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Original Research Article

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 AT TERTARY CARE CENTRE: AN HOSPITAL BASED PROSPECTIVE STUDY

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ABSTRACT

Background: Proximal tibial articular fractures can be caused by auto accidents and injuries from bumper collisions. The fracture patterns are very complex and may involve medial, lateral, or both the tibial plateaus. 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. The aim of this study to assess the outcome of Schatzker type 5 and type 6 tibial plateau fractures treated with Ilizarov external fixator in terms of functional and radiological outcome.

Materials and Methods: This is a hospital based prospective study done on 25 patients who were diagnosed with Schatzker type V or VI tibial plateau fractures, aged 18 to 75 years, of both sexes in orthopaedic department in JLN Medical College, Ajmer, Rajasthan, India during one-year period. They were counselled for circular Ilizarov ring fixator method of treatment after explaining the benefits and limitations of the procedure. Radiological assessment criteria were done using Rasmussen radiological scoring system and functional outcome assessment was done using the Rasmussen clinical score and Lysholm knee score.

Results: Out of the 25 patients, 22 were male and 3 were female. Mean age of incidence was 42.3 years with a range of 18 to 75 years. All patients had high velocity injury in form of road traffic accidents or fall from height. Duration of hospital stay was from 1 to 27 days with an average of 8.3 days. Of the 25 cases 22 were close injuries, 3 were open. 16 patients had Schatzker type V injury and 9 patients were having type VI injury. Average duration of frame application was 118 days with a range of 75 days to 160 days. Based on clinical rasmussen scores and functional score more than 80 % of patients had that were excellent or good results. 60% patients had early weight bearing permitted due to circular fixator stability followed by 20% patients had permitted partial weight bearing within 1–2 weeks.

Conclusion: We concluded primary external fixation by Ilizariov ring fixator in Schatzker type V and VI fractures of proximal tibia is a safe and effective method. It can be done in same surgical sitting thus avoiding staged procedures as in other methods.

Keywords: Knee Joint, Schatzker Type 5 And Type 6, Tibial Plateau Fractures, Ilizarov External Fixator, Functional Outcome, Radiological Outcome.

INTRODUCTION

The knee joint is a superficial joint of the lower extremities and complex movements take place during motion at the knee joint. Proximal tibial articular fractures can be caused by auto accidents and injuries from bumper collisions. Less severe trauma, such as falls or sports injuries, can also frequently result in them, especially in older patients with osteopenia.[1] Proximal tibial plateau fractures are among the most common intra-articular fractures. Either direct trauma that produces axial compressive patterns or indirect trauma that produces coronal fracture patterns are the causes of them. This makes up 1% of all fractures.[2] The fracture patterns are very complex and may involve medial, lateral, or both the tibial plateaus.

Fractures of the proximal tibia, particularly those that extend into the knee joint are serious injuries that frequently result in functional impairment. In the past 3 decades, with improvements in surgical techniques and implants, there has been an unmistakable trend toward surgical management of these injuries. Nevertheless, proximal tibial fractures remain challenging because of their number, variety, and complexity. Despite a plethora of articles, written in the past 50 years, that have addressed the problems of classification and results of various treatments, the optimal method of management remains controversial.[3-5] The indications of nonoperative versus operative treatment vary widely among surgeons, as do the specific methods of treatment for the many fracture configurations.

There are various classification systems for Tibial plateau fractures but a widely accepted classification method was developed by Schatzker. High-energy tibial plateau fractures remain a challenge to orthopedic surgeons, with the bicondylar type (Schatzker type V) and the comminuted type (Schatzker type VI) fractures being the most difficult to treat.[6] Schatzker type V and VI fractures are high-energy fractures often accompanied by other local and systemic injuries.

There are several treatment options for high-energy tibial plateau fractures, such as single plating, dual plating, and definitive external fixation; nevertheless, there is ongoing debate on the most effective approach. Major wound complications have occasionally been linked to the open reduction and internal fixation procedure, particularly when it is applied via wounded soft tissues. Due to the delayed mobilization of the knee joint, the use of external fixators as a therapy method frequently results decrease in joint stiffness.[7]

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.[8,9] 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.[10,11] The aim of this study to assess the outcome of Schatzker type 5 and type 6 tibial plateau fractures treated with Ilizarov external fixator in terms of functional and radiological outcome.

MATERIALS AND METHODS

This is a hospital based prospective study done on 25 patients who were diagnosed with Schatzker type V or VI tibial plateau fractures, aged 18 to 75 years, of both sexes in orthopaedic department in JLN Medical College, Ajmer, Rajasthan, India during one-year period.

Inclusion Criteria

1. Persons aged between 18 and 75 of either sex.
2. Schatzker type 5 or type 6 tibial plateau fracture.
3. Closed or open 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.
4. Patients with any history of acute illness (e.g. renal or pancreatic diseases, ischemic heart disease, asthma, COPD etc.

