

International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(1): 491-496
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www.orthopaper.com
Received: 16-11-2019
Accepted: 20-12-2019

Dr. Somashekara SA
Assistant professor, Department of Orthopedics, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India

Dr. Manoj Kumar HV
Professor, Department of Orthopedics, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India

Dr. Ajay VM
Post graduate, Department of Orthopedics, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India

Dr. Abhijit Patil
Assistant professor, Department of Orthopedics, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India

Dr. Preetham N
Assistant professor, Department of Orthopedics, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India

Corresponding Author:
Dr. Ajay VM
Post graduate, Department of Orthopedics, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India

Functional outcome assessment of columnar fixation in proximal tibia fractures: A prospective study

Dr. Somashekara SA, Dr. Manoj Kumar HV, Dr. Ajay VM, Dr. Abhijit Patil and Dr. Preetham N

DOI: <https://doi.org/10.22271/ortho.2020.v6.i1i.1913>

Abstract

Introduction: Tibial plateau fractures are common intra-articular fractures, representing 1.2% of all fractures. Most complex tibial plateau fractures are a result of the high-energy injury. Comminution makes interpretation of fracture patterns difficult. Complete understanding of these fractures is the basis for successful treatment.

Material and Methods: This is a prospective study; 30 patients with tibial plateau fractures operated at Bangalore medical college were included in this study. The follow-up period was 24 months. The fractures were evaluated by computed tomography using three-column concepts and managed as per column-specific fixation. Follow-up analysis was made using KSS & Modified Rasmussen Radio-logical Criteria.

Results: In our study of posterior column fixation group radio-logical outcome results were excellent in 4 (66.68%) cases and good in 2 (33.32%) cases and in posterior column non fixation group excellent were 3 (16.68%), good were in 12 (66.66%), fair were in 3 (16.68%). Functional outcome in posterior column fixation group were excellent in 5 (93.33%) cases, fair in 1 (3.33%) case and in non-fixation group 15 (83.32%) cases showed excellent and 3 (16.68%) cases showed good scores. Based on the final results achieved, posterior column fixation group showed excellent radiological results compared with posterior column non fixation group in which results are good, but functional outcome was same in both groups.

Conclusion: Based on our study we conclude that column specific fixation is a better option compared to conventional method of fixation as it provides better visualization, control over fragment, stable reduction and fixation of fragment. Even though radio-logical outcome is better in posterior column fixation group, functional outcome remains to be same in both the groups. It requires long term follow up and large number of patient study to assess the effectiveness of posterior column fixation. However column specific fixation requires surgeon's expertise and experience.

Keywords: Posterior column, proximal tibia plateau, three column classification

Introduction

Proximal tibia fractures, particularly those that extend into the knee joint are termed as tibial plateau or tibial condylar fractures. Fractures of the proximal tibia involve a major weight bearing joint. These are serious injuries that frequently result in functional impairment, as they affect knee alignment, stability and movement.

Tibial plateau fractures represent approximately 1% of fractures in adults^[1]. Tibial plateau fractures most often occur with the leg in a weight-bearing position, with mechanism of injury being valgus or Varus forces in case of split fractures, axial forces alone in case of pure local compression fractures and combinations of both forces in split depression fractures^[2]. The objective of treatment of tibial plateau fractures is precise reconstruction of the articular surfaces, stable fragment fixation allowing early motion, and repair of concomitant lesions.

Classifying tibial plateau fractures is important for surgeon to surgeon communication, for estimation of prognosis, and for planning surgery although the Orthopedic Trauma Association uses the AO/OTA fracture classification system^[3] owing to its applicability to many extremities, the classification described by Schatzker *et al.*^[4] remains a relatively simple and familiar system for the tibial plateau.

However, its inconsistent and somewhat limited inter observer reliability is a shortcoming, because it was designed for classification based on anteroposterior radio-graphs, the system does not include injury patterns with major fracture lines in the coronal plane or those simply not visible on plain radio-graphs. Posteromedial fragments are seen in 59% to 74% of bicondylar fractures^[5]. These are important because they affect the surgical plan in terms of patient positioning, surgical approach, and incision placement.

