FUNCTIONAL AND RADIOLOGICAL OUTCOME OF TIBIAL PLATEAU FRACTURES (SCHATZKER TYPE 5 & 6) TREATED WITH ILIZAROV CIRCULAR EXTERNAL RING FIXATOR

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ABSTRACT

INTRODUCTION

Fractures of the tibial plateau are the result of high energy trauma. Because of the nature of the trauma and the relative high frequency of soft tissue injuries, the rate of complications is high. Complications include joint stiffness, compartment syndrome, malunion, skin loss, osteomyelitis, and possible amputation. The Ilizarov external fixator helps in minimizing these complications by allowing early mobilization and weight bearing, minimal soft tissue injury and blood loss along with a stable fixation

MATERIAL AND METHODS

In our prospective study of 20 patients which included adults with open/closed Schatzker type 5 and 6 tibial plateau fractures, we studied the outcome following surgery with Ilizarov external fixation using the modified Hohl and Luck criteria which includes functional (extensor lag, valgus or varus instability, knee range of movement, walking distance and pain) and radiological parameters (valgus/varus deformity, depression of articular surface and osteoarthritis).

RESULTS

All patients (n = 20) started weight bearing the day after the surgery. Functionally, 55% (n=11) had a excellent result, 40% (n=8) had a good result. 75% (n=15) had an excellent result radiologically. 3 patients out of 20 had a pin tract infection and one patient had an early implant removal due to non-compliance.

CONCLUSION

Treatment of open/ closed tibial plateau fractures with Ilizarov circular external ring fixator has proven to be advantageous in terms of early weight bearing and minimal soft tissue compromise. Excellent Radiological outcome is not necessarily associated with similar functional outcome.

KEYWORDS

Tibial Plateau Fractures (Schatzker 5 & 6), Ilizarov ring fixator.

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INTRODUCTION: Fractures of the tibial plateau (Schatzker type 5 and 6) result of high energy trauma.[1] Because of the nature of the trauma and the relative high frequency of soft tissue injuries, the rate of complications is high.[2,3] Complications include joint stiffness, malunion, skin loss, osteomyelitis, amputation and even death. The incidence has been as high as 50% for joint stiffness[4,5,6,7,8] and the occurrence of postoperative skin infection and osteomyelitis has been reported as 42% and 33%, respectively.[9] All of these complications are exacerbated if open reduction methods are employed.

Several attempts have been made to classify tibial plateau fractures. Early attempts at classifying tibial plateau fractures by Palmer in 1951,[10] Hohl and Luck in 1956,[11] and Hohl in 1967[11] recognized some of the major themes common to many classification systems for these fractures: split of a condyle, subchondral depression, articular incongruity and comminuted bicondylar involvement. Schatzker et al. published their classification system in 1979,[12] deriving it from the AP radiographs of a series of 94 patients, most of whose tibial plateau fractures were treated nonoperatively (Figure 1) They divided tibial plateau fractures into six types: split fracture of the lateral tibial plateau (Type I), split depression of the lateral tibial plateau (Type II), central depression of the lateral plateau (Type

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III), split of the medial tibial plateau (Type IV), bicondylar tibial plateau fracture (Type V), and dissociation between the metaphysis and diaphysis (Type VI).

In the technique described by Ilizarov, the fractures of the tibial plateau–Schatzker type 5 and 6–have been reduced and fixed with circular Ilizarov external fixator with minimal complications.[13,14] There is no surgical incision involved. The other significant advantages of the technique are immediate post-operative mobilization of knee and weight bearing ambulation once the alignment (mechanical axis) is restored. It allows immediate weight bearing as it is a very stable and rigid external fixator imparting rotation and angular stability as well.[15,16]

