

Original Research Article

ASSESSMENT OF USEFULNESS OF CT- SCAN BASED THREE COLUMN CLASSIFICATION IN EVALUATION OF PRE AND POST SURGERY PARAMETERS OF PROXIMAL TIBIA PLATEAU FRACTURES- A TERTIARY HOSPITAL BASED STUDY

Keyurkumar M Vaghela¹, Manish P Barot², Suril A Shah³, Chintan N Patel⁴

¹Senior Resident, Department of Orthopaedics, GMERS Medical College and Hospital, Gandhinagar, Gujarat, India.

²Professor and Head, Department of Orthopaedics, GMERS Medical College and Hospital, Gandhinagar, Gujarat, India.

³Associate Professor, Department of Orthopaedics, GMERS Medical College and Hospital, Gandhinagar, Gujarat, India.

⁴Assistant Professor, Department of Orthopaedics, GMERS Medical College and Hospital, Gandhinagar, Gujarat, India.

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Corresponding Author:

Dr. Chintan N Patel

Assistant Professor, Department of Orthopaedics, GMERS Medical College and Hospital, Gandhinagar, Gujarat, India.
Email: toofanshines@gmail.com

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ABSTRACT

Background: CT scan assesses articular surface depression and comminution. Also, it delineates fracture pattern, size of fracture fragment, shape, and location for surgical planning. A lipohemarthrosis is an indication of an occult fracture. CT scan can alter fracture classification and a treatment plan formulated based on the initial radiographs. The present study was undertaken to identify 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 highlight the usefulness of this classification in identification of complex fracture pattern.

Materials and Methods: The present study enrolled 56 patients with proximal tibia fractures. Once stabilized, relevant X-rays and CT scan were asked for. Fractures were classified according to Schatzker's classification and three column classification. The various parameters pre and post surgery were assessed as per three column classification. Data was collected and descriptive statistical methods and expression of results in terms of mean, chi-square test and others using Microsoft excel software with significant p value <0.05 were used for computation of data.

Results: We had 43(86%) of patients operated with open technique while 7(14%) of patients were operated with MIPPO technique. Due to complexity of the fracture (due to more involvement 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 3 plate was used in 1 patient. 92% patients achieve union status within 6 months of the surgery.

Conclusion: CT scan-based 3 column categorization for tibial plateau fracture therapy is the study's major goal. Our patients' functional outcomes are acceptable, showing that CT scan-based 3 column categorization can help evaluate fracture pattern and choose a method. Previously employed Schatzker classification never addresses posterior column fracture, limiting articular comprehension and surgical planning. In contemporary era, all tibial plateau fractures necessitate a CT scan as CT scan-based three-column classification simplifies complex fracture care.

Keywords: MIPPO Technique; Three Column Classification; Tibial Plateau Fractures.

INTRODUCTION

Bicondylar intra-articular tibial plateau fractures represent a complex, high-energy injury associated with high complication rates. Soft tissue damage is the primary concern even in closed fractures, and early definitive fixation can aggravate complications, making time for open reduction and internal fixation (ORIF) controversial and challenging. There is no specific or ideal treatment protocol described for managing such fractures.^[1]

The management of tibia plateau fractures has improved dramatically for the past 50 years. In the early 1950's these fractures were treated non-operatively and many surgeons published favourable results by this management.^[2] Apley in his study found that longitudinal traction would control the deformity and knee can be mobilized early.^[3,4] Lasinger et al had an extensive 20 year follow up of patients with non-operative management. He concluded that coronal instability of less than 10 Degree had favorable outcome.^[5] Duwelius and Conoly,^[6] showed that early mobilization of patients managed by closed reduction with or without percutaneous pins had 89 % good clinical outcome. Hence from these studies it is evident that proximal tibia can tolerate modest deformities. CT scan assesses articular surface depression and comminution. Also, it delineates fracture pattern, size of fracture fragment, shape, and location for surgical planning. A lipohemarthrosis is an indication of an occult fracture. CT scan can alter fracture classification and a treatment plan formulated based on the initial radiographs.^[7]

The present study was undertaken to assess and analyze the clinical outcomes of operatively managed proximal tibia plateau fractures based on their column of involvement. Further, this 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 highlight the usefulness of this classification in identification of complex fracture pattern.

