

TIBIAL PLATEAU FRACTURES: FUNCTIONAL OUTCOME EVALUATION OF OPEN REDUCTION AND INTERNAL FIXATION TECHNIQUES.

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ABSTRACT

OBJECTIVE: To evaluate the functional outcome of open reduction and internal fixation surgical technique used in different types of tibial plateau fractures among patients in Hyderabad, Pakistan.

METHODOLOGY: Prospective study was conducted from September 2018 to September 2019 on patients presented with injuries and fractures involving knee joint admitted in the orthopedic unit of Liaquat University Hospital, Hyderabad. Patients > 18 years of age, either gender, having fracture involving knee joint, having confirmed tibial plateau fracture were included. Pre-operative X-ray upper tibia and/or distal femur of the affected limb of all the patients followed by Computed Tomography scan with or without 3D were performed. Open or closed reduction and internal fixation were performed. The functional outcome of the participant was assessed through the Knee Society Score. Data was analyzed using student's t-test in SPSS ver. 22. **RESULTS:** Most common mode of injury was fall followed by road traffic accidents (41.25%). There was a statistically significant difference in functional mobility score between the age groups and gender ($p < 0.05$). While the statistically significant ($p < 0.05$) decline in mean Knee Society Score was observed in participants who had been bearing full weight for 3 months.

CONCLUSION: Tibial plateau fractures are commonly occurring among males and usually resulting due to road traffic accidents. Early knee mobilization and consequent good mid- to long-term functional results, open or closed reduction, as well as stable internal fixation, is the treatment of choice.

KEYWORDS: Functional Outcome, Knee Fracture, Schatzker Classification, Tibial Plateau Fracture

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INTRODUCTION

Among the many long bones in the body, the tibia, owing to its unique anatomical position as almost one-third of the surface of the bone is subcutaneous, is one of the most commonly injured as well as fractured bones.¹ The fractures of the tibial plateau, i.e. the proximal part of the bone consisting of the weight-bearing articular surfaces, are exceedingly common when this bone is exposed to unwarranted axial load and/or twisting stress.^{2, 3} Such fractures are commonly seen in blunt-force traumas such as in road traffic accidents, injuries sustained in various sporting events, fall on a hard surface, etc.⁴ Most of these fractures of the tibial plateau are intra-articular that require anatomical reduction and stable fixation.⁵ Among these fractures, 50%-70% involve the lateral plateau, 10%-20% involve the medial plateau, whereas almost 10%-30% are bicondylar, i.e. involving some portion of both the medial and lateral articular surfaces.^{1, 6} These fractures not only cause injury to the involved bone but also damage the surrounding structures

such as the ligaments, muscles, tissues in the joint capsule and the skin.⁷ To make a proper assessment of the extent and severity of the injury, to plan a proper treatment strategy, and to make better predictions regarding the prognosis, clinicians use multiple classification systems of tibial plateau fractures, out of which the Schatzker classification system is the most widely accepted as well as the most commonly used.^{8, 9} The Schatzker classification categorizes tibial plateau fractures in the six different types, as shown in the figure below

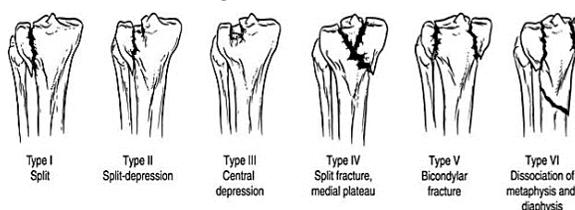


Figure. Schatzker classification of tibial plateau fractures⁽¹⁰⁾

The primary objective of treating tibial plateau fractures is the attainment of a steady knee joint, which possesses a free and functional range of

movement without causing any pain. In this regard, open reduction and internal fixation techniques have proven to be the method of choice for the management of such fractures.^{10,11} However, different types of fractures, based on the Schatzker classification, have shown to respond differently to treatment as, type I fractures have shown to respond well to type VI, which are commonly related to high-energy trauma, have had a rather poor prognosis.¹² The treatment of such fractures requires the utmost skill of a surgeon as post-surgical complications are common and can be divided into early (i.e. loss of reduction, deep vein thrombosis, infection), or late (i.e. nonunion and/or malunion, breakage of the implant, post-traumatic arthritis).¹³

Keeping in view, the present study was designed to evaluate the functional outcome of open reduction and internal fixation surgical techniques used in different types of tibial plateau fractures among patients in Hyderabad, Pakistan.

METHODOLOGY

Ethical approval was sought from the research ethics committee of Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro while informed consent was sort from all the participants. This prospective study was conducted over a period of one year from September 2018 to September 2019 on patients presented with injuries and fractures involving knee joint admitted in the orthopedic unit of Liaquat University Hospital, Hyderabad. Patients over 18 years of age, of either gender, having fracture involving knee joint (confirmed on initial x-ray), having confirmed tibial plateau fracture (TPF) were included. While patients less than 18 years old, presented with compound fractures, having fractures with vascular involvement were excluded from the study.