To address this limitation, Luo *et al* developed a three-column model^[6] based on axial (CT) imaging to classify tibial plateau fractures as having medial, lateral, and posterior column involvement. This system identifies posterior fractures needing posterior fixation. Although such fractures are typical of Types V and VI of the Schatzker system^[7], the Schatzker system is not able to indicate if a posterior approach would be necessary.

Nevertheless, management of tibial plateau fractures remain challenging because of their varied pattern, associated soft tissue and ligament injury. Varying opinions regarding surgical management including various approaches, implants and whether to use single plate, dual plate or three column fixation for fractures of tibial plateau exists. This study aims to know the functional outcome of proximal tibial fracture treated based on three column concept.

Materials and Methods

This prospective study was conducted in the Department of Orthopaedics, Bangalore Medical College and Research Centre for 9 months from November 2017 to May 2019. 30 Patients with proximal tibia plateau fractures were selected for the study. Mode of injury was Road traffic accident in maximum cases. Patients are evaluated with X-rays (Anteroposterior and lateral views) and Computed tomography (axial, coronal, and sagittal sections) with 3-dimensional reconstruction views. Fractures were Classified based on Three Column concept classification. Functional and radiological outcome was assessed using knee society score^[8] and Modified Rasmussen score^[9].

Inclusion criteria

Patients between 18 – 60 years of age with closed proximal tibia plateau fractures & closed injuries were included in this study.

Exclusion criteria

Patient who are not willing to provide informed consent, Skeletally immature individuals, Open fracture of tibial plateau, Ipsilateral femur, tibial shaft, ankle and foot fractures & are those who are not willing for surgery were exclude from study.

Surgical procedure

Maximum cases were operated under Spinal Anesthesia and Tourniquet application. For posterior fixation (Figure 1&2) through posterolateral approach by using reverse L incision (Figure 3&4), patient was laid prone on the radiolucent table. After posterior fixation, reduction of fracture is confirmed by image intensifier. For medial column and posterior column fractures, medial approach was used in which both medial and posterior column fracture column (Figure 5) exposed and reduced and plating was done. Primary reduction and stabilization were done under image intensifier control (Figure 6&7).



Fig 1: X-ray of patient with posterior tibia plateau fracture

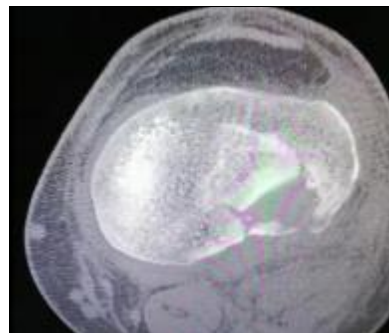


Fig 2: Computed Tomography scan showing involvement of posterolateral column.



Fig 3: Patient in prone position, reverse L incision is placed for posterolateral approach



Fig 4: Inspection and handling of Neurovascular bundle through posterolateral approach.

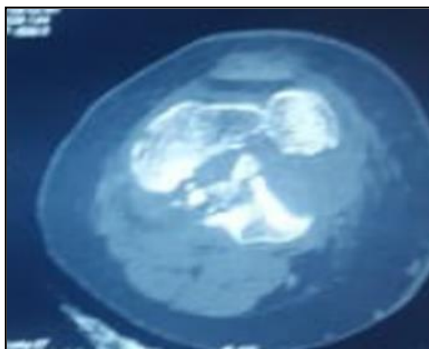


Fig 5: Computed tomography scan showing involvement of medial and posterior column.



Fig 6: Perioperative assessment of reduction of medial and posterior tibial plateau fracture by medial approach.



Fig 7: Fluoroscopic image showing fixation of medial and posterior column fracture by plating.

Assessment of outcome

Patient were evaluated by plain radiograph at 6 weeks, 3 months, 6 months and 9 months. Fracture union assessed by cortical continuity and progressive loss of fracture line on X-rays. Knee functional outcome was assessed by knee society score and radiological outcome by Modified Rasmussen score.

Results

In our study, age group varied from 21 to 60 years with maximum incidence of fracture seen in between 31 to 40 years (Table-1). Among the total, males were of 83.3% and females were of 16.7%.

Table 1: Gender distribution of patient studied.

