

# Functional Outcome of Hybrid Ilizarov Technique in patients with Complex Tibial Plateau Fractures

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## ABSTRACT

**Background:** Tibial fractures are the most common long bone fracture, with approximately 25% being open. The majority of open tibial fractures result from a high velocity trauma, such as a motorcycle accident, or a low energy, torsional type injury, such as skiing. They are complex fractures to treat because of the lack of soft tissue coverage and blood supply of the tibial shaft.

**Aim:** To determine the functional outcome of hybrid ilizarov technique in patients with complex tibial plateau fractures

**Study Design:** Descriptive case series.

**Place of Study:** Orthopedics Surgery Department, Jinnah Hospital, Lahore.

**Duration of Study:** Study was carried out over a period of six months from 28-07-2021 to 28-01-2022

**Methods:** All the 73 patients fulfilling the selection with complex tibial plateau fractures of Schatzker's type V and VI were enrolled. Informed consent and demographic information were recorded. All the patients were evaluated for injuries, haemodynamically stabilized. Bone grafting and minimal internal fixation with cc screws was done in severely comminuted fractures. The functional results were measured by Rasmussen's knee functional score (as per operational definition).

**Results:** Distribution of the functional outcome of the patients was done, it showed that out of 73 patients 20(27.4%) were in excellent outcome, 41(56.2%) were in good outcome, 7(9.6%) were in fair outcome, 5(6.8%) were in poor.

**Conclusion:** Based on our results, the use of hybrid ilizarov fixation for the treatment of complex tibial plateau fractures is safe and effective in terms of low rates of complication and good functional results.

**Keywords:** Functional outcome, Tibia plateau fracture, Hybrid ilizarov.

## INTRODUCTION

Complex tibial plateau fractures are considered a challenging surgical problem.<sup>1</sup>The challenges are due to fracture pattern (articular depression, condylar comminution, diaphyseal involvement), associated soft tissue and ligament injuries, associated neurovascular damage and compartment syndrome<sup>2</sup>. Failure to restore articular congruity and presence of ligamentous instability are the most important factors causing poor outcome in a long term<sup>3</sup>. Success depends on restoration of articular cartilage, preservation of biology, alignment of mechanical axis, restoration of joint stability and preservation of functional motion<sup>4</sup>.

A survey of the literature indicates that many authors report only slightly better than 50% satisfactory results with either closed or operative methods of treatment<sup>5-6</sup>. The failures of treatment are usually due to residual pain, stiffness, instability deformity, recurrent effusions, and giving way. Review of over 140 of these fractures treated by both closed and operative methods has shed considerable light on the reason for the failures<sup>7-8</sup>.

Standard open reduction and internal fixation (ORIF) either by dual plate or lateral locking plate has been successful in restoring osseous alignment, but surgical morbidity, especially deep infection and wound necrosis, has been reported frequently. The Ilizarov technique solves many such problems and provides a method of closed reduction and fixation that does not necessitate excessive soft tissue stripping and avoids devitalization of tissues<sup>9,10</sup>.

The Ilizarov circular ring fixator can also be a valuable option for high-energy fractures with gross intra-articular comminution (Association of Orthopaedics/Orthopaedic Trauma Association [AO/OTA] type C3), especially when associated with severe soft-tissue compromise. Achieving stability even in cases of bone comminution when internal fixation devices can do no better than tenuous fixation. Indirect reduction is achieved through ligamentotaxis by spanning the knee with Ilizarov. After anatomical alignment of the leg has been achieved, the articular surface can be reconstructed using indirect reduction and percutaneous fixation either by K-wires or olive wires<sup>11-12</sup>.

In a study, according to Rasmussen's knee functional outcome, 25% rated excellent, 60% rated good, 10% rated fair and 5% rated poor with hybrid ilizarov technique.<sup>13</sup> In another study, according to Rasmussen's knee functional outcome, 40% rated excellent, 40% rated good, 15% rated fair and 5% rated poor with hybrid ilizarov technique<sup>14</sup>.



