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FUNCTIONAL AND RADIOLOGICAL OUTCOME IN TIBIAL PLATEAU FRACTURE FOLLOWING COLUMN SPECIFIC FIXATION

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ABSTRACT **Introduction:** Tibial plateau fractures account for 1% of all intra-articular fractures. High-energy trauma leads to the most complex proximal tibia fractures. The tibial plateau fractures were previously classified based on a two-dimensional X-Ray done to assess the fracture and classify based on Schatzker classification. Schatzker type V and VI and A.O. type C fractures are high-energy fractures with a more complex fracture pattern with multiplanar articular comminution. Using multiplanar computed tomography (C.T.) scans as the foundation, Luo introduced a brand-new three-column classification in 2010 based on the axial section of C.T. scans. This study was done to assess the functional and radiological outcome of proximal tibia fractures fixed column specifically in our institution. **Material And Methods:** This is a prospective study; 25 patients with tibial plateau fractures operated in our hospital who fulfilled the inclusion and exclusion criteria were included. After clinical and radiological diagnosis (using Xray and C.T.), the patient underwent surgery, and standard rehabilitation protocol followed post-surgery. Using the Modified Rasmussen Functional and Radiological scoring system, a follow-up analysis was conducted at the 6th week, 12th week and 24th week. **Results:** In our study, the mean age was 46.28 ± 19.2 and 19 were males, 6 were females. Among our participants, the mode of injury were 4 cases with fall from height, 19 cases with RTA, and 2 cases with slip and fall. 11 cases were 2-column fractures, and 14 cases were 3-column fractures. The complications we had in our study were 1 screw back out, 2 cases with surgical site infection, and 2 cases with valgus malunion. In our study, the Modified Rasmussen Functional outcome was excellent in 16 cases, good in 5 cases, and 4 had a fair outcome. Modified Rasmussen Radiological outcome was excellent in 11 cases, good in 10 cases and fair in 4 cases. **Conclusion:** Computed tomography-derived three-column classification, could help better in understanding the fracture pattern preoperatively and plan the surgical approach needed for column-specific fixation, which facilitates a better functional outcome. Applying this classification through anatomical reduction and rigid fixation of fracture fragments, we could obtain a stable fixation. This permits in early aggressive rehabilitation, thus resulting in an excellent functional and radiological outcome within a short duration.

KEYWORDS : Tibia plateau, Column theory, Tibia plating.

INTRODUCTION:

Tibia fractures are the commonest long bone fracture, most commonly resulting from high velocity injuries.[1] Tibial plateau fracture comprises 1% of all fractures. The age distribution is bimodal, with high energy trauma in the young and trivial injury in the elderly.[1] Tibial plateau fractures are becoming more common due to the increased incidence of motor vehicle accidents. High-energy trauma leads to the most complex proximal tibia fractures. The tibial plateau fractures were previously classified based on a two-dimensional X-Ray using the Schatzker classification system and AO classification in which Schatzker type V and VI and AO type C fractures are high-energy fracture patterns. This classification is based on two-dimensional radiographs. The development of three-dimensional Computed Tomography studies for Tibial plateau fractures has helped with a better understanding of fracture patterns, intraarticular extension of the fracture line and comminution of the fracture fragments. Previously dual-column plating was done following two-dimensional X-ray information, but it does not address the multiplanar articular comminution, which usually has posterior shearing or a coronal fracture. The treatment plan for these fractures was also based on classification systems that used two-dimensional radiography. This technique does not consider the injury patterns with significant fracture lines in the posterior plane that are not visible on plain radiographs. A bicondylar fracture might have posteromedial fragments in 59% to 74% of cases. Patient positioning, surgical approach, and incision placement are decided based on this. Using multiplanar computed tomography (CT) scans as the foundation, Luo introduced a brand-new "three-column classification" in 2010.[2] Several authors have noted that the CT-based three-dimensional consideration of the fracture pattern helps to assess the fracture in detail. Following this, the three- column classification system is being widely followed. This study was done to assess the functional and radiological outcome of proximal tibia fractures fixed column specifically in our institution.