MATERIAL AND METHODS

The present descriptive longitudinal study was carried out at Department of Orthopaedics, SMIMER medical college, Surat over a period of 2 years. During this period, 65 patients with proximal tibia fractures were identified of which all 56 patients were enrolled in the study based on the inclusion and exclusion criteria. With 6 patients being lost to follow-up during the course of study before completing at least 6 months of follow-up, we had 50 patients remaining to study.

Inclusion Criteria comprised of skeletally mature patients with proximal tibia fracture, closed fracture, open grade 1 and 2 fracture according to Gustilo Andersons' classification. Exclusion criteria

comprised of other fracture in ipsilateral limb, open grade 3 injury according to Gustilo- Andersons' classification requiring plastic or vascular surgeries, patients with congenital deformities, fracture older than 4 week, pathological fractures, old neglected fractures, pregnant females, previously operated fractures, fractures with existing or impending compartment syndrome and or neurological problems (local or general) which could affect the functional outcome assessment.

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. All patients were monitored stringently for signs and symptoms of compartment syndrome. All wounds (if any) were covered by sterile dressing after cleansing and normal saline wash. Temporary immobilization was given by above knee posterior plaster splint. Tetanus prophylaxis in form of Tetanus Toxoid and Tetanus immunoglobulin were given in open fracture after local suturing under local anesthesia. Parenteral antibiotics and analgesics were started in all open injuries.

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 on as soon as the fitness for anesthesia was obtained.

Open fractures were dressed daily after primary thorough debridement. Once the wounds' healed surgery was planned. In all our patients we used proximal tibia plate. Approach and 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.

Spinal, epidural or general anesthesia was given to the patient as per the anesthetics opinion. But spinal anesthesia was most preferred. Tourniquets were used in all cases. Surgery was performed on a plain table for open reduction in prone or supine position. Various approaches for tibial plateau were used for open reduction of tibial plateau fracture based on column involvement.

Fluoroscopic assisted reduction was attempted in all cases. Depending on the quality of bone, cortex or locking screws were used to fix the plate distally. Insertion of cortex screw first distally pulls the bone flush to the plate. However, this was avoided if it compromised the quality of reduction, and the

fixation was continued using locking screws. The wound was closed in layers in layers over a negative suction drain. Post-operative regime was followed. A post-operative X-ray was advised when the patient could be shifted comfortably, usually after 48 hours of surgery. Depending on the post-operative fracture stability and pain tolerance of the patient, quadriceps strengthening exercises, knee and ankle mobilization exercises and non-weight bearing-crutch walking were started. After suture removal between 10-15th day, the patient was discharged.

Data was collected and descriptive statistical methods and expression of results in terms of mean, chi-square test and others using Microsoft excel software with significant p value <0.05 were used for computation of data.

RESULTS

Majority (55.56%) of our patients were males between 31-50 years of age. [Table 1] Table 2 shows patients out of 50 patients showed posterior column involvement which was diagnosed only after CT scan.

We had 43(86%) of patients operated with open technique while 7(14%) of patients were operated with MIPPO technique. [Table 3] Due to complexity of the fracture (due to more involvement 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 3 plates were used in 1 patient (table 4).

92% patients achieve union status within 6 months of the surgery. Table 5]

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 (table 6).

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. [Table 7]

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 (table 8).

Table 9 shows the details of comparison of mean time taken for union according to three column classification. No statistical significance observed in mean time taken for union for one column, two column and three column classification.

Table 1: Comparison between age and type of fracture

Age Group	Zero Column	One column	Two Column	Three column	Total no of patients
18-20	0	2	0	1	3
21 – 30	0	5	2	2	9
31- 40	0	8	5	3	16
41 – 50	1	6	6	1	14
51 – 60	0	4	3	1	8
Total	1	25	16	8	50

Table 2: Posterior column involvement

Posterior Column Involvement	No. of Patients	Percentage%
Yes	18	36%
No	32	64%

Table 3: Surgical methods used in our study

Method	Patients	Percentage (%)
Open reduction and fixation	43	86
Closed and MIPPO	7	14
Total	50	100

Table 4: Number of plates used in different column class

Three Column Classification	No of Plates Used				
	1 plate	2 plates	3 plates	4 plates	Total
Zero	1	0	0	0	1
One	26	0	0	0	26
Two	2	12	1	0	15
Three	1	4	2	1	8
	30	16	3	1	50

