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A Prospective Study of Functional Outcome of Surgical Management of Tibial Plateau Fractures

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ABSTRACT

Among the most prevalent types of intra-articular fractures, tibial plateau fractures rank high. These injuries can cause a wide range of compression and articular displacements and can involve fractures in the medial, lateral, or both tibial plateaus. Fractures of this kind are critically important since the knee is one of the body's primary joints that bears weight. Although there are a number of effective methods for fixing these fractures, no one seems to agree on which one provides the greatest functional outcome or proves its superiority. This is why we set out to compare and contrast many commonly used fixation techniques in our current study. Our goal is to find the most effective one. To measure the reduction and stability of fractures after internal fixation, the frequency of complications following surgery, and the functional outcome of tibial plateau fractures following surgical management. A prospective comparative study conducted in Department of Orthopaedic surgery, District hospital Tumakuru for a period of 2 years (September 2020-August 2022) in 66 patients admitted in dept of orthopaedics in district hospital Tumakuru, fulfilling the inclusion criteria and willing to participate in the study. The primary objective was to compare the functional and radiological outcome which was assessed using Rasmussen criteria during follow up. For secondary objective, cases were followed up for 6 months and complications are noted. Of the 66 patients in our study the majority were between the ages of 31 and 40. We discovered that there were more men than women in the population and the ratio of men to women was 3.4:1. It was discovered that the poor group had a higher percentage of patients with left lateralization than the good, fair, and excellent groups. Most of the patients had RTA in Good group, Fair group, Poor group compared to excellent group. The study showed that ORIF with buttress plating and bone grafting has better functional outcome with better pain score and preserve good range of motion. Also lower risk of knee stiffness and other related complications at the end of 6 months of our follow up.

INTRODUCTION

Over 1% of all long bone fractures and 8% of all fractures in the elderly are caused by fractures of the tibial plateau. Their yearly incidence is 10.3 per 100,000 people. Males account for 70% of fractures, with the mean age of 40-44 years being the most affected patient population overall. Females experience fractures most frequently between the ages of 55 and 59. The age distribution is bimodal for both genders.

One of the most frequent intra-articular fractures that arises from direct axial compressive forces or indirect coronal compressive forces is the tibial plateau fracture. Tibial plateau fractures account for 1% of all fractures and 8% of fractures in the elderly[1]. These fractures include a wide range of fracture configurations with varying degrees of articular displacement and depression that affect the lateral condyle (55-70%), medial condyle (10-23%), or both (11-30%). If the plateau surface and leg axis are not properly restored, these fractures may result in early osteoarthritis, ligament damage, as well as chronic pain and incapacity[2]Meniscal and ligamentous injuries to the knee may also occur in conjunction with tibial plateau fractures[4].

Until the 1950s, the majority of tibial plateau fractures were treated non-operatively with cast immobilization, however, the majority of tibial plateau fractures are now treated surgically. For tibial plateau fractures, open reduction internal fixation (ORIF) is the most often utilized surgical procedure. The objectives of surgical management for a fractured tibial plateau are to reinstate knee functionality, axial alignment, articular congruity and joint stability.

Since the knee joint is one of the body's main weight-bearing joints, fractures surrounding it are among the most frequent orthopaedic injuries seen in trauma centers. They may arise from trauma with high energy or from falls with low energy. Indirect shear forces and direct axial compression, respectively, are the causes of indirect shear forces and falls from heights, which account for the majority of tibial plateau fractures, which involve articular extension[3]. Because the subchondral bone in older patients with osteopenic bones is less resistant to axially directed loads, depression-type fractures are more common in these patients. Internal fixation had not yet supplanted conservative approaches as the preferred course of treatment until recently. It ignores soft tissue complications in favor of early mobilization and lower morbidities. When treating tibia plateau fractures surgically, the primary goal is:

- To bring back articular congruency
- In order to fix the mechanical axis
- In order to reestablish ligamentous stability