MATERIALS AND METHODS:

This is a single center prospective study. The study population were patients who visited the outpatient and the emergency services department in our hospital diagnosed with tibia plateau fracutures. The sample size was calculated as per the statistics and data collected from the Medical records department from our hospital with the prevailed pandemic situation. The study was conducted from January 2021 to May 2022 including the follow up period. Patients above the age of 18 years of age with closed tibial plateau fractures were included in the study and the patients with inflammatory conditions, previous or associated injury to the ipsilateral limb, compartment syndrome, neurovascular injuries and compromised soft tissue were excluded from this study. After getting approval from the Institutional Ethics Committee, the study was conducted. Informed consent was obtained from all the patients after clinical and radiological (X-ray Antero-Posterior & Lateral view and Computed tomography scan with 3D Reconstructed image) diagnosis were made. Then patients were

classified according to Luo three-column classification system. They were categorized as 1) Medial and Lateral column injury, 2) Lateral and Posterior column injury, 3) Medial and Posterior column injury 4) Medial, Lateral and Posterior column (Triple column) injury. All the patients in the study group underwent routine preoperative checkups and fitness for surgery were obtained. All the patients falling under the inclusion criteria were given antibiotic prophylaxis 30 minutes before surgery and up to 48 hours after surgery.

One or two of the following approaches was used for surgery based on the column concept Anterolateral approach or Posteromedial approach or Combined approach. For lateral column fracture fixation, anterolateral approach was used. Patient in supine position, knee was flexed to 60 degrees with the help of wooden block. Inverted L-shaped incision was made starting from 1-3 cm distal to the joint line, staying just lateral to the lateral border of the patella tendon. The incision was curved anteriorly over Gerdy's tubercle and distally extended, lasting about 1 cm lateral to the anterior border of the tibia. The incision was deepened proximally through the subcutaneous tissue and exposed the lateral aspect of the knee joint capsule. The capsule was incised transversely just below the lateral meniscus. Below the joint line, the incision was deepened through the subcutaneous tissue to expose the fascia overlying tibialis anterior. The knee joint was entered by submeniscal arthrotomy. The Lateral meniscus was detached and the underlying tibia is visualized.

The Posteromedial approach was used to approach the medial column and posteromedial segment of the posterior column. The patient was positioned supine with the affected limb in abduction and external rotation, with the knee slightly flexed, a curved incision from the medial epicondyle towards the posteromedial edge of the tibia was made. Skin, subcutaneous tissue incised, fascia cut and pes anserinus exposed. Pes anserinus and gastrocnemius were retracted posteriorly and distally, and the medial edge of the tibial plateau was identified. The knee joint was accessed by identifying the meniscus and the edge of the tibial plateau. The medial column was exposed by subcutaneous dissection anteriorly and Pes anserinus retracted posteriorly.

Postoperatively Antero-Posterior and Lateral View X-rays were taken during the immediate postoperative period, at 6 weeks, 12 weeks and 24 weeks. Postoperatively rehabilitation protocol was initiated according to fracture pattern and fixation (Non-weight-bearing crutch walking and knee mobilization). The results were analyzed based on pain, walking capacity, knee extension, the total range of movements, stability and power of quadriceps using the Modified Rasmussen Functional Scoring System[4] and articular depression, condylar widening, varus/valgus angulation and osteoarthritis using Modified Rasmussen Radiological Scoring System[4] at the end of 24 weeks. Additionally, complications arising post- surgery were assessed during the follow-up period and treated according to the standard protocols in Orthopaedics. After collection, the data were compiled and entered in Microsoft Excel sheet. SPSS statistical software (SPSS for windows, version 20.0; SPSS, Inc., Chicago, IL, USA) was used for statistical calculation. Calculations were expressed as mean (+/- standard deviation) or Median (with inadequate range) according to distribution. Categorical variables were presented as frequency and percentages.