Gender	Frequency	Percent
Female	5	16.7
Male	25	83.3
Total	30	100

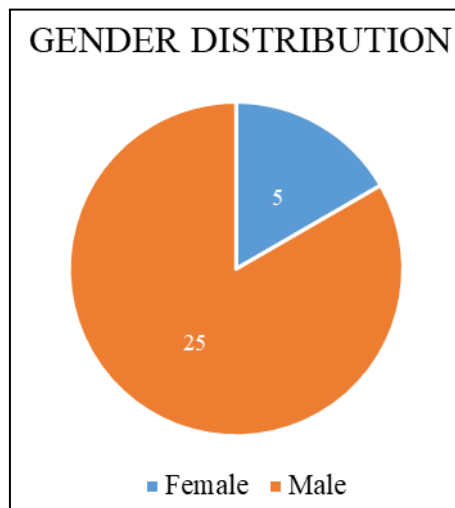


Fig 8: Gender distribution of patients studied

In our study most common mode of injury was RTA. In our study we had used Three column classification to evaluate the fracture morphology and to plan for fracture fixation.

Out of 30 patients, fracture distribution of one column fractures were 6 (19.8%), of which 4 (13.2%) cases had medial column and 1 (3.3%) had posterior column involvement. Two column fractures were 17 (56.3%) cases of which lateral and posterior column involved in 13 (42.9%) cases, medial and posterior column involved in 3 (9.9%) cases, medial and lateral column involved in 1 (3.3%) case and 7 (23.3%) cases had three column fracture.

In our study, duration since injury to procedure were up to 7 days in 25(63.3%) cases, 8-14days in 3 (10.1%) cases and 18-22 days in 2 (6.6%) cases, with predominance in up to 7 days group. Because of superficial blebs at the time of admission, two patients got operated after 18 days of admission.

After operative procedure, 11 (36.3%) patients got discharged on post op day-5, 8 (26.4%) patients on post op day-8, 4 (13.2%) on post op day-14 and 7 (23.1%) on post op day-14. Mean duration of stay in hospital post-surgery was 8.5 days.

Out of 30 patients, posterior column was involved in 1 (3.3%) case of one column fracture, 16 (52.8%) cases of two column fracture and in 7 (23.1%) cases of three column fractures. In these cases posterior column was fixed in 1 (3.3%) case of one column fractures, 2 (6.6%) cases of two column fractures and 3 (9.9%) cases of three column fractures.

We had fixed one column fractures by single plate in 6 (19.8%) cases, two column fractures by single plate in 16 (52.8%) cases and by dual plating in 1 (3.3%) case. In three column fracture fixation was done by dual plating in 3 (9.9%) cases & by plating and cc screw fixation in 4 (13.2%) cases.

Table 2: Age incidence of patient studied

Plating	One column	Two columns	Three Column
Single plating	6	16	NIL
Dual plating	NIL	1	3
Dual plating &ccscrew	NIL	NIL	1
Single plate &cc screw	NIL	NIL	2
Total 30	6	17	7

Mean duration of surgery required for the fixation of single column fractures were 100 minutes. For two column fracture fixation with single plate were 131.25 mins & with dual plate were 120 mins. For three column fracture fixation with dual plate were 170 mins, fixation with dual plate & one cc screw

were 180 mins, fixation with single plate & cc screw were 180 mins.

There were 2 patients with superficial infections which healed with regular dressings, valgus malunion seen in 5 (16.5%) case, Varus malunion seen in 7 (23.3%) cases, knee stiffness was in 1(3.3%) case.

Out of 30 patients, one column fracture were seen in 6 (19.8%) cases of which posterior column were involved in 1(3.3%) case for which posterior column fixation was done. We observed that radiological score (16) & functional score (95) were excellent and range of movement achieved were 0 to 140 degrees of flexion.

Two column fracture were seen in 17 (56.9%) cases. Among them posterior column was involved in 16 (53.6%) cases of which fixation of the same was done in 2 (6.6%) cases. Among them mean radiological score (15) & mean functional score (95) were excellent, mean range of movements achieved were 0 to 140 degrees of flexion and in non-fixation group of 14 (47%), mean radiological score (13.6) was good & mean functional score (86.3) was excellent with mean range of movement achieved were 0 to 130 degrees of flexion.