Table 5: Union Status in CT based three column classification

Union Status	Zero Column	One Column	Two Column	Three Column	Total	Percentage (%)
United	1	22	15	7	45	92
Delayed Union	0	3	1	1	5	8

Non-union	0	0	0	0	0	0
Total	1	25	16	8	50	100

Table 6: Time taken for Union in different column types

Time period in weeks	Zero Column	One column	Two Column	Three Column	total	Percentage (%)
12-15	1	22	13	5	41	82
16-20	0	2	3	3	8	16
21-24	0	1	0	0	1	2
25-28	0	0	0	0	0	0
Total	1	25	16	8	50	100

Table 7: Different complication in our study

Complication	Patients	Percentage (%)
Infection	1	2
Instability	1	2
Knee joint stiffness	2	4
Implant Failure	0	0
Varus deformity	1	2
Limping (due to shortening of limb)	1	2
None	44	88
Total	50	100

Table 8: Starting of weight bearing postoperatively

Time in weeks	Partial weight bearing	Percentage (%)	Full weight bearing	Percentage (%)
8-12	40	80	4	8
12-16	8	16	39	78
16-20	2	4	5	10
20-24	0	0	2	4
24-28	0	0	0	0
28-32	0	0	0	0
Total	50	100	50	100

Table 9: Comparison of time of union in three column classification

Three column classification	Time		P-Value
	Mean	SD	
One Column	13.42308	2.579505	0.3992
Two Column	13.33333	1.838737	
Three Column	14.625	2.445842	

*ANOVA test applied

DISCUSSION

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. This can be attributed to outdoor activities being performed predominantly by young males and use of motor bikes. Similarly, Aseri MK et al⁸ reported that the majority of fractures occurred between the age of 20 and 50 years with maximum incidence being involving the productive age group 20-30 years (40%) with mean average of the patient was 38.7 years. In our study, majority of patients having road traffic accidents (74%). In our study, majority of patients having occupation related to heavy work suggesting this fracture is common in high activity which is also similar to the study reported by Aseri MK et al.⁸

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 under-evaluated 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. Zhu Y et al,¹⁰ reported that The Three-Column Classification demonstrates a higher interobserver reliability and can be used as a supplement to the conventional Schatzker Classification, especially in the complex and posterior comminuted tibial plateau fractures. Furthermore, the Three-Column Classification is clinically relevant and, to some degree, can instruct the surgeon in preoperative planning.

Barei et al,¹¹ 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. Sharma M et al utilized minimal invasive percutaneous plate osteosynthesis (MIPPO) and found satisfactory results proving that minimal invasive surgery reduces operative trauma to soft tissues, reduces immobilization and infection,

reduces stiffness, and improves knee joint function, and found that tibial plateau fracture surgery is difficult, but it provides excellent anatomical reduction, rigid fixation to restore articular congruity, and early knee motion.

In our study, 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 3 plates were used in 1 patient which suggests that in 2 and 3 column fracture, using CT based 3 column classification better pre-operative planning can be done. This suggest multiple plate is used when 2 and 3 column fracture require when more than one column is involved.

Union was defined as bridging three of the four cortices and removal of the fracture line on plain radiographs for full-weight bearing patients. Delays in union occurred when fractures were not joined at 16 weeks. 78% of patients started complete weight bearing at 12-16 weeks, while 80% started partial weight bearing at 8-12 weeks. Within 20–24 weeks, all patients began full weight bearing. 92% of patients unionize within 6 months after surgery. Our biggest study challenge was joint stiffness and instability.

CONCLUSION

CT scan-based 3 column categorization for tibial plateau fracture therapy is the study's major goal. Our patients' functional outcomes are acceptable, showing that CT scan-based 3 column categorization can help evaluate fracture pattern and choose a method. Previously employed Schatzker classification never addresses posterior column fracture, limiting articular comprehension and surgical planning. CT scans examine fracture patterns, aid fixation and operation planning. We found superior clinical outcomes in our study. More difficult fractures like Schatzker type 5 and 6 including posterior column had poor outcomes using X-ray-based Schatzker classification, while our study found good to exceptional outcomes with

three columns. In contemporary era, all tibial plateau fractures necessitate a CT scan as CT scan-based three-column classification simplifies complex fracture care.

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