After admission, patients were stabilized and the clinical examination of the affected limb was performed. Patients were then monitored closely for the signs and symptoms of compartment syndrome soon after the admission. The condition of the affected limb was then observed for any blister formation over the skin. After collecting the basic information, pre-operative X-ray upper tibia and/or distal femur anteroposterior, lateral, and oblique views (whichever required) of the affected limb of all the patients. Furthermore, Computed Tomography (CT) scan with or without 3D (Three Dimensional reconstruction Views) whichever was needed were performed for a detailed evaluation of the fracture. The knees of all patients were then identified, analyzed, and classified retrospectively according to the Schatzker classification.⁽¹⁴⁾

Patients were then kept on waiting for under-observation till the skin around the proximal part of the tibia was ready for the surgery. Healing of fracture blisters and reduction of swelling around the proximal tibia were the expected pre-operative clinical findings. Broad-spectrum antibiotics were then administered prophylactically to all the patients half an hour before the surgery. All the surgeries were performed under general or spinal anesthesia. In

some patients, graft procedure was preferred depending on the amount of collapse of the joint surface after reducing the joint level. Anatomical locked plate or cannulated cancellous screws 6.5-mm diameter were used per fracture pattern on medial and/or lateral proximal tibia. A long leg splint was placed postoperatively till the edema of soft tissue disappeared after the surgical procedure.

The functional outcome of the participant was assessed through the Knee Society Score (KSS) while its relationship between the age of the participants (≤ 40 and > 40 years), gender, the duration of immobilization (up to 6 and ≥ 6 weeks), time to start full weight-bearing (≤ 3 months and over 3 months) was evaluated.

The collected data was analyzed using SPSS ver. 22. Preoperative data such as age, sex, side of injury, mechanisms of trauma, and type of fracture according to Schatzker classification. Statistical analysis for numeric a variable (means and standard deviation) was performed using student's t-test with the significance level of alpha was accepted at p -value < 0.05 .

RESULTS

A total of 201 patients with tibial site injury were admitted in orthopedic OPD, of which 80 had TPF with 5mm or more displacement or depression or step. The majority of participants were 60(75.00%) male and 20(25.00%) female patients, with the mean age of 41.21 ± 3.32 years and age range of 19–58 years at the time of injury. The mean interval between the trauma and surgery was 9.63 ± 1.30 days. All the participants with tibial fracture then had undergone the CT-scan to confirm the type of fracture. CT-scan of all participants were reviewed and based on these findings, Schatzker type I was observed in 23(28.75), II in 19(23.75), III in 9(11.25) tibial plateau fractures while 15(18.75) patients showed a Schatzker type IV, 8(10.00) showed type V and 6(7.50) had type VI TPF.

Table I: Presenting features of the study participants (n=80)

	n	%
Site of injury		
Right	41	51.25
Left	39	48.75
Mode of Injury		
Motorbike	30	37.50
Pedestrian	19	23.75
Fall	24	30.00
Other	07	08.75

The average length of stay in the hospital for the patients was 6.60 ± 1.22 days (range 4-16 days) while the average time from injury to surgery was 3.81 ± 1.34 days (range 1-9 days). The mean postoperative hospital stay was 2.92 ± 1.51 days (range 2-8 days) whereas; the mean immobilization duration was 4.51 ± 2.81 weeks (range 0-7 weeks). Full weight-bearing meantime was 3.40 ± 1.51 months (range 1.4-5 months) and the average follow-up time of patients was 48.10 ± 13.34 months (range 16-98 months). The findings of the passive range of motion of the joint and knee flexion degree of the patients evaluated at the last postoperative follow-up are

demonstrated in figure 1 below. Based on the findings, the most frequent result was 0°–140° with 48.75%. (Figure 1)

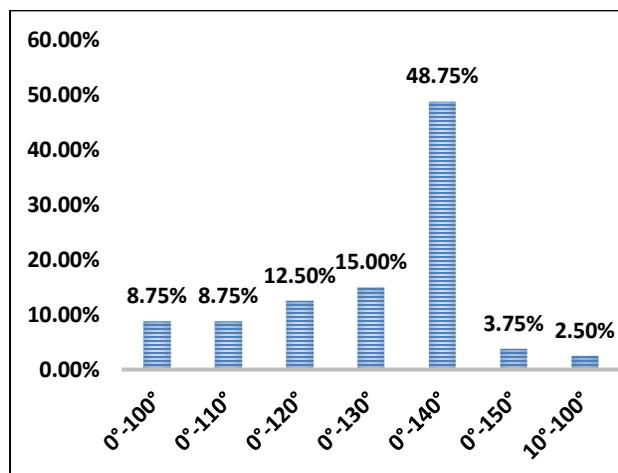


Figure 1: Patients' passive knee range of motion ratios at the last follow-up

The range of KSS of admitted patients was from 40 to 100 with mean KSS was 83.78 ± 4.34 . Excellent KSS was observed in 62 (72.94%) patients, good in 12 (14.12%) patients, fair in 6 (7.06%) patients, and poor in 5 (5.88%) patients. Post-surgical wound infection was identified in four patients. Out of which, two patients were healed with only superficial debridement along with antibiotic therapy in the first month after surgery. While in the remaining 2 patients, despite deep debridement and antibiotic use, it was essential to remove the hardware in the 3rd and 5th month after the surgery. Table II below is demonstrating the relationship between the different ages and gender with functional scores of the patients. There was a statistically significant difference between the two age groups and gender ($P < 0.05$). While no statistically significant difference between the affected side of the patients and functional outcomes. (Table II)