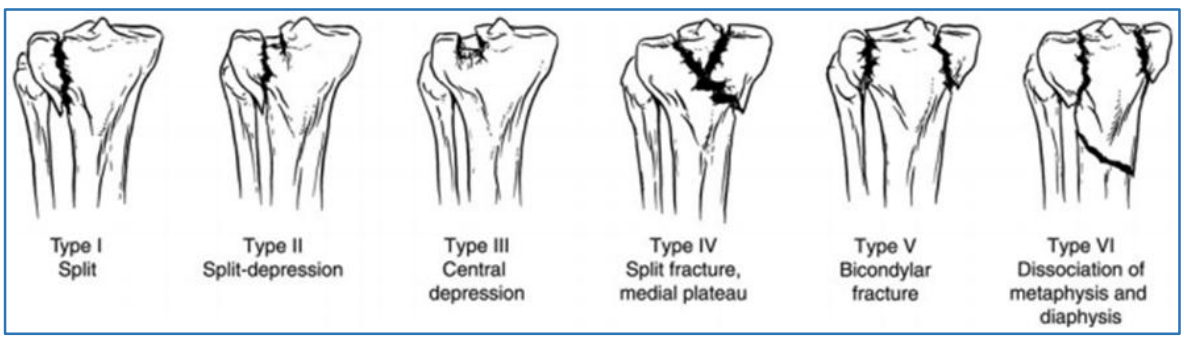

Fig. 1: Schatzker classification of tibial plateau fractures into 6 types

AIM AND OBJECTIVE: To study the outcome of Schatzker type 5 and type 6 tibial plateau fractures treated with Ilizarov external fixator in terms of functional and radiological outcome.

MATERIAL AND METHODS: The study was conducted at JSS Medical College and teaching hospital, Mysore, India. It is a major urban tertiary care referral hospital in this area. Design of the study was prospective. Study period was from April 2014 onwards and included all the patients fitting the inclusion criteria and coming to the emergency department or the outpatient clinic.

Inclusion Criteria:

1. Persons aged between 18 and 75 of either sex.
2. Schatzker type 5 or type 6 tibial plateau fracture.
3. Open or compound fractures falling under any grade of the modified Gustilo–Anderson classification.

Exclusion Criteria:

1. Persons with age less than 18 or more than 75.
2. Schatzker type 1 to type 4 tibial plateau fractures.
3. Patients with concomitant distal femoral fractures.

Data collection: Following ethics committee approval, 20 patients were included in the study. Informed consents were taken. A structured Proforma was filled while admitting the patient which included demographics, staging of fracture and a head to toe examination of the patient. Pre-operative radiographs were taken. CT scan of the affected area was taken in 10 cases.

Operative technique: Following routine investigations and a pre anaesthetic evaluation, all patients were operated within a period of 5 days. Cefoperazone 1g and Sulbactam 500mg single dose were used as antibiotic prophylaxis and were given to the patient on table right before the anaesthetic procedure.

All patients underwent a standard Ilizarov operative procedure. Those with open fractures underwent a through wash with normal saline depending on the size of the wound followed by wound debridement. Primary wound closure with tension free sutures was done. All cases were operated under epidural anaesthesia.

The surgery was performed without a tourniquet on a traction table with the foot fixed in a shoe. Calcaneal traction was used in 8 cases. Biplanar C arm guidance was used during reduction, pin insertion and assembly of the frame. The axial reduction was achieved with traction. The joint surface was reconstructed using closed pressure with percutaneously inserted elevators, reduction forceps or/and wires with olives. Arthrotomy or arthroscopy was not done. Assembly of the frame was done on table. The proximal ring was placed at the level of the fibular head. Additional stability was achieved using 2 or more 2 mm wires parallel to the articular surface depending on the fracture fragments with posts secured on the rings. The wires were tensioned. Depending on the complexity of the fracture, another one to three rings were fixed with two to three wires in the tibia, and they were then connected with connecting rods restoring the mechanical axis. Pin tracts were dressed with 5%w/v povidone iodine soaked gauze pieces. 3 patients with Schatzker type 6 fractures had a distal femoral ring inserted for additional stability.