## METHODOLOGY

The study was conducted in orthopedics department jinnah Hospital Lahore from 28-07-2020 to 28-01-2021. After taking approval from Hospital Ethical Committee and written informed consent from and included 73 patients (both male and Female), age >18 yrs and less than 60 yrs, both schatzkers V and VI tibial plateau fractures, both open (involving skin wound) and closed fractures, fully mobile patients were included while those having previous surgery or intervention for tibial fractures determined by history, advanced osteoporosis as diagnosed by x ray knee, bilateral tibial plateau fractures and poly trauma patients were excluded from the study. Demographic information (including name, age and gender) was recorded on a structured

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questionnaire along with follow up of outcome variables like clinical and radiological union, functional outcome and pin tract infection. A uniform protocol of hybrid external fixation was adopted. Anterior T frame, half pin external fixator with percutaneous internal fixation for management of complex injuries. The proximal half pin configuration consisting AP directed schanz pins into lateral and medial condylar fragments as well as an oblique pin was placed from anteroinferior to posterosuperior in the proximal tibial metaphysis hence achieving the triangulation effect to stabilize the periarticular metaphyseal segment in three planes. Bone grafting and minimal internal fixation with cc screws was done in severely comminuted fractures. Care was taken to minimize the devitalization of bone and its periosteum during the percutaneous insertion of the articular wires.

The time period between the trauma and the surgery varied. Patients were followed up at 6 week and 3 months. The functional results were measured by Rasmussen's knee functional score (as per operational definition).

**Functional Outcome:** It was assessed by Rasmussen's knee functional score. Score ranging from 27-30 was considered as excellent outcome followed by 20-26 as good outcome, 10-19 as fair outcome and 6-9 as poor outcome.

Knee Function Grading System (Rasmussen)				
	Proton	Excellent	Good	Unacceptable
A. Subjective complaints				
a. Pain				
No pain	6			
Occasional ache, but no work pain	5			
Swelling pain in certain positions	4			
Afternoon pain, intense, constant pain around the knee after activity	3			
High pain at rest	2			
b. Walking capacity				
Normal walking capacity (in relation to age)	6			
Walking outdoors at least 7 hour	5			
Short walks outdoors > 12 minutes	4			
Walking indoors only	3			
Mixed stairs, hobble	2			
B. Clinical signs				
a. Extension				
Normal	6			
Lack of extension (0-10 degrees)	5			
Lack of extension > 10 degrees	4			
b. Flexion range of motion				
At least 140	6			
At least 120	5			
At least 90	4			
At least 60	3			
At least 30	2			
0	1			
c. Stability				
Normal stability in extension and 20 degrees of flexion	6			
Abnormal stability 20 degrees of flexion	5			
Instability in extension > 10 degrees	4			
Instability in extension > 10 degrees	3			
Sum (maximum)	27	20	41	5

## RESULTS

Total of 73 patients fulfilling inclusion and exclusion criteria were selected to determine the functional outcome of hybrid illizarov technique in patients with complex tibial plateau fractures. Age distribution of the patients was done, it showed that out of 73 patients, 53(72.6%) were in age group of 20-40 years and 20(27.4%) were in age group of 41-60 years and mean age was calculated as 36.41±8.79 years. Gender distribution of the patients was done, it showed that 53(72.6%) were male whereas 20(27.4%) were females. Distribution of the functional outcome of the patients was done, it showed that out of 73 patients 2(2.7%) were in excellent outcome, 41(56.2%) were in good outcome, 7(9.6%) were in fair outcome, 5(6.8%) were in poor (Table 1). Further stratification of results with respect to age and gender are shown in Table 2 and Table 3 respectively.

Table 1: Distribution of functional outcome (n=93)

	Frequency	%	Valid%	Cumulative%
Excellent 27-30	20	27.4	27.4	27.4
Good 20-26	41	56.2	56.2	83.6
Fair 10-19	7	9.6	9.6	93.2
Poor 6-9	5	6.8	6.8	100.0
Total	73	100.0	100.0	

Table 2: Stratification of functional outcome with respect to age using chi-square test (n= 73)

Age group		Functional outcome				Total
		27-30 Excellent	20-26 Good	10-19 Fair	6-9 Poor	
20-40	Count	13	31	6	3	53
	% Total	17.8%	42.5%	8.2%	4.1%	72.6%
41-60	Count	7	10	1	2	20
	% Total	9.6%	13.7%	1.4%	2.7%	27.4%
Total	Count	20	41	7	5	73
	% Total	27.4%	56.2%	9.6%	6.8%	100.0%

P value 0.62

Table 3: Stratification of functional outcome with respect to gender using chi-square test (n=73)

Gender		Functional outcome				Total
		27-30 Excellent	20-26 Good	10-19 Fair	6-9 Poor	
Male	Count	12	33	4	4	53
	% Total	16.4%	45.2%	5.5%	5.5%	72.6%
Female	Count	8	8	3	1	20
	% Total	11.0%	11.0%	4.1%	1.4%	27.4%
Total	Count	20	41	7	5	73
	% Total	27.4%	56.2%	9.6%	6.8%	100.0%

P value 0.28

## DISCUSSION

Tibial plateau fractures both high velocity injury and low velocity injuries due to osteoporosis pose a challenge to the treating surgeon. Over years' various treatment options have evolved to manage these complex periarticular fractures<sup>19</sup>.