Data Collection: History was taken and clinical examination was performed following the standard procedure of clinical methods. Antero-posterior and lateral radiographs of affected knee with leg were taken. Those patients with type V and VI fracture were included in the study. They were counselled for circular Ilizarov ring fixator method of treatment after explaining the benefits and limitations of the procedure. Those patients who gave written informed consent to undergo the procedure were finally included in the study.

Surgical Procedure: All patients underwent computed tomogram to assess extent of intra-articular involvement. Open fractures were treated with thorough debridement and appropriate antibiotics as part of primary care. Once patient was stable he or she was posted for surgery. All underwent standard ilizarov procedure on traction table after giving calcaneal pin traction. Knee joint was aspirated in all cases to drain haemarthrosis. Axial traction coupled with ligamentotaxis was done to achieve maximum anatomical articular reduction under fluoroscopic guidance. Some intraarticular fractures needed percutaneous manipulation to achieve reduction. In few cases temporary kirschner wires were used to hold the reduction. Once reduction was satisfactory, olive wires were used in medio-lateral direction in metaphyseal region and fixed to circular ring of appropriate size. Step by step assembly of frame was completed by passing remaining wires and transfixed

to ring. All type VI injuries underwent across knee fixation with additional ring in distal femur which was kept for around 3 to 4 weeks and removed subsequently. Post-operative antero-posterior and lateral radiographs were taken for records.

Post-operative care: Gentle knee mobilization exercises were started in all type V fractures after 24-48 hours as per pain tolerance capacity of patient. All type VI fracture patients were encouraged to start weight bearing by 48 to 72 hours. Subsequent follow-up was done at one-month interval till frame removal was done and then final follow-up at six months was done. Patients were taught the standard "kurgan protocol'' for pin tract care.[12] Frame removal was done at the end of clinical and radiological union under short general anesthesia and it was not considered as re-operation. Radiological assessment criteria were done using Rasmussen radiological scoring system[13] and functional outcome assessment was done using the Rasmussen clinical score[13] and Lysholm knee score.[14]

Radiological Outcome Criteria: Radiological assessment is performed on AP and lateral radiographs at regular follow-up. The Rasmussen radiographic score[13], rated out of 10 points and distributed into four stages: excellent (18 points), good (12–17 points), moderate (6-11 points), and poor (< 6 points);

II. Functional Outcome Criteria: The clinical assessment included the the Lysholm score[14] and the Rasmussen score[13]. (Rasmussen Clinical Score + Lysholm Knee Score)

III. Weight-Bearing and Rehabilitation Outcomes:

- Early weight bearing permitted due to circular fixator stability
- Partial weight bearing within 1–2 weeks
- Full weight bearing by 6–8 weeks
- Early knee mobilization reduces stiffness

Statistical Analysis: Statistical analysis was performed by using SPSS 22.0v (Statistical package for social sciences) for Windows version 10. Continuous variables were compared by student's t test between two parameters, and analysis of variance (ANOVA) test when parameters were more than two.

RESULTS

Out of the 25 patients, 22 were male and 3 were female. Mean age of incidence was 42.3 years with a range of 18 to 75 years. All patients had high velocity injury in form of road traffic accidents or fall from height. Duration of admission to operation interval was from 1 to 14 days with a mean of 4.6 days. Duration of hospital stay was from 1 to 27 days with an average of 8.3 days. Of the 25 cases 22 were close injuries, 3 were open. 16 patients had Schatzker type V injury and 9 patients were having type VI injury. Average duration of frame application was 118 days with a range of 75 days to 160 days. [Table 1]

Radiological outcome: Based on Rasmussen radiological scoring system, eight patients (32%) had excellent, 12 patients (48%) had good, 3 patients (12%) had fair and 2 patients (8%) had poor radiological outcome. [Table 2]

Functional outcome: Based on Rasmussen clinical scoring system, 17 patients (68%) had excellent, 5 patients (20%) had good, 2 patients (8%) had fair and 1 patient (4%) had poor functional outcome. [Table 2]

Based on Lysholm Knee Score system, 18 patients (72%) had excellent, 4 patients (16%) had good, 2 patients (8%) had fair and 1 patient (4%) had poor functional outcome. [Table 2]

60% patients had early weight bearing permitted due to circular fixator stability followed by 20% patients had permitted partial weight bearing within 1–2 weeks, 12% patients had permitted full weight bearing by 6–8 weeks and only 2 patients can early knee mobilization. [Table 2]

Figure 1: Postoperative X-ray with Ilizarov frame in situ

Table 1: Summarized of variables in study

Variables		No. of cases (N=25)	Percentage
Mean age (years)		42.3±13.58	Range (18-75 years)
Male to female		22/3	-
Mode of injury	RTA	19	76%
	Self-Fall	6	24%
Duration of admission to operation interval (days)		4.6±1.2	Range (1-14 days)
Duration of hospital stay (days)		8.3±2.6	Range (1-27 days)
Type of injury	Open	3	12%
	Closed	22	88%
Schatzker type	V	16	64%
	VI	9	36%
Average duration of frame application (days)		118	Range (75 days-160 days)