Post-operative care: Postoperatively, all patients were made to weight bear within 24 hours of the procedure with the help of an adjustable walker. Post-operative radiographs were taken the next day after surgery. Physiotherapy in form of quadriceps strengthening, Hip and ankle range of motion exercises was started. Patients were followed up at week 4, 8 and 12, following which the frequency was decreased to once in 6 weeks till radiographic union was achieved. Serial radiographs were taken at all follow-ups. Implant removal was done under spinal anaesthesia or in the outpatient department once union was achieved.

Fig. 2 & 3

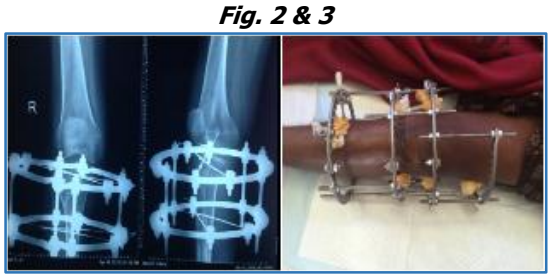

Fig. 4 & 5

Figure 2-5: showing preoperative 3D CT SCAN and radiograph of knee of patient with Schatzker type 5 bicondylar fracture variant. post-operative radiograph with rings in situ. post-operative Clinical photograph showing frame assembly with distal femoral ring.

The results were evaluated following implant removal independently by the authors. Modified Hohl and luck criteria was used which includes both radiological and functional outcome[17] (Table 1 and 2).

Functional outcome was measured in terms of lack of extension, range of movement, valgus or varus instability, walking distance and pain. Radiological outcome was measured in terms of valgus/varus deformity, depression of articular surface and amount of osteoarthritis developed.

Grade	Lack of extension (degrees)	Range of movement (degrees)	Varus or valgus instability (degrees)	Walking distance (meters)	Pain
Excellent (all of the following)	0	≥120	<5	≥3000	None
Good (not more than one of the following)	>0	<90	>5	<1000	Mild on activity
Fair (not more than two of the following)	≥10	<75	>5	<100	Moderate on activity or intermittent at rest
Poor (all results worse than fair)					

Table 1: Functional grading used in the evaluation

Grade	Valgus/ Varus Deformity (Degrees)	Depression of Articular surface (MM)	Osteoarthritis
Excellent (all of the following)	≤5	<5	None
Good (not more than one of the following)	>5	>5	Minimal
Fair (not more than two of the following)	>10	>5	Moderate
Poor (All results worse than fair)			

Table 2: Radiographic grading used in the evaluation

RESULTS: Table 3 shows the individual details of the patients included in the study. Out of the 20 patients, 17 were males and 3 females. Majority of them had the injury due to a Road traffic accident (n=15, 75%). 13out of 20 were Schatzker type 6 injuries and the remaining were type 5. 7 out of 20 injuries had open wounds over the fracture site, whereas the remaining 13 were closed. Average age of the patients was 40.5 years. Average follow up period was 30 weeks.

Figure 6 shows a graphical representation of the results achieved functionally. 55% patients (n=11) had an excellent functional outcome, followed by 40 % (n=8) achieving a good outcome. Only one patient had a fair outcome and none of the patients had a poor functional outcome.

Figure 7 similarly shows the radiological outcome achieved amongst the patients. 75%(n=15) achieved an excellent result followed by a good result in 20 % patients. A fair outcome was achieved in just one patient and none of the patients had a poor outcome.

Table 4 shows a summary of the results with age correlation for each of the studied variables. The only significance can be observed is that Schatzker type 6 fractures can be correlated to an older age group of 40–59 years.

The complications observed were pin track infections in 5 patients and non-compliance in 1 patient. Pin track infections were managed by local dressing and antibiotic application in 4 cases. 1 case required admission and a course of injectable antibiotics. Implant was removed in the non-compliant patient after one month and a long knee cast applied. Nonetheless, the patient achieved a good radiological and functional result. No reoperations were done in any patient with the fixator in situ.