The treatment goal for bicondylar tibial plateau fractures is to obtain a stable, aligned, painless and mobile knee and to minimize the risk of post-traumatic osteoarthritis. In order to achieve this outcome, the value of early joint mobilization has been well established by the work of Apley. Fracture reduction and stable fixation is required to allow early joint motion<sup>10</sup>.

In order to overcome this complication, less invasive techniques with external fixators were introduced as a strategy to minimize the iatrogenic soft tissue injury. Monolateral fixators have been used in this regard and, although they have been successful in reducing the rate of the soft tissue complications,<sup>[15-16]</sup> the mechanical stability of this technique is not adequate, and loss of reduction has been reported<sup>16</sup>.

**Date analysis and scoring:** In our study when data of patients was analysed and scored according to the Knee function grading system (Rasmussen), the distribution of the functional outcome of the patients showed that out of 73 patients 20(27.4%) were in excellent outcome, 41(56.2%) were in good outcome, 7(9.6%) were in fair outcome, 5(6.8%) were in poor outcome.

One study found that Rasmussen's knee functional score, the results were excellent in five cases, good in 12 cases, fair in two cases, and poor in one case. The mean duration of surgery was 100 min (range: 80-150 min). The mean trauma to surgery interval was 23 h (range: 5-74 h). The average hospital stay was 11 days<sup>13</sup>. Catagni et al in their series of high energy schatzkers V and VI tibial plateau fractures treated with circular external fixators recorded excellent and good results in 30(50.85%) and 27(45.76%) patients respectively. In another study by Shahnawaz et al in a total of 90 patients, functional outcome of tibial plateau fractures by hybrid illizarov technique was measured and showed (54.4%) excellent outcome, (25.56%) good and (7.8%) with fair functional outcome.

The tibial plateau is one of the most critical loadbearing areas in the human body; fractures of the plateau affect knee alignment, stability, and motion. Early detection and appropriate treatment of these fractures are critical for minimizing patient disability and reducing the risk of documented complications, particularly posttraumatic arthritis<sup>20</sup>.

The magnitude of soft-tissue injury was also an important predictor of functional outcome. The technique for bicondylar fractures was originally performed through a single anterior incision, with subperiosteal dissection of the proximal tibia on both the medial and lateral sides. This massive soft-tissue stripping leads to the devascularization of bone and a high rate of infection. Open reduction and internal fixation were considered to be the best mechanical method of stabilization for bicondylar tibial plateau fractures. It has the advantage of an accurate reduction and stable fixation. However, it carries the risk of further soft-tissue damage and infection<sup>13</sup>.

The functional outcome of this series compares favorably to other published studies, achieving an average Knee Society Clinical Rating Score of 84.2. Several published papers have confirmed these good functional results, with average Knee Rating scores ranging from 65.9 to 80.2. Many of these studies included polytrauma patients that resulted in lower average scores. Complex tibial plateau fractures are usually high energy injuries presenting with significant articular and soft tissue damage in a major weight bearing joint. The restoration of the articular surface, joint stability and axis is technically demanding. The soft tissue damage associated with the injury severity, only adds to the challenge of optimizing outcomes for these injuries<sup>17</sup>. The tibial plateau fractures represent 1-2% of all fractures and approximately 8% of the fractures in elderly<sup>21</sup>.

## CONCLUSION

In current study, we assessed functional outcome of hybrid ilizarov fixation in complex tibial plateau fracture. Hybrid fixator offers an advantage of good knee range of movements due to unhampered knee movements with proximal half ring. Based on our results, the use of hybrid ilizarov fixation for the treatment of complex tibial plateau fractures is safe and effective in terms of low rates of complication and good functional results.

**Conflict of interest:** Nothing to be declared

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