RESULTS:

A total of 25 patients with tibial plateau fractures who came to our hospital outpatient department and Emergency medicine service department who fulfilled the inclusion and exclusion criteria were selected in this study after getting and informed consent.

The study population, was divided into patients age group who are less than 65 and more than 65 to differentiate the geriatric population and 76% (n=19) were found to be in the geriatric age group and 24% (n=6) were in the age group less than 65 years of age. The mean age was found to be 46.28+/- 19.2 years. Among the study population 76% (n=19) were male and 24% (n=6) were female. The commonest mode of injury was road traffic accident which was 76%(n=19) and 16% (n=4) had history of fall from height and 8%(n=2) had slip and fall. The commonest site involved in our study was left side 64% (n=16) and right side it was 36%(n=9).

44%(n=11) of the study population had 2 column type fracture and 56%(n=14) had 3 column type of fracture as per Luo 3 column classification and none of the patient had single column involvement in our study. 28%(n=7) had lateral and posterior columns involved, 16%(n=4) had medial and posterior columns involved and 56%(n=14) of the patients had all 3 columns involved as per Luo 3 column classification.

Among the study population 2 patients (8%) had bronchiectasis, 1 patient (4%) had Coronary Artery disease, 3 patients (12%) were Diabetic, 3 patients (12%) were Hypertensive and 1 patient (4%) had Hypothyroidism. 60% (n=15) of the patients didn't have any comorbidities.

Table 1, shows the time of presentation to the hospital, the time interval between injury to surgery and the time interval between time of presentation and the time of surgery. Among our study population, the mean duration of injury to surgery was 6.8 days.

Table 1: Time Of Presentation, Time Of Injury To Surgery Interval, And Time Of Presentation To Surgery Interval Among The Study Participants (n=25)

S No	Variable	Mean	SD
1	Time of presentation	3.56	4.42
2	Time interval between injury to surgery	6.8	4.18
3	Time of surgery from presentation	3.24	2.08

In this study, 24% (n=6) of the patients underwent anterolateral approach, 16% (n=4) had posteromedial approach and 60% (n=15) had combined approach among our study population.

Table 2 & 3, shows the Modified Rasmussen Functional score and outcome, where 64%(n=4) had fair outcome, 20%(n=5) had good outcome and 64%(n=16) had excellent outcome.

Table 2: Modified Rasmussen Functional Outcome Score (n=25)

S No	Variable	Frequency	Percentage
1	Pain		
	Stabbing pain in certain position	1	4
	Occasional	16	64
	None	8	32
2	Walking capacity		
	Walking outdoors (<15 min)	1	4
	Walking outdoors (15 min – 1 hr)	4	16
	Walking outdoors (> 1 hr)	9	36
	Normal walking capacity for age	11	44
3	Knee extension		
	Normal	25	100
4	Total range of motion		
	At least 90^0	5	20
	At least 120^0	12	48
	Full	8	32
5	Stability		
	Abnormal stability in 20^0 flexion	1	4
	Normal stability in extension and 20^0 flexion	24	96
6	Power of quadriceps		
	Grade 3- 4	2	8
	Grade 5	23	92

Table 3: Modified Rasmussen Functional Outcome (n=25)

S No	Functional outcome	Frequency	Percentage
1	Excellent	16	64
2	Good	5	20
3	Fair	4	16
4	Poor	0	0

Table 5 & 6 shows Modified Rasmussen Radiological score and outcome. Among the study population, 16% (n=4) had fair outcome, 40% (n=10) had good outcome and 44% (n=11) had excellent outcome.

