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Research Article

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF TIBIAL PLATEAU FRACTURES MANAGED WITH INTERNAL FIXATION

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ABSTRACT

Objectives: Tibial plateau fractures constitute a wide spectrum of severity from simple to complex fracture patterns. Treatment methods such as internal fixation and hybrid external fixation are commonly administered with specific limitations. The present study was designed to evaluate radiological and functional outcome of tibial plateau fractures managed with internal fixation.

Methods: Thirty-six cases with tibial plateau fractures above 21 years were recruited. All the study cases were managed with open reduction and internal fixation. The post-operative follow-up was continued till 6 months with proper clinicoradiological evaluation to check range of motion, reduction loss, and fracture union. The functional outcome was assessed by Oxford Knee Society score and operative outcome was assessed by modified Rasmussen clinical and radiological criteria.

Results: Functional outcome assessed by Oxford Knee Society score showed both excellent and good outcomes in 91.67% of cases cumulatively. Clinical outcome by modified Rasmussen assessment criteria reported excellent outcome in 33.33%, good in 44.44%, fair in 13.88%, and poor in 8.33%. Radiological outcome was excellent in 16.6%, good in 63.88%, fair in 11.11%, and poor in 8.33%.

Conclusion: The post-operative functional, clinical, and radiological outcomes indicate that open or closed reduction and internal fixation had gained excellent results and are effective modalities in the management of tibial plateau fractures.

Keywords: Tibial plateau fractures, Internal fixation, Knee Society score, Modified Rasmussen assessment criteria.

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INTRODUCTION

Tibial plateau fractures are also articular fractures due to high-energy trauma and result in severe functional defect of major weight-bearing joint of the body [1]. It accounts for 1% of fractures in adults with male predominance (62%) [2]. The prevalence of tibial plateau fractures is increasing in elderly cases aged between 40 and 60 years due to low-energy falls [3]. The optimal treatment option is still ongoing debate because inappropriate management can lead to post-operative adverse conditions such as non-union, delayed union, infection, arthrosis, and dermal necrosis [4-6].

The treatment goals of tibial plateau fractures are to restore anatomic reduction of fractured contents while providing stability and range of motion, joint stability, and early recovery of joint movements and weight-bearing [7,8]. For less to moderate grade fractures, open or closed treatment methods are ideal and for severe tibial plateau fractures (type V and type VI), open reduction and internal fixation, closed reduction with percutaneous screw fixation, wire-guided cannulated screw, conservative methods, ligamentosis, and minimal invasive plating techniques have been suggested [9]. However, external fixator often led to permanent joint stiffness due to early range of motion and internal fixation leads to devascularization at fracture site, thus diminishes the recovery [10]. Even though open reduction and internal fixation was widely accepted modality in the treatment of tibial plateau fracture. In this regard, the present study was aimed to evaluate radiological and functional outcome of tibial plateau fractures managed with internal fixation.

METHODS

Thirty-six cases with tibial plateau fractures were recruited for this prospective study that conducted at the Department of Orthopaedics, Government Medical College and Hospital, Nalgonda, from January2020 to December 2021. Cases with unstable and closed tibial fractures and willing to participate were included in the study. Cases with skeletal deformities, open tibial fractures, pathological fractures, fractures to femur and foot skeleton, vascular injuries, open growth plate, and not willing to participate were excluded from the study. Written informed consent was obtained from all the study participants and study protocol was approved by the Institutional Ethics Committee. Tibial plateau fractures were classified according to Schatzker staging system [11].

Classification of tibial fractures according to Schatzker staging system

Fracture type	Condition
Type I	Wedge-shaped pure cleavage fracture
Type II	Pure cleavage fracture with a depressed component
Type III	Pure central depression
Type IV	Medial tibial plateau fracture with depressed component
Type V	Lateral and medial tibial plateau fractures
Type VI	Discontinuity of metaphysis and diaphysis.

Surgical procedure: The details of general, clinical, and radiological examination were obtained. Surgical procedure was conducted under C-arm control. All the study cases were managed with open reduction and internal fixation. Different methods such as ORIF with buttress plate, ORIF with buttress plate and bone grafting, percutaneous cancellous screw fixation, and locking compression plate were administered. Ipsilateral iliac crest was utilized for bone graft. After operative procedure, cases were immobilized with compression bandage and advised static quadriceps exercises for 3 weeks. Passive range motions were continued for next preceding 3 weeks. The post-operative follow-up was continued till 6 months with proper clinicoradiological evaluation to check range of motion, reduction loss, and fracture union. The functional outcome was assessed by Oxford Knee Society score and

operative outcome was assessed by modified Rasmussen clinical and radiological criteria [12,13].

