Original Article

Evaluation of Functional Outcome of Tibial Plateau Fracture Fixation Based on CT Scan Based Three Column Classification

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ABSTRACT

Introduction: Tibia plateau fractures are a diverse group of fractures that represent a wide spectrum of severity that ranges from a single injury with predictably excellent outcomes after non operative treatment to complex fracture patterns that challenge even the most experience surgeons. Management of proximal tibia plateau fractures using CT based three column classification addresses fracture efficiently and advantageous in planning for fixation especially in bi-condylar fractures involving posterior column. Several different surgical approaches have been described for tibia plateau fractures (medial, lateral, posteromedial, posterolateral and combined) depending on the location of the fracture. This classification provides ease for selection of these approaches for particular fracture involving particular column preoperatively.

Aim and objective: To access and analyze the functional, radiological and clinical outcomes of operatively managed proximal tibia plateau fractures based on their column of involvement. The study will help in identifying advantages in management of proximal tibia plateau fracture with help of CT- scan based three column classification. As this is recent advances, outcome of this study will highlights the usefulness of this classification in identification of complex fracture pattern.

Method: This study was mainly a Descriptive longitudinal study. With the ethical committee clearance this study was carried out at Department of Orthopaedics, SMIMER medical college, Surat from July 2017 to November 2019, inclusive of both. A sample size of 50 (41 male, 9 female) patients was selected to evaluate fractures of Tibia plateau using CT scan based 3 column classification.

Results: The functional outcome of the patients are acceptable in our study, suggesting that CT scan based 3 column classification is useful in evaluation of fracture pattern and selecting proper approach. Previously used Schatzker classification never addresses posterior column fracture which has limitation in articular understanding and planning for operation. CT scan helps in assessment of fracture pattern and also highly useful in planning for fixation and execution of procedure. Therefore, better clinical outcome is present in our study. More complex fracture like Schatzker type 5 and 6 involving posterior column had poor outcome previously using X-ray based Schatzker classification, whereas in our study threecolumn involving posterior column has good to excellent outcome. So, in present Era,

Conclusion: CT scan is necessary for investigation in all tibial plateau fractures. Using CT Scan, CT based three column classification provides.

Key words: Tibial platue fracture, CT scan

INTRODUCTION

Tibia plateau fractures are a diverse group of fractures that represent a wide spectrum of severity that ranges from a single injury with predictably excellent outcomes after non operative treatment to complex fracture patterns that challenge even the most experience surgeons. Previously X-ray based schatzkar classification was widely used for treating proximal tibia plateau fractures, which is based on two dimensional X-rays.[1] Now a day due to recent advances, a CT scan based three column classifications is used to overcome the limitation of previous classification. CT Scans recognizes a posterior column separately and addresses posterolateral, posteromedial and pure posterior condyle fractures, and a revolution comes in management of complex proximal tibia plateau Fracture.

Traditionally, the treatment for tibia plateau fractures is based on two-dimensional classification systems. The three-column classification is described by Luo et al.[2]Several authors have noted computed tomography (CT)-based three-dimensional consideration of the fracture pattern was important in the treatment of tibia plateau fractures.

Management of proximal tibia plateau fractures using CT based three column classification addresses fracture efficiently and advantageous in planning for fixation especially in bi-condylar fractures involving posterior column. Several different surgical approaches have been described for tibia plateau fractures (medial, lateral, posteromedial, posterolateral and combined) depending on the location of the fracture. This classification provides ease for selection of these approaches for particular fracture involving particular column preoperatively.

Open reduction and internal fixation using CT scan based three column classification has been practiced in our institute, Surat Municipal Institute of Medical Education and Research (SMIMER), Surat.

AIMS AND OBJECTIVES

To access and analyze the functional, radiological and clinical outcomes of operatively managed proximal tibia plateau fractures based on their column of involvement. The study will help in identifying advantages in management of proximal tibia plateau fracture with help of CT- scan based three column classification. As this is recent advances, outcome of this study will highlights the usefulness of this classification in identification of complex fracture pattern.

MATERIAL AND METHOD

This study was mainly a Descriptive longitudinal study. With the ethical committee clearance this study was carried out at Department of Orthopaedics, SMIMER medical college, Surat from July 2017 to November 2019, inclusive of both. A sample size of 50 (41 male, 9 female) patients was selected to evaluate fractures of Tibia plateau using CT scan based 3 column classification.

Inclusion Criteria includes Skeletally mature patients with Proximal tibia fracture**,** Closed fracture**,** Open grade 1 and 2 fracture according to Gustilo Andersons' classification

Patients satisfying the selection criteria were identified after emergency management as per ATLS protocol in the casualty. History taking, general examination and local examination were conducted in the trauma care centre. Once stabilized, relevant X-rays and CT scan were asked for. Fractures were classified according to Schatzker's classification and three column classification. Necessary investigations for surgical fitness were conducted. Closed fractures with edema were splinted and regular calf girth charting was done with oral proteolytic enzymes, intravenous antibiotics and limb elevation. Surgery was done after swelling subsided. The closed fractures were operated as soon as the fitness for anesthesia was obtained. In all our patients we used proximal tibia plate. Approach & Plate placement and its length were evaluated according to the fracture geometry visible on CT SCAN and identifying column involved. Size of implant was decided pre-operatively considering magnification on X-rays. The size was determined as requiring 6-8 cortices in the metaphysis and 8-10 in the diaphysis spanning the fracture.