Case no.	Age	Sex	Schatzker type	Mode of injury	Open/Closed injury	Follow up(months)	Functional result	Radiological result
1	26	M	6	RTA	Open	10	Good	Good
2	48	M	6	RTA	Open	12	Excellent	Excellent
3	59	M	6	Self-fall	Open	6	Good	Good
4	53	M	6	RTA	Open	8	Excellent	Excellent
5	47	F	5	Self-fall	Closed	9	Fair	Excellent
6	40	M	5	Self-fall	Closed	8	Good	Excellent
7	30	M	6	RTA	Closed	9	Excellent	Good
8	50	M	5	RTA	Closed	9	Good	Fair
9	44	M	6	RTA	Closed	8	Excellent	Excellent
10	59	M	6	RTA	Closed	7	Good	Excellent
11	42	F	5	RTA	Closed	6	Excellent	Excellent
12	56	M	5	RTA	Closed	8	Good	Good
13	26	M	6	RTA	Closed	6	Excellent	Excellent
14	40	M	5	Self-fall	Closed	7	Excellent	Excellent
15	35	M	6	RTA	Open	8	Excellent	Excellent
16	38	M	6	RTA	Closed	8	Good	Excellent
17	26	M	6	RTA	Open	7	Excellent	Excellent
18	21	M	6	Self-fall	Closed	6	Excellent	Excellent
19	30	M	6	RTA	Open	3	Excellent	Excellent
20	40	F	5	RTA	Closed	7	Good	Excellent

Table 3: Individual patient details with outcome

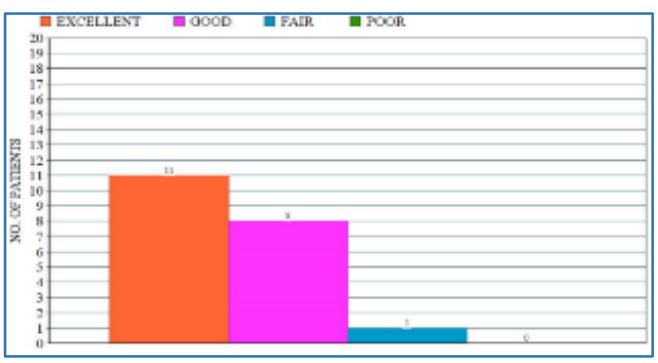

Fig. 6: Functional outcome

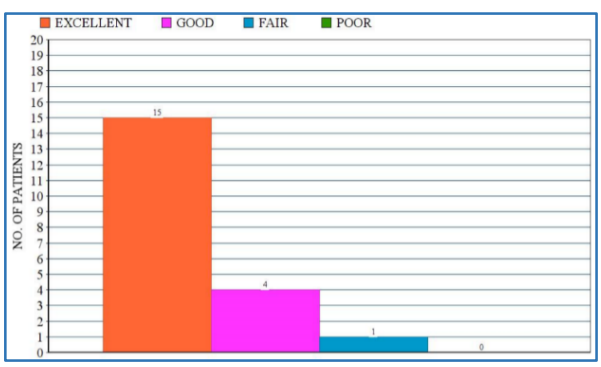

Fig. 7: Radiological outcome

Variables	Total (n=20)	Age Group(in years)		χ^2 (p value)
	Frequency (%)	20-39 (n=8) Frequency (%)	40-59 (n=12) Frequency (%)	
Sex				
Male	17(85)	8(100)	9(75)	2.353 (0.125)
Female	3(15)	0	3(25)	
Schatzker type				
5	7(35)	0	7(58.3)	7.179(0.007)*
6	13(65)	8(100)	5(41.7)	
Mode of injury				
RTA	15(75)	7(87.5)	8(66.7)	1.111(0.292)
SELF FALL	5(25)	1(12.5)	4(33.3)	
Open/closed injury				
Open	7(35)	4(50.0)	3(25)	1.319(0.251)
Closed	13(65)	4(50.0)	9(75)	
Follow up months				
≤ 6 months	5(25)	3(37.5)	2(16.7)	1.111(0.292)
> 6 months	15(75)	5(62.5)	10(83.3)	