Oxford knee society score

Grading	Score
Excellent	80–100
Good	70–79
Fair	60–69
Poor	<60

Modified Rasmussen's clinical and radiological criteria

Grading	Score
Excellent	28–30
Good	24–27
Fair	20–23
Poor	<20

Statistical analysis

Descriptive statistics were used to express categorical variables and continuous variables were represented in mean and SD.

RESULTS

Among the 36 cases, majority were between 31 and 50 years (88.89%) of age with more male participants (58.33%). Ten cases were managed with ORIF with buttress plate, eight cases with ORIF with buttress plate and bone grafting, 13 cases with percutaneous cancellous screw fixation, and five cases with locking compression plate.

Road traffic accidents (66.67%) were the common cause of injury followed by falling from height (27.78%) and injuries due to assault (5.55%). Left-sided fractures (52.78%) were commonly observed with mean time from injury to surgery which was 3.45 days (Tables 1-4). According to Schatzker staging system, majority cases had type II fractures (27.70%) followed by type V (19.40%) and type I (16.60%) (Graph 1).

DISCUSSION

Management of tibial plateau fractures remains a challenging task for orthopedic surgeons concerning to restoration of normal anatomy, function, and range of movement [14]. Open reduction and internal fixation is effective treatment modalities for successful outcomes with few reported flaws [15-17]. The present study included 36 cases above 21 years of age. The road traffic accidents were reported to be predominant cause of fractures, with mean time from injury to surgery which was 3.45 days.

Table 1: Demographic details of study participants

Demographic parameters	Total number of cases (n=36)	
	Frequency	Percentage
Age (in years)		
21–30	03	8.33
31–40	08	22.22
41–50	15	41.67
51–60	09	25
>60	01	2.78
Gender		
Male	21	58.33
Female	15	41.67
Mode of injury		
Falling from height	10	27.78
Road traffic accidents	24	66.67
Assault	02	5.55
Side of injury		
Right side	17	47.22
Left side	19	52.78
Mean time from injury to surgery	3.45±0.66	

Manidakis *et al*. found 15.2% of superficial infection rate, 9.6% of deep infection, and 3.9% of septic arthritis [7]. Khatri *et al*. reported superficial wound infections in 9.2% and deep infection in 4.6% [14]. Jagdev *et al*. noticed post-operative superficial infection in 8.69% of cases [16]. Angelo *et al*., on tibial fractures managed with internal fixation, reported that 5.3% of cases had wound infection [18]. Ahearn *et al*. reported 13% of overall superficial infection rate and 2% of deep infection rate [19]. Canadian Orthopaedic Society reported high rate of superficial (17%) and deep infection (13.8%) [20]. Ochen *et al*. reported 20% of overall infection rate including superficial and deep [21]. A study by Yu *et al*. reported knee stiffness in 13.84%, varus and valgus deformity in 7.69%, and wound infection in 3.07% of cases [22]. Polat *et al*. reported 5.7% superficial wound infection and 3.8% deep infection [23]. Shekhar *et al*. reported 5.6% superficial infection, 5.6% soft-tissue debridement, 3.7% deep venous thrombosis, 3.7% non-union, and 3.7% delayed union [24]. Ravikumar *et al*. reported superficial infection in 10% and deep infections in 6.6% [25]. Rohra *et al*. reported knee stiffness in 8.8% and superficial wound infection in 5.8% [13]. Similar post-operative complications were reported in the present study such as implant irritation in 8.33%, deep venous thrombosis (5.55%), superficial infection (5.55%), soft-tissue debridement (5.55%), knee stiffness (5.55%), delayed union (2.78%), and non-union (2.78%) and varus or valgus deformity was observed equally in 2.78% (Table 2).

In the present study, functional outcome assessed by Oxford Knee Society score showed both excellent and good outcomes in 91.67% of cases cumulatively. Findings were less than Khatri *et al*. (93.7%) and Rohra *et al*. (94.1%) and similar to the other study findings (Table 5). Khatri *et al*. reported that cases with superficial and deep infections were reported low Oxford Knee Society score than cases without infection [14].