Table II: Distribution of mean clinical scores according to age groups and gender

	Knee Society Score	
	Mean± SD	P-value
Age		
≤ 40 years	90.71±7.34	0.0001*
> 40 years	80.11±9.78	
Gender		
Male	91.24±6.45	0.0003*
Female	85.13±7.08	

* Statistically significant (t-test findings) p-value < 0.05

The functional scores of KSS among the patients with joint-level collapse after the use of grafts in the TPF were found to be statistically significant (p -value < 0.05). Participants with a longer duration of immobilization i.e. over six weeks had decreased KSS, this finding was not statistically significant ($p > 0.05$). While the statistically significant ($p < 0.05$) decline in mean

KSS was observed in participants who had been bearing full weight for 3 months. (Table III)

Table III: Patient's effect on functional scores of immobilization and weight-bearing time

	Knee Society Score	
	Mean± SD	P-value
Immobilization Time		
< 6 weeks	87.81±10.68	0.054
≥ 6 weeks	81.32±13.22	
Weight-bearing Time		
≤ 3 months	87.54±13.27	0.010*
> 3 months	79.48±13.54	

* Statistically significant (t-test findings) p-value < 0.05

DISCUSSION

TPF resulting from high energy mechanism and are quite difficult to treat due to the involvement of cancellous bone, their intra-articular nature, and the proximity to a major weight-bearing joint. Despite the recent advances in the field of orthopedic surgery, the management of tibial plateau fractures is still challenging for orthopedic surgeons as they are often concomitant with several complications.

Several studies have reported that there is no satisfactory outcome of conservative treatment of such fractures. Selection of surgical implant for TPF should be according to the type of TPF. In the Schatzker type II, III, and IV TPFs, only screws may be sufficient if the fracture is not displaced. Studies have documented that open reduction and stable internal fixation is the treatment of choice for TPF for displaced, depressed, and unstable fractures to regain the early and complete range of motion. Patient compliance with treatment and appropriate physiotherapy is important to attain a good outcome.¹⁴ The present study was designed to evaluate the functional outcome of surgically treated different types of tibial plateau fractures. The mean age of the patient in our study was 41.21 ± 3.32 years and an age range of 19–58 years at the time of injury. These findings are consistent with another Pakistani study by Haq et al 2017.¹⁵ In the present study, the majority (75.00%) of the patients were males. This can be attributed to the setup of Pakistan where males use to go outside for work and are more involved in outdoor activities and are more prone to accidents and such injuries. Jain et al reported that out of the patients with TPF in their study, 79% were male.¹⁶ Road traffic accidents including motorbike and pedestrian, fall due to a slip on the floor or from height were the common modes of injury while TPF type I and II were more common than type III, IV, V, and VI in the present study. The findings are consistent with the findings reported by Shrestha et al. 2016 and Jain et al. 2016.^{16, 17} Patients with type-I, II, III, and IV showed satisfactory results in the present study while patients with type-V and VI TPF

showed poor results. After surgery, the time to start weight-bearing by a patient remains a subject of debate. The time to start weight-bearing after surgery is the most controversial issue and remains a subject of debate. Some studies recommend weight-bearing immediately within the brace, indicating that it stimulates fracture healing.^{18,19} Conversely, other studies recommend that weight-bearing should be delayed by up to 12 weeks.²⁰ Moreover, some authors use the radiographic merger as an indicator of headway to full weight-bearing.^{18, 21} Early weight-bearing after TPF surgery may cause a loss of reduction and malunion. The time to start weight-bearing should be determined based on the patient's weight, the amount of atrophy in the muscles around the knee, and the quality of the fixation rigidity. Our study demonstrated that when full weight-bearing after TPF surgery is delayed by more than 12 weeks, the KSS decrease is statistically significant. After this study, we have started to give partial load after 6 weeks postoperatively and full weight-bearing between 6 and 12 weeks, according to the condition of the patient mentioned above. These findings are consistent with the findings reported by Polat et al. 2019.²² In our study, 2 (2.50%) patients had deep wounds infection, whereas superficial wound infection was also detected in 2 (2.50%) patients. These findings are consistent with Polat et al.²²

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CONCLUSION

We concluded that tibial plateau fractures are commonly occurring among males and usually resulting due to road traffic accidents. For achieving a congruent joint surface, early knee mobilization, and consequent good mid- to long-term functional results, open or closed reduction, as well as stable internal fixation, is the treatment of choice.

ETHICS APPROVAL: The ERC gave ethical review approval

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin

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