Table 4: Modified Rasmussen Radiological Outcome Score (n=25)

S No	Variable	Frequency	Percentage
1	Articular Depression		
	6 -10 mm	2	8
	< 5 mm	8	32
	None	15	60

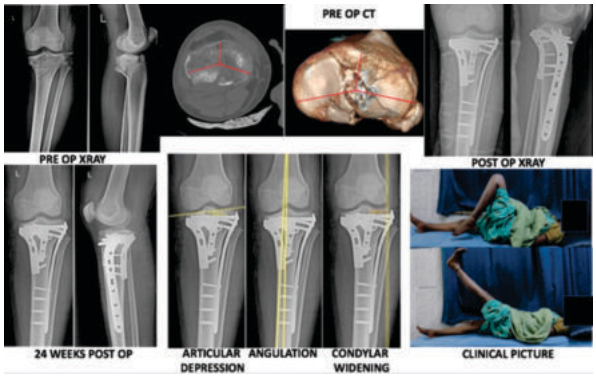
2	Condylar widening 6 - 10 mm < 5 mm None	 6 12 7	 24 48 28
3	Angulation 10 - 20^0 <10^0	 2 15	 8 60
	None	8	
4	Osteoarthritis None/No progress	 25	 100

Table 5: Modified Rasmussen Radiological Outcome (n=25)

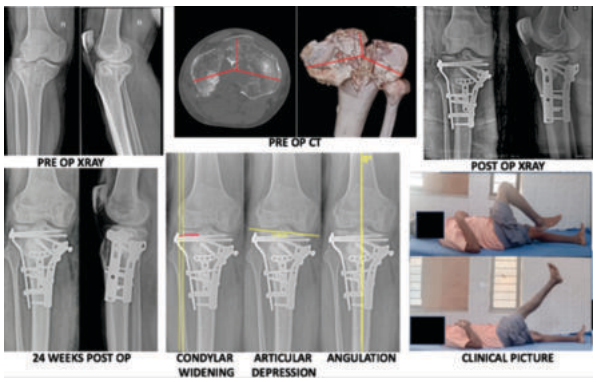
S No	Functional outcome	Frequency	Percentage
1	Excellent	11	44
2	Good	10	40
3	Fair	4	16
4	Poor	0	0

The complications encountered in our study were screw back out in 1 patient (4%), surgical site infection in 2 patients (8%) and 2 patients (8%)had valgus malunion.

CASE ILLUSTRATIONS:



Case: 1



Case:2

Case:3

DISCUSSION:

Tibial plateau fractures are complex intra-articular fractures with soft tissue disruption, often leading to unsatisfactory clinical results. Numerous treatment modalities have been proposed and adopted in the last few decades to achieve an optimum clinical and radiological outcome. There is no specified method validated in treating tibial plateau fracture, as surgeons prefer to their way of fixation based on their own experience. The utmost importance of managing a tibial plateau fracture is in understanding the fracture pattern thoroughly with the use advance imaging technologies, which will help to analyze the fracture pattern in three dimensions with sagittal and coronal plane reconstruction. As most of the tibial plateau fractures result from high-velocity injury, the fracture pattern is usually comminuted in more than one plane. It warrants a proper analysis of the injury in respect to plane and intensity of fracture, intra-articular displacement, and posterior comminution, which are often missed in an X-Ray.

Understanding the fracture before planning is necessary, which was critical in deciding the surgical approach to be performed.

Among the study population of 25 participants, the mean age was 46.28 years, with 19 years being the minimum and 87 years of age as the maximum. This is comparable to the study done by Dave et al[5]. (42.85 years), Luo et al[3]. (46.8 years), Thapa et al[6]. (40.47 years) and Selvaraj et al[7]. (41.4 years). Thus, the majority of the population are were in earning age group in all the studies.

In our study, 76% population were males, and 24% percent were females. This is comparable to the study done by Dave et al[5]., Luo et al[3]., Thanappan et al[8]., Somashekara et al[2]. and Selvaraj et al[7]., all showing male gender predominance. Thus, the male gender was most commonly involved.