The above can all lead to a knee that is optimally functional, pain-free and has a good range of motion[4]. After undergoing initial treatment with traditional locking plates intended to achieve rigid internal fixation, it was discovered that the bone in contact with the plate thins and atrophics, which can result in complications like non-union or follow-up fractures following implant removal. As a result, biological fixation a novel theory of fixation was born. The idea behind biological fixation is comprised of Indirect reduction Adequate stability
Preservation of osteogenic potential Limited bone-plate contact[5] The development of minimally invasive percutaneous plate osteosynthesis, or MIPO (MIPPO), was prompted by the idea of biological fixation. Although MIPO was theoretically superior to open plating the clinical success of the conventional plate was not sustained and its ability to hold the bone rigidly enough was questioned, particularly in cases of osteoporotic fractures[6]. Thus, a novel approach to implant design resulted in the development of limited contact DCP and subsequent to it, the more recent locking compression plates (LCP)[7]. These plates were thought to be biomechanically more advanced technically and capable of providing a stable fixation even in osteoporotic bones. The purpose of this study is to treat tibial Plateau fractures using this novel plate fixation technique.

In order to determine the most effective surgical technique for treating tibial plateau fractures and to determine the functional outcome following treatment the current study is being conducted. Over a two-year period the study will be conducted and the results will be analyzed to determine which type of fixation will produce the best functional outcome.

MATERIALS AND METHODS

Study area: The proposed study is a hospital based prospective comparative study including all the cases presenting to the orthopaedic department and fulfilling the inclusion criteria will be taken up for the study centred at District hospital, Tumakuru, Karnataka.

Study population: Patients belonging to both the sexes after the age of 60 years will be the study population.

Sample size: Where, outcome variable = functional outcome Proportion of excellent/good (p) = 0.875 (87.5%) Precision (d) = 0.08 (8%) Z-value for 95% CI = 1.96. Therefore, Sample size (n) = 1.96x1.96x 0.875 (1-0.875) = 65.65 (0.08) 2 Minimum sample required, n = 66.

Study design: This was a time bound, hospital based, prospective study. Cases satisfying the inclusion criteria admitted in District hospital, Tumakuru during the

study period of 2020-2022 was included. The patient was assessed functionally using the Modified Rasmussen criteria and was followed up with for a duration of six months.

Study duration: The duration of the study is of 2 years consisting of follow up period at interval of 2 weeks, 6 weeks, 3rd month and 6th month.

Methods of measurement of outcome of interest: Measurement of functional outcome was done using Modified Rasmussen criteria which is a subjective functional outcome score.

Data collection method: Patient subjected to surgery will be followed up at regular interval with clinical and radiological data. Assessment will be done on based on a proforma.

Data collection forms: All the data pertaining to the research (including the medical history, medication history and physical examination) will be entered in the data collection form in the form of patient information sheet.

Inclusion criteria:

- All closed proximal tibia fractures (Schatzker classification, type 1-4)
- Adult patient aged between 20-60 years.
- Patients of both the sexes

Exclusion criteria

- Fractures more than 1 week old.
- Fractures associated with distal femur fracture and patella fracture
- Patient less than 20 years of age
- Patients who are medically unfit for surgery
- Patients with Uncontrolled diabetes even after insulin therapy
- Pathological fractures secondary to metastasis, osteoporosis, osteomyelitis etc

RESULTS

Age in group:

- In Excellent, the mean Age in group (mean±s.d.) of patients was 30.3125±5.1459
- In Fair, the mean Age in group (mean±s.d.) of patients was 41.0000±2.7689
- In Good, the mean Age in group (mean±s.d.) of patients was 51.0556±2.8589
- In Poor, the mean Age in group (mean±s.d.) of patients was 58.0000±2.0000
- Distribution of mean Age in group with group was statistically significant (p<0.0001)

Rasmussen clinical assessment:

- In Excellent, the mean Rasmussen Clinical Assessment (mean±s.d.) of patients was 25.2188±4.1716
- In Fair, the mean Rasmussen Clinical Assessment (mean±s.d.) of patients was 27.0769±1.7541
- In Good, the mean Rasmussen Clinical Assessment (mean±s.d.) of patients was 26.1667±3.8387
- In Poor, the mean Rasmussen Clinical Assessment (mean±s.d.) of patients was 27.3333±1.1547
- Distribution of mean Rasmussen Clinical Assessment with group was not statistically significant (p = 0.4141)

Rasmussen scan radiology assessment:

- In Excellent, the mean Rasmussen scan radiology assessment (mean±s.d.) of patients was 7.3750±.9070
- In Fair, the mean Rasmussen scan radiology assessment (mean±s.d.) of patients was 7.5385±.5189
- In Good, the mean Rasmussen scan radiology assessment (mean±s.d.) of patients was 7.4444±.9835
- In Poor, the mean Rasmussen scan radiology assessment (mean±s.d.) of patients was 7.6667±.5774
- Distribution of mean Rasmussen scan radiology assessment with group was statistically significant (p = 0.9046)

DISCUSSIONS

The current study was a prospective, time-limited, hospital-based investigation. This study was carried out at the Tumakuru, Karnataka, District Hospital in 2020-2022. This study included 66 patients in total. Hansen *et al*.[8] examined that The main goal of the current study was to compare baseline characteristics between patients who needed TKR within three years of a lateral tibial plateau fracture and patients who did not. An analysis of comparative cohort data, When comparing the two patient group's baseline characteristics, it can be seen that there were more female patients (56.4% vs. 80%), more patients with diabetes (8% vs. 20%), more patients with a higher BMI (25.9 vs. 29.9), more patients with the fracture type AO 41-B1 (8% vs. 80%) and more patients with soft tissue injuries (46% vs. 100%).

Of the 66 patients in our study, 22 (33.3%) were between the ages of 31 and 40. A statistically significant (p = <0.0001) proportion of the patients (53.8%) were 41-50 years of age in the Fair group and 10 (55.6%) were 51-60 years of age in the Good group. Three (100.0%) patients were 51-60 years of age in the Poor group, sixteen (50.0%) patients were 21-30 years

Table 1: Association between with all parameter

	Result					
Surgery	Excellent	Fair	Good	Poor	Total	p-value
ORIF with BP	20	0	0	0	20	<0.0001
Row %	100.0	0.0	0.0	0.0	100.0	
Col %	62.5	0.0	0.0	0.0	30.3	
ORIF with BP and BG	12	13	3	0	28	
Row %	42.9	46.4	10.7	0.0	100.0	
Col %	37.5	100.0	16.7	0.0	42.4	
ORIF with CCS	0	0	15	0	15	
Row %	0.0	0.0	100.0	0.0	100.0	
Col %	0.0	0.0	83.3	0.0	22.7	
PCCS	0	0	0	3	3	
Row %	0.0	0.0	0.0	100.0	100.0	
Col %	0.0	0.0	0.0	100.0	4.5	
TOTAL	32	13	18	3	66	
Row %	48.5	19.7	27.3	4.5	100.0	
Col %	100.0	100.0	100.0	100.0	100.0	
Complication						
Infection	2	1	2	0	5	0.4048
Row %	40.0	20.0	40.0	0.0	100.0	
Col %	33.3	50.0	66.7	0.0	41.7	
Knee Stiffness						
Row %						
Col %	3,75.0,50.0	0, 0.0, 0.0	1, 25.0, 33.3	0, 0.0, 0.0	4, 100.0, 33.3	
Varus1	1	0	1	3		
Row %	33.3	33.3	0.0	33.3	100.0	
Col %	16.7	50.0	0.0	100.0	25.0	

Table 2: Distribution with All Parameter with group

Age group	NO.	Mean	SD	Min	Max	Median	p-value
Excellent	32	30.3125	5.1459	21.000	38.000	30.500	<0.0001
Fair	13	41.0000	2.7689	38.000	45.000	41.000	
Good	18	51.0556	2.8589	46.000	55.000	51.000	
Poor	3	58.0000	2.0000	56.000	60.000	58.000	
Rasmussen clinical assessment							
Excellent	32	25.2188	4.1716	10.000	29.000	26.500	0.4141
Fair	13	27.0769	1.7541	23.000	29.000	27.000	
Good	18	26.1667	3.8387	15.000	29.000	28.000	
Poor	3	27.3333	1.1547	26.000	28.000	28.000	
Rasmussen scan radiology assessment							
Excellent	32	7.3750	.9070	6.00	9.00	8.00	0.9046
Fair	13	7.5385	.5189	7.00	8.00	8.00	
Good	18	7.4444	.9835	6.00	9.00	8.00	
Poor	3	7.6667	.5774	7.00	8.00	8.00	

of age and sixteen (50.0%) patients were 31-40 years of age in the Excellent group. the mean Age was higher in [58.0000±2.0000] Poor group compared to [51.0556±2.8589] good group, [41.0000±2.7689] Fair group and [30.3125±5.1459] Excellent group which was statistically significant (p<0.0001).