Three column fractures were observed in 7 (23.1%) cases, among them posterior column fixation was done in 3 (9.9%) cases, mean radiological score (14) were good & mean functional score were (83) excellent and mean range of movements achieved was 0 to 130 degrees flexion. Posterior column was not fixed in 4 (13.2%) cases, mean radiological score were (12) fair & mean functional score (83.3) were excellent with mean range of movement achieved was 122.5 degrees of flexion.

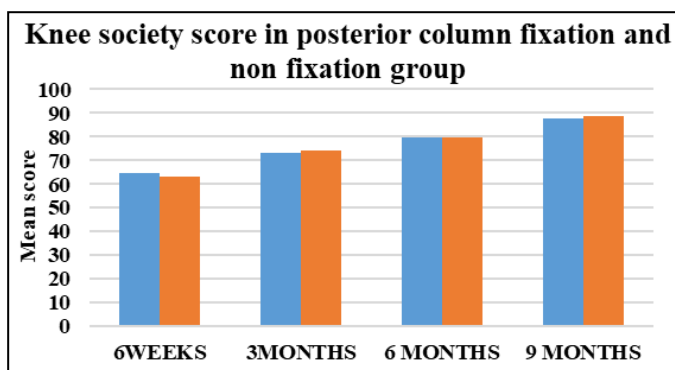


Fig 9: Knee society score assessment during 9months of follow up

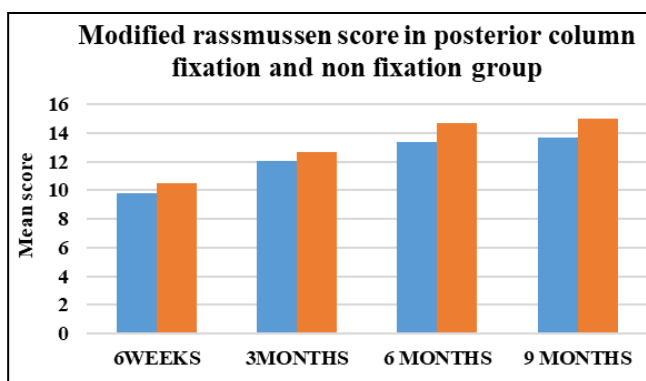


Fig 10: Radiological score assessment during 9 months of follow up

In our study, considering posterior column fixation group of all the cases, radiological outcome results were excellent in 66.68% of the cases and good in 33.32% of cases and in posterior column non-fixation group results were excellent in 16.68%, good in 66.66%, fair in 16.68% cases.

Functional out come in posterior column fixation group were excellent in 93.33% cases, fair in 3.33% of cases and in non-fixation group 83.32% cases had excellent & 16.68% cases had good outcome.

Discussion

Proximal tibia fractures which are one of the commonest intra articular fractures are occurring as a result of motor vehicle accident, accidental fall from height, violence etc. The management of proximal tibia fracture has always been a subject of discussion because of their complexity and variety. Tibia plateau fractures are more commonly seen in the active, younger age group due to their exposure to high velocity motor vehicle accidents. Most common intra articular fractures were tibia plateau fractures, occurring as a result of RTA. Because of the complexity of injury and fracture pattern, management of these fractures are quite challenging for the Orthopedic surgeons. It is extremely important to adequately visualize the fragments, reduce the fracture and obtain stable rigid fixation Figure 8,9 & 10.

In our series, 25 were male and 5 were females. Mean age of the patients were 38.13 years with age ranging from 21 years to 60 years which is compared to study done by Egli *et al* [10], in which maximum incidence of fracture were in males. Right side involvement was seen in 63.3% of the cases studied. Road traffic accident was the commonest mode of injury (56.3%).

Of the total, we encountered 19.8% cases of one column fracture with posterior column involvement in 3.3% of cases. Two column fracture were encountered in 56.3% cases and posterior column was involved in 52.8% cases. In 23.1% of cases, all the three columns were involved. Among one column fracture, fixation done by single plate in 19.8% cases, two column fracture fixation done by single plate in 52.8% cases, dual plating done in 3.3% case, three column fracture fixation done by plating and cc screw in 23.1% cases.