Table 2: Radiological and functional outcome

Outcome	Score	No. of patients	Percentage
Radiological outcome (Rasmussen radiological scoring system)			
Excellent	**18**	8	32%
Good	**12-17**	12	48%
Fair	**6-11**	3	12%
Poor	**<6**	2	8%
Functional outcome (Rasmussen Clinical Score)			
Excellent	**27-30**	17	68%
Good	**20-26**	5	20%
Fair	**10-19**	2	8%
Poor	**<10**	1	4%
Functional outcome (Lysholm Knee Score)			
Excellent	**95-100**	18	72%
Good	**84-94**	4	16%
Fair	**65-83**	2	8%
Poor	**<65**	1	4%
Weight-Bearing and Rehabilitation Outcomes			
Early weight bearing permitted due to circular fixator stability		15	60%
Partial weight bearing within 1–2 weeks		5	20%
Full weight bearing by 6–8 weeks		3	12%
Early knee mobilization reduces stiffness		2	8%

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.

Bicondylar tibia fractures are usually a direct effect of high velocity injury resulting in extensive soft tissue damage, both internal and external and associated with ligament and meniscal injuries as well. Conservative management of type V and VI fractures has consistently given poor functional outcome.[15] Traditional methods of external fixation using monoplanar fixator have been associated with higher incidence of pin tract infection, loosening and subsequent loss of reduction during the course of treatment.[16] Nowadays their use is getting restricted to initial stabilization until soft tissue healing occurs and definitive fixation can be done at a later stage.

The mean age of the patients was 42.3±13.58 years (range: 18-75 years). In the developing world, the population is predominantly composed of younger individuals who are frequently on the road. Because of cultural norms and societal roles, this demographic is predominantly male. As a result, our study reflects this distribution. With more men actively on the streets, there is a higher likelihood of exposure to high-energy trauma, such as RTAs.[17] Therefore, the majority male population in our analysis aligns with the increased incidence of RTAs and other traumatic injuries. A recent study by Nawaz et al found the mean age was 31.25±7.29 years.[18] Another recent study conducted by Tahir et al stated the mean age of the patients was 45.08±10.52.[19] Yu et al also showed the mean age was 45.2 years. This is the most productive phase of life with maximum mobility.[20]

Out of 25 patients, 88% were male and 12% were female. Tahir et al showed in their study the male-to-female distribution was 107/30 (78.1% and 21.89%).[19] Nawaz et al showed that 63 (70%) were male and 27 (30%) were females.[18] Rohra et al found out of 34 patients, 29 (85.29%) were males and 5 (14.71%) were females.[21] Another study revealed that females were 38.9% and males were 61.1%.[20]

According to closed/open injury, out of 25 patients, 22 (88%) had closed injury and 3 (12%) had open injury. A study conducted by Bari et al found that 30 (75%) cases had closed injuries and 10 (25%) cases had closed injuries.[22]

Of note, more than 80 % of patients in all studies included in this study had clinical Rasmussen scores that were excellent or good, including one study,[23] in which all patients had type V or VI fractures. The poorer radiological outcomes in the study described by Roerdink et al,[24] may be due to the fact that the patients were far older (mean age = 72 years) than patients in any of the other studies, while the lower scores in the study reported by Siegler et al,[25] may reflect the high rate (48 %) of osteoarthritis among the participants. The reasons for the poorer radiological outcomes in the study reported by Pogliacomi et al,[26] are less obvious, but may reflect surgical technique differences, namely combined arthroscopic and radioscopic-assisted fracture reduction. Taken together, we believe there is a strong evidence that AARIF results in satisfactory (good or excellent) clinical outcomes in a large proportion of patients. Radiological outcomes also appear to be satisfactory in the majority of patients; however, the evidence is not as strong as that for clinical outcomes.

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.[27] 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.[28] 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.[29] 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.[30] Our study has also shown comparable results with these studies. Immediate weight bearing was started in all patients which was tolerated well. None of the patients developed compartment syndrome.

In our study we have proposed the use of Ilizarov ring fixator as a definitive management protocol for such fractures. This technique has certain distinct advantages over the traditional methods of ORIF. It causes minimal soft tissue injury in an already compromised soft tissue envelope. Periosteum is not disturbed in this method which is very essential for osteo-induction. Early range of motion exercises can be initiated and weight bearing could be started which itself acts as a stimulus for healing. Minor adjustments and realignment are always possible during the course of the treatment. However, this technique has its own sets of limitations. Anatomical restoration of articular surfaces is not always possible. Entrapped meniscus can impede in achieving reduction by closed means and may necessitate mini open reduction. Concomitant cruciate ligament injuries are not addressed which may be a cause of early onset of osteoarthritis and late knee instability. There is always a risk of losing the terminal range of flexion or extension which can at times limit certain future activities of the patient.

CONCLUSION

We concluded primary external fixation by Ilizariov ring fixator in Schatzker type V and VI fractures of proximal tibia is a safe and effective method. It can be done in same surgical sitting thus avoiding staged procedures as in other methods. It avoids potential complications of skin necrosis, infection, extensive soft tissue stripping, and long-term metal or hardware irritation and discomfort to patients.

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