Assessment of radiological outcome by modified Rasmussen assessment criteria reported excellent and good outcome in 80.48% of

Table 2: Associated complications observed during post-operative follow-up

Complications	Total cases	
	Frequency	Percentage
Without complications	20	55.55
Implant irritation	03	8.33
Deep venous thrombosis	02	5.55
Superficial infection	02	5.55
Soft-tissue debridement	02	5.55
Delayed union	01	2.78
Non-union	01	2.78
Varus or valgus deformity	01	2.78
Knee stiffness	02	5.55

Table 3: Functional outcome assessed by Oxford Knee Society score

Outcome	Frequency (%)
Excellent	20 (55.55)
Good	13 (36.12)
Fair	02 (5.55)
Poor	01 (2.78)

Table 4: Clinical and radiological outcome of study participants

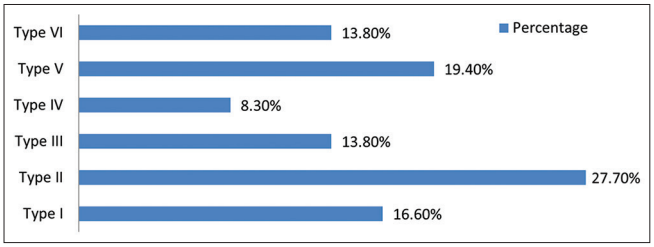
Grading	Clinical outcome (%)	Radiological outcome (%)
Excellent	12 (33.33)	06 (16.6)
Good	16 (44.44)	23 (63.88)
Fair	05 (13.88)	04 (11.11)
Poor	03 (8.33)	03 (8.33)

Table 5: Comparison of function outcome status Oxford Knee Society score

Author and year	Functional outcome by Oxford Knee Society score			
	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Present study	55.55	36.12	5.55	2.78
Khatri *et al*., 2014 [14]	83	10.7	4.6	1.5
Rohra *et al*., 2016 [13]	70.58	23.52	2.94	2.94
Jagdev *et al*., 2017 [17]	65.21	26.08	8.71	0
Ravikumar *et al*., 2018 [25]	40	43.3	10	6.7
Polat *et al*., 2019 [23]	73.1	13.5	7.7	5.8

Table 6: Comparison of radiological outcome assessed by modified Rasmussen criteria

Author and year	Radiological outcome by modified Rasmussen criteria			
	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Present study	16.6	63.88	11.11	8.33
Rohra *et al*., 2016 [13]	32.35	61.76	5.88	0
Ravikumar *et al*., 2018 [25]	30	53.3	16.7	0
Mecharla *et al*., 2018 [26]	33.33	50	10	6.67
Paleti *et al*., 2019 [27]	12.5	67.5	12.5	7.5
Angelo *et al*., 2022 [18]	24.56	61.40	12.28	1.75
Shekhar *et al*., 2022 [24]	53.8	33.3	12.9	0



Graph 1: Distribution of cases according to Schatzker staging system

cases. The findings were higher than Paleti *et al*. (80%) and lower than other study findings (Table 6).

In the present study, assessment of clinical outcome by modified Rasmussen assessment criteria reported excellent outcome in 33.33%, good in 44.44%, fair in 13.88%, and poor in 8.33% (Table 4). Sekhar *et al*. reported excellent clinical outcome in 64.8% and good in 35.2% of cases [24]. Paleti *et al*. reported excellent outcome in 47.5%, good in 40%, fair in 7.5%, and poor in 5% of cases [27].

Khatri *et al*. concluded that open reduction and internal fixation has excellent outcome for appropriately selected type V and type VI tibial fractures [14]. Similarly, open reduction and internal fixation by plate osteosynthesis of closed tibial plateau fractures has remarkable radiological and functional outcome with minimal soft-tissue infection [25]. Rohra *et al*. stated that management of high-energy tibial plateau fractures by open reduction and internal fixation gained excellent to good functional outcome with minimal soft-tissue complications [13]. Oh *et al*. reported excellent outcome in 91% of cases managed with open reduction and internal fixation [28]. The present study has limitations in terms of short post-operative follow-up, lack of comparison group, and limited to minimal number of participants. Further long-term follow-up studies are required with multiple methods comparison.

CONCLUSION

The post-operative functional, clinical, and radiological outcomes indicate that open or closed reduction and internal fixation had gained excellent results and is effective modalities in the management of tibial plateau fractures.

AUTHORS' CONTRIBUTIONS

Conceptualization, data acquisition, data analysis and interpretation, manuscript preparation, revision of manuscript, and approval of final version of manuscript: Dr. M. Lakshmi Narayana and Dr. K. Nagaraju.

CONFLICTS OF INTEREST

Nil.

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