We observed that involvement of posterior column were in 3.3%, 52.8% and 23.1% cases of one column fracture, two column fracture and three column fracture respectively. Whereas fixation of these posterior column fractures were done only in 3.3%, 6.6% and 10% cases of one column fracture, two column fracture and three column fracture respectively. Even though there is no obvious reason for low rate of posterior column fixation, it could be the surgeon's choice.

Mean duration of surgery required for fixation of single column fractures were 100 mins. Two column fractures fixed with single plate (131 mins) had taken longer duration compared to dual plate (120 mins) fixation. For three column fracture fixation with dual plate were 170 mins, fixation with dual plate & one cc screw were 180 mins, fixation with single plate & cc screw were 180 mins.

Patients in our study encountered various complications, among which 24.1% had varus malunion. Knee stiffness was observed in only one case.

Out of 30 cases, we observed that posterior column fixation done in one column fractures had excellent radiological and functional score, range of movements achieved was 0 to 140 degrees of flexion.

Posterior column fixation done in two column fractures had excellent mean radiological and functional outcome, mean range of movement were 0 to 130 degrees of flexion and in posterior column non fixed group had good radiological score (mean) and excellent functional score (mean) with mean range of movements of 0 to 130 degrees flexion.

Posterior column fixation done in three column fractures had good mean radiological score and excellent mean functional score & mean range of movement achieved were 130 degrees

of flexion. In posterior column non-fixed group had fair mean radiological score, excellent mean functional score and mean range of movement achieved were 122.5 degrees of flexion.

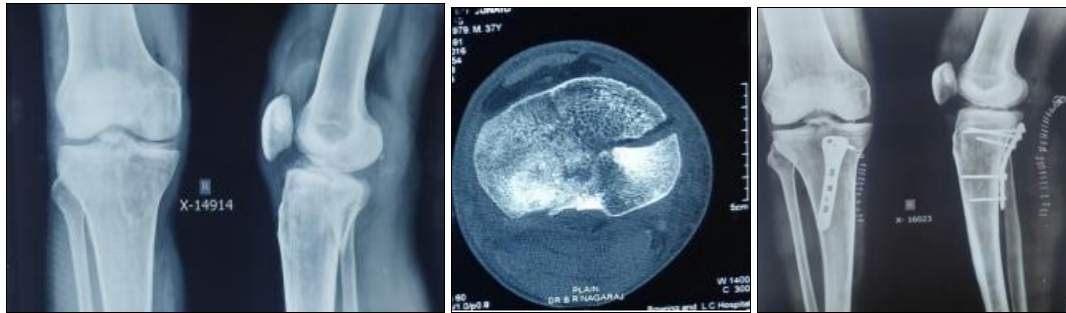


Fig 11: Pre-operative and post-operative pictures



Fig 12: Follow up X-rays at 3 months, 6 months and 9 months



Fig 13: Assessment of Range of movements during follow up

Functional outcome of our study is excellent in maximum cases of both fixation (93.3%) and non-fixation (83.3%) group, which is contrary to study done by Sinha *et al.* [11] in which excellent functional outcome were seen in posterior tibia plateau fracture fixation group.

Radiological outcome in posterior column fixation group were excellent in 66.68% cases and good in 33.32% cases and in posterior column non fixation group excellent 16.68% had excellent, 66.66% had good & 16.68% cases had fair outcome results. Our study is compared to study done by Rohra *et al.* [12], in which maximum patients has excellent radiological outcome.

Conclusion

Proximal tibia fractures present with many different configurations, though different imaging modalities are available to give better fracture geometry, adequate surgical skills and specific column fixation are necessary to achieve proper fracture reduction.

In our study posterior column was not fixed in few cases as it could be the surgeon's choice or lack of expertise. Based on our study we observed that column specific fixation is a better option compared to conventional method of fixation as it provides better visualization, control over fragment, stable

reduction and fixation of fragment.

Even though radiological outcome is better in posterior column fixation group, functional outcome remains to be same in both the groups. It requires long term follow up and large number study to assess the effectiveness of posterior column fixation. However column specific fixation requires surgeon's expertise and experience.

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