Functional results				
Fair	1(5)	0	1(8.3)	2.386(0.303)
Good	8(40)	2(75)	6(50.0)	
Excellent	11(55)	6(25)	5(41.7)	
Radiological results				
Fair	1(5)	0	1(8.3)	0.833(0.659)
Good	4(20)	2(25.0)	2(16.7)	
Excellent	15(75)	6(75.0)	9(75.0)	

Table 4: Summary of results and correlation of variables with age groups

Fig. 8: Radiographic union achieved in a patient after 24 weeks of follow up

Fig. 9

Fig. 10

Fig. 9 & 10: Full range of motion of knee restored in the same patient

DISCUSSION: High energy tibial plateau fractures are a challenge to any orthopaedic surgeon. Very often they are comminuted and open fractures making the rate of complications such as infection, bleeding, stiffness and malunion higher.

The recommended treatment options for fractures of the proximal tibia (Schatzker type 5, 6) are open reduction and internal fixation with plate and screws, conservative management and external fixation of the fracture fragments. However, Ilizarov external fixator is also considered to be an established modality of treatment.[18,19] Regardless of the treatment instituted the rate of complications remains high.[3]

Various studies using different modalities of treatment are there in the literature. In a study by Yu et al. which included 54 patients with tibial plateau fractures treated with ORIF with plate and screws, weight bearing was started 19 weeks after surgery and the ROM achieved was 0 to 108 degrees, 2 patients ultimately required Total knee replacement.[20] Lee et al operated 35 similar fractures with ORIF and started weight bearing at 12 weeks post surgery. Deep infections were noted in 2 patients.[21] Similarly, in a study by Oh et al. 23 patients with tibial plateau fractures were treated with ORIF and could only start weight bearing 14 weeks after surgery.[22]

Similar studies were carried out using the Ilizarov external fixator. In a study conducted by El–Barbary et al. which included 29 patients with Schatzker type 5 and 6 fractures a median knee ROM of 0 to 112 degrees was achieved and weight bearing was started after 6 weeks with no complications.[23] Dendrinos et al conducted a similar study on 24 patients with high energy tibial plateau fractures. 90 % patients achieved a median ROM of 110 degrees with 3 patients developing compartment syndrome. Weight bearing was started after 14 weeks.[24] Zecher et al in 21 patients with Schatzker type 5 and 6 tibial plateau fractures treated with circular ring fixator achieved greater than 90 degrees knee ROM in all their patients. However, 7 patients developed compartment syndrome.[25] In a recent study by Ramos et al. which included 19 patients with high energy tibial plateau fractures treated with ring fixator, immediate weight bearing was started with a median range of motion of 0 to 120 degrees was achieved. 2 patients needed a Total knee replacement and 2 patients developed a compartment syndrome.[26]

Our study has also shown comparable results with the above mentioned studies. Immediate weight bearing was started in all patients which was tolerated well. None of the patients developed compartment syndrome. The only complications encountered were pin track infections in 5 patients and non-compliance in 1 patient, emphasizing the need for sterile surgical technique and regular pin track dressings along with proper patient counselling.

In comparison to studies in which ORIF was used as the treatment modality, it can be observed that weight bearing is usually delayed and also more number of patients end up having an infection due to the wider exposure involved. In case of the circular ring fixator the major advantage lies in the ability to make the patient weight bear immediately thereby avoiding complications like postoperative knee stiffness. Also, since it is a closed technique, soft tissue compromise is significantly less and chances of infection are considerably decreased.

The limitations of the study were a small sample size along with the absence of a comparative group. Also, associated injuries like ligament injuries could not be assessed as none of the patients underwent MRI scanning of the affected joint.

CONCLUSION: The management of tibial plateau fractures specially the type V and type VI Schatzker are difficult to treat with the regular modalities like open reduction and internal fixation, in view of the risks and complications which it poses like compartment syndrome, skin problems, infections, late varus and valgus malreductions, loss of alignment, inability to restore the mechanical axis, This method of Ilizarov curtails all the problems restoring the mechanical axis, with least complications, and early weight bearing it can be primary modality of fixation in the high energy fractures.

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