The population of men [51(77.3%)] was found to be higher than the population of women [15(22.7%)]. however (p = 0.2971), this was not statistically significant. Vasanad *et al*.[5] showed that Increases in the quantity and severity of fractures have coincided with advances in mechanization and travel acceleration the tibial plateau is not an exception. The indicated fractures were treated using CRIF, external fixators, percutaneous cannulated cancellous screws, ORIF with a buttress plate and either bone grafting or not, and other methods according to the Schatzker's types. Early range of motion began immediately following the procedure. No lifting weight for six to eight weeks. Deferred until 12 weeks or until the fracture heals completely. POP cast immobilization was maintained for three to six weeks in cases of insecurely fixed fractures. We observed that, most of the patients had RTA in Good group [18 (100.0%], Fair group [13(100.0%)], Poor group [3 (100.0%)] compared to [14 (43.8%)] Excellent group which was statistically significant (p = 0.0018). Robertson *et al*.[10] found that to conduct a systematic review of all research on the return to sport after tibial plateau fracture in order to gather data on the rates and duration of return to sport as well as evaluate the differences in athletic outcomes between treatment modalities. For the entire cohort, 70% of them returned to sports. The return rate for the fractures that were treated conservatively was 100%. The return rate for fractures treated surgically was 70%. The return rate for fractures treated with ORIF was 60%. The return rate for fractures treated with ARIF was 83%. 52% of fractures were treated with FRAME. It was discovered that the return rate for ARIF was significantly higher than the return rates for FRAME (OR 4.33, 95%CI: 2.89-6.50, p<0.001) and ORIF (OR 3.22, 95%CI: 2.09-4.97, p<0.001). The return rates for FRAME and ORIF did not differ from one another (OR 1.35, 95%CI: 0.92- 1.96, p = 0.122).

Le Baron *et al*.[11] showed that The development of minimally invasive techniques to treat tibial plateau fracture has been made possible by arthroscopy.

38±23 months (24-90 months) were spent monitoring 317 patients (317 fractures), aged 48±14 years (range, 18-82 years), with 77 fractures (24%) in the ARIF group and 240 (76%) of the group ORIF. Clinical analysis revealed no significant inter-group differences for Lysholm and IKDC scores, active flexion, passive or active extension, or HSS (ARIF: 74±29, ORIF: 70±31, p<0.01) but there were significant differences for passive flexion (ARIF: 130±19° (range, 80-160°), ORIF: 130±15.965° (range, 60-140°), p<0.05) and HSS (ARIF: 74±29 ORIF: 70±31, p<0.01). Regarding radiology, there were no noteworthy variations between the groups in terms of reduction quality, lower-limb mechanical axis, or osteoarthritis symptoms.

Our study showed that, higher number of patients had ORIF with BP and BG [13 (100.0%)] in Fair group and [3 (100.0%)] poor group compared to [15 (83.3%)] good group and [20 (62.5%)] Excellent group which was statistically significant (p<0.0001). Rohra *et al*.[12] found that high energy intra-articular fractures involving the tibial plateau causes various problems related to management like wound dehiscence, severe comminution leading to misalignment and delayed complications like varus collapse, implant failure and arthritis of knee joint This study was done to determine functional, radiological outcome and the complications of Schatzker V and VI tibial plateau fractures treated with bipillar plating with dual plates with a regular follow-up of at least 3 years.

From our study, more number of patients had [1(100.0%)] Varus in Poor group compared to [2(66.7%)] good group, [3(50.0%)] Excellent group, and [1 (50.0%)] Fair group but this was not statistically significant (p = 0.4048). Cho *et al*.[13] examined that This study set out to assess the efficacy of a midline longitudinal incision and dual-plate fixation in the treatment of Schatzker type V and VI tibial plateau fractures. An analysis was conducted on ten patients who underwent dual plating and a midline longitudinal incision for treatment of Schatzker type V and VI tibial plateau fractures. The patients underwent at least a year of follow-up. Range of motion, the visual analogue scale (VAS) and the Knee Society Score were used to assess clinical outcomes. The medial proximal tibial angle (MPTA), posterior proximal tibial angle (PPTA), and bony union time were used to assess radiological outcomes.

