results, the clinical-radiological association in our study showed that the quality of articular reduction had less of an impact on the final result. Significant early comminution seemed to produce the worst results. Overall, this study emphasizes the Ilizarov method's therapeutic success and minimal morbidity rate. The technique is ideally suited to the treatment of difficult tibial plateau fractures in which comminution would necessitate extensive dissection and internal fixation with plates and screws, further compromising the soft tissue. The findings of this investigation support those of several predecessors. The reduced incidence of soft tissue problems, early range of motion, early weight bearing, and strong functional recovery all compare favorably with other reported results, supporting the notion that external fixation should be the preferred therapy for such injuries.

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