Surgery was performed on plain table for open reduction in prone or supine position. In case of open reduction the ipsilateral greater trochanter was raised to 20-25° to keep the knee facing upwards and counter normal external rotation of the lower limb. The knee was flexed on a quadriceps board with variable adjustment or with a bolster under the knee for fracture alignment and ease of reduction. Patients were followed up for sequential evaluation every 4 weekly. Final follow up assessment was done at minimum follow up period of 6 months.

RESULTS

During the period from July 2017 to November 2019, 50 patients with proximal tibia fractures were identified of which all patients were enrolled in the study based on the inclusion and exclusion criteria. So here there is a study of total 50 patients.

Table 1: showing details of distribution of various fracture types along with CT scan based three column classification

Type of Fracture	Three column type classification				
	Zero Column	One column	Two Column	Three Column	Total (%)
Closed	1	21	16	8	46 (92)
OG-1	0	2	0	0	2 (4)
OG-2	0	2	0	0	2 (4)
Total	1	25	16	8	50 (100)

Table 2: details of schatzker classification types of patients in our study

Schatzker classification	Three column classification				Total (%)
	Zero Column	One column	Two Column	Three Column	
I	0	8	0	0	8 (16)
II	0	2	0	0	2 (4)
III	1	1	0	0	1 (2)
IV	0	12	0	0	12 (24)
V	0	0	11	5	16 (32)
VI	0	5	3	3	11 (22)
Total	1	25	16	8	50 (100)
Percentage%	2	50	32	16	100

Table 3: details of functional outcome score in three column classification

Results	Zero Column	One Column	Two Column	Three Column	Total	(%)
Excellent	1	10(40%)	8(50%)	2(25%)	21	42
Good	0	12(48%)	8(50%)	4(50%)	24	48
Fair	0	3(12%)	0	2(25%)	5	10
Poor	0	0	0	0	0	0
Total	1	25	16	8	50	100

Table 4:- details of Comparison of difference of score at 6, 12 and 24 weeks

Rasmussen score component	6 weeks Mean± SD	12 weeks Mean± SD	24 weeks Mean ± SD	P value
Pain	1.88± 0.3316	4.84±0.553	5.56 ± 0.5066	<0.001
Walking Capacity	1.96±0.6757	4.28±0.9797	5.16 ± 0.6	<0.001
Knee Extension	1.16± 0.4725	2±0	3.92 ± 0.4	<0.001
Total ROM	1.36±0.4898	4.84±0.5537	4.84 ± 0.7461	<0.001
Stability	1.48±0.5099	4±0	4.72 ± 0.9797	<0.001
Power of Quadriceps	1.08±0.4	1.56±0.5066	1.68 ± 0.4760	<0.001
Total	8.92±1.4696	21.52±1.6360	25.8 ± 2.5658	<0.001

As we can see in above table that Majority of the patients having close fractures. In above table most of the patients are falling in type 5 and one column fracture.

Most commonly occurring complex fractures are falling in type 5 & 6 of schatzker classification and in 2 & 3 column of three column classification. In above table shows 18 patients out of 50 patients showed posterior column involvement after CT scan which was not classified under Schatzker classification.

We had 43(86%) of patients operated with open technique while 7(14%) of patients were operated with MIPPO technique. Due to complexibility of the fracture (due to more involment of two columns and three columns patients) we have chosen our first surgical treatment as open reduction and fixation. During 3 column fracture fixation, among total 8 patients in 4 patients 2 plates were used , in 2 patients 3 plates were used and in one patient 4 plates were used. During 2 column fracture fixation, among 15 patients, 2 plates were used in 12 patients and 3plate was used in1 patient. This suggest multiple plate is used when 2 and 3 column fracture require when more than one column is involve.

Post operatively 92% patients achieve union status within 6 months of the surgery. The union status in all columns has highest between 12 to 15 weeks periods according to this study. This is around in 82% of the patients in total. There was knee joint stiffness seen in total 2 patients which is 4% of total study. 1 Patient got infected and one has instability and one came with the limping complaint.

Rest of the patients around 88% of the study got no complications and doing well with their life. 80% of the patients started their partial weight bearing at the period of 8 to 12 weeks & 78% of the patients started their full weight bearing at the period of 12- 16 weeks. All the patients started their full weight bearing within 20 to 24 weeks.