In our study, we had 76% of Road traffic accidents, 16% were fall from height and 8% had slip and fall. The majority of cases had high-velocity trauma and had more complex fracture patterns. This is as per the series of patients reported by Pradeepkumar et al[1], where he had 76.7% of high velocity injury due to road traffic accident. Thapa B et al[6]., had 83% of Road traffic accidents. Thanappan et al[8]. reported road traffic accidents in all cases as a mode of injury. In our study, we have cases of domestic fall and fall from a height which were other modes of injury mechanism involved in proximal tibia fractures.

In our study, based on the C.T. morphology of fracture pattern, these fractures are classified based on the Luo Three Column classification. According to this classification, 44% of the study population were 2-column fractures, and 56% were 3- column fractures. In contrast to our study, Luo et al[3]. had 100% 3-column fractures in their study. According to the study by Somashekara et al[2]., 19.8% were one-column fractures, 56.3% were two-column fractures, and 23.3% were three-column fractures. As per the study by Thanappan et al[8]., 30% were 1-column fractures, 30% were 2- column fractures, and 40% were 3-column fractures. The absence of one-column fractures in our study could be attributed to the low sample size and the involvement of the posterior column, even in isolated lateral tibial plateau fractures.

In our study, the mean duration of time since injury to surgery was 8.5 days, the mean time of presentation since injury was 3.56 days, and the time of surgery from the presentation was 3.24 days, which was similar to the study done by Luo et al[3]. who had 8.5 days and the study by Somashekara et al[2]., where the mean duration of injury to surgery was 7 days.

In our study, 8% had surgical site infections, 4% had screw back out, 8% had valgus malunion, and 88% of patients had no complications.

Surgical Site Infection:

Out of the 2 patients with surgical site infection, one had a superficial infection treated with regular dressing and culture-specific intravenous antibiotics, and the other had a deep surgical infection treated by wound wash and culture- specific intravenous antibiotics.

Screw Back out:

One patient had screw back out, but the patient had a good radiological outcome at 24 weeks. The patient clinically had only skin tenting but had an excellent functional outcome, so the patient was advised for implant removal after the fracture union.

Valgus Malunion:

2 patients had valgus malunion, of which 1 had an excellent functional outcome and 1 had a fair functional outcome.

In contrast to the study by Luo et al[3]., he reported no surgical site

infections. Still, he reported 2 cases (6%) with screw back out, 1 case (3%) with varus malunion and 1 case (3%) with valgus malunion. Thapa B et al[6]. reported 2 cases (6%) of surgical site infections, and 1 case (3%) had post-operative CPN nerve palsy. Wang et al[9]. had 12 cases (4%) of surgical site infection, 18 cases (6%) with hardware irritation, and 13 cases (4%) with nerve injuries. We reported a similar complication rate when compared with Thapa B et al[6].

Our study assessed functional outcomes using the Modified Rasmussen Functional Scoring System. 84% of the study population had satisfactory results. This outcome is comparable to the study done by Chen et al[10]. (87.17%) and Thapa et al[6]. (86.7%). The higher outcome showed by Selvaraj et al[7]. (95.7%) can be attributed to the longer duration of follow-up, where we usually expect the functional outcome to improve over a period of time.

The radiological outcome was assessed using the Modified Rasmussen Radiological Scoring system. 84% of the study population had a satisfactory outcome. However, studies by Thapa B et al[6]., Chen et al[10]., and Selvaraj et al[7]. showed greater than 90% satisfactory radiological outcomes. Though our radiological outcome appears to be less satisfactory in comparison, it did not significantly influence our functional outcome, which was comparable to most standard studies.

CONCLUSION:

Computed tomography-derived three-column classification, could help better in understanding the fracture pattern preoperatively and plan the surgical approach needed for column-specific fixation, which facilitates a better functional outcome. Applying this classification through anatomical reduction and rigid fixation of fracture fragments, we could obtain a stable fixation. This permits in early aggressive rehabilitation, thus resulting in an excellent functional and radiological outcome within a short duration.

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