As we can see in the table In our study in zero column classification patients we have found the excellent result. We had total 25 patients of one column classification in which we found excellent result excellent result in 40% of the patients. While in next 48% patients we have found good results. In two column classification we have found good and excellent results have equal distribution.In three column classification we have found good result in 50% while 25% were found to have excellent results while rest 25 % is having fair results.

Functional outcome score (according to Modified Rasmussen) changes in reference to follow up at regular intervals (At 6, 12,24 weeks)

Here we have compared the study between 6 weeks,12 weeks and 24 weeks in which total 6 criteria are added as per the modified Rasmussen score. Here all criteria have P value less than 0.001 which shows the results are improving with the time of period. The pain is decreasing, the walking capacity is increasing, the knee extension is increasing, the range of motion is increasing, the stability and power of quadriceps are increasing.

DISSCUSSION

In our study, out of 50 patients, 41 patients were male and 9 patients were female. These outnumbering of male patients over female is explained by the more active lifestyle and mobility of males and hence more chances of road traffic accidents in male. This is in accordance with the series of 14 patients reported by Eggli et al., in which 10 were male and 4 female. But in the study of Lee et al, there were 21 males and 24 females among 32 patients.

The majority of fractures occurred between the age of 21 to 50 years accounting for 78% (39 patients) of the 50 patients with mean age of 38.29 years. In our study, majority of patients having road traffic accidents (74%)

In our study we use modified Rasmussen score for functional outcome. The mean Rasmussen score 25.94 was found in our study, where in study of Hasnain Raza et al[6]Mean Rasmussen score was 25.3. In our study mean time of union is 13.58 weeks, P. Gupta et al.[7]Had mean time of 14.7 weeks in their study. In our study most of the patients are falling in type 5 and one column fracture.

Table 5: showing male and female ratio in different studies

Studies	Total patients	Males	Females
Eggli et al[3]	14	10	4
Lee et al[4]	45	21	24
Walia et al[5]	50	45	5
our study	50	41	9

Table 6: comparison of our study with Luo et al study

	Patients(%) Acc. To Schatzker Classification					
	I	II	III	IV	V	VI
Luo et al	15.1	15.6	9.6	18.7	21.4	19.6
Our study	16	4	2	24	32	22

Table 7: Showing results of different studies

Study	Satisfactory results
Rambold,1992[11]	93%
Seppo E,1993[12]	86%
Our Study 2019	90%

Most commonly occurring complex fractures are falling in type 5 & 6 of schatzker classification and in 2 & 3 column of three column classification.

According to schatzker classification in our study there were 16% patients in type 1, 4% in type 2, 2% in type 3, 24% in type 4, 32% in type 5 and 22% in type 6.Luo et al[1] found 15.1% patients in type 1, 15.6% in type 2, 9.6% in type 3, 18.7% in type 4, 21.4% in type 5 and 19.6% in type 6.

According to three column classification, in our study classification comparable with Leo et al classification

Macarini et al[8] studied 25 cases of tibial plateau fractures. After CT scan, only 48% of the cases had the same classification as before the CT scan and 60% of the cases had changes in the operative plan. Wicky et al[9]reported a cohort of 42 cases with tibial plateau fractures, which were assessed by plain radiographs and three-dimensional CT separately. As a result, 43% (18 of 42) of the fractures were underevaluated by plain radiographs. On the other hand, such fractures can be difficult to fit into the classification systems currently used, which makes diagnosis and preoperative planning difficult. Barei et al[10] investigated 57 bicondylar fractures with CT scans and found the occurrence of the posteromedial fragment in approximately one third of the cases. In our study, we found posterior column involvement in 36% of patients after doing CT scan which was not classified under schatzker classification.

In our study we treated patients with ORIF & MIPPO technique. In our study, we have compared the study between 6 weeks and 12 weeks in which total 6 criteria were added as per the modified Rasmussen score, in which all criteria have P value less than 0.001 which shows that result is improving with the time of period. We have also found same result in the comparison between 12 and 24 weeks but there is no significant change in range of motion after 6 weeks. The result is steady after the 12weeks period. The power of quadriceps also does not increase after 12 weeks. In our study we were able to achieve 42% excellent result, 48% good result (overall 90% acceptable results). In addition we have 10% fair results. These results are comparable and on par with other documented standard studies.

CONCLUSION

The functional outcome of the patients are acceptable in our study, suggesting that CT scan based 3 column classification is useful in evaluation of fracture pattern and selecting proper approach. Previously used Schatzker classification never addresses posterior column fracture which has limitation in articular understanding & planning for operation. CT scan helps in assessment of fracture pattern and also highly useful in planning for fixation & execution of procedure. Therefore, better clinical outcome is present in our study. More complex fracture like Schatzker type 5 and 6 involving posterior column had poor outcome previously using X-ray based Schatzker classification, whereas in our study three column involving posterior column has good to excellent outcome. So, in present Era, CT scan is necessary for investigation in all tibial plateau fractures. Using CT Scan, CT based three column classification provides ease to management of these complex fracture.

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