Lee *et al*.[14] observed that tibial plateau fracture (TPF) includes different fracture patterns with varied degrees of articular depression and displacement. Many kinds of fixators, including newly designed plate with locking screws, were applied to treat these complicated fractures. We intended to follow up the surgical outcomes of unilateral locking plate, (2) classic dual plates, or (3) hybrid dual plates for TPF. We retrospectively reviewed 76 patients with TPF, Schatzker types V and VI, who we operated from June 2006 to May 2009 in our institute.

Khatri *et al*.[15] found that to report issues with the way complicated closed proximal tibial fractures are managed. The infectious and non-infectious complications that arose during the treatment of high-energy Schatzker type V and VI tibial plateau fractures were examined in a retrospective study. The level 1 trauma center saw all patients from January 2011 to March 2014. The study included sixty-two patients. There were 60 male patients and 2 female patients, with a mean age of 43.16±11.59 years. During the immediate postoperative period and the follow-up period, infectious complications such as deep and superficial infection, wound dehiscence, and misalignment were observed.

We found that, the mean Non-weight-bearing (weeks) higher in [5.3846±.9608] Fair group compared to [5.3333±1.1547] Poor group, [5.0313±1.1496] Excellent group and [4.8889±1.0226] good group and it was not statistically significant (p = 0.6126). It was found that, the mean Rasmussen scan Clinical Assessment was lower in [25.2188±4.1716] Excellent group compared to [26.1667±3.8387] good group, [27.0769±1.7541] Fair group and [27.3333±1.1547] Poor group which was not statistically significant (p = 0.4141).

We observed that, the mean Rasmussen scan radiology assessment was less in [7.3750±.9070] Excellent group compared to [7.4444±.9835] good group, [7.5385±.5189] Fair group and [7.6667±.5774] Poor group but this was not statistically significant (p = 0.9046). Pereira *et al*.[16] showed that After high-energy traumas, both tibial plateaus can fracture. The tibial tubercle may occasionally be compromised by a fracture. Infections weren't present. Knee range of motion was 120º flexion (90º-140º) and 10º extension (0º–20º). In one instance, the osteosynthesis material needed to be taken out. For the treatment of a meniscal injury, one patient needed an arthroscopy. One tibial tubercle fragment was visible in 20.8% of all fractures in both tibial plateaus in our series. Fixing this fragment using 3.5-mm screws or a 1/3 tubular plate is a good way to ensure that it is stabilized enough.

Our study showed that, the mean Knee ROM was not significantly higher in [100.0000±12.9099] Fair group compared to [96.6667±21.9625] good group, [96.6667±15.2753] Poor group and [86.4063±25.9725] Excellent group (p = 0.2222). From our study, higher number of patients had Varus Schatzker type 3 [2 (66.7%)] in Poor group compared to [6 (46.2%)] Fair group, [8 (44.4%)] good group and [13 (40.6%)] Excellent group but this was not statistically significant (p = 0.8860).

CONCLUSION

Of the 66 patients in our study, the majority were between the ages of 31 and 40. Age did not significantly affect the outcome statistically. We

discovered that there were more men than women in the population, and the ratio of men to women was 3.4:1. It was discovered that there were more patients with left lateralization in the poor group than in the good, fair, or excellent groups, though this difference was not statistically significant. Our study showed that, higher number of patients had ORIF with BP and BG in Fair group and poor group compared to good group and excellent group which was statistically significant. From our study, more number of patients had Varus in Poor group compared to good group, excellent group, and Fair group but this was not statistically significant. We found that the mean Non-weight-bearing (weeks) higher in Fair group compared to Poor group, Excellent group and good group and it was not statistically significant and the mean Rasmussen scan Clinical Assessment was lower in Excellent group compared to good group, Fair group and Poor group which was not statistically significant. We found that the Excellent group's mean Rasmussen scan radiology assessment was lower than that of the Good group. The mean knee range of motion (ROM) was not statistically significantly higher in the Fair group when compared to the Good, Poor and Excellent groups. However, there was a difference between the Fair group and the Poor group. From our study, higher number of patients had Varus Schatzker type 3 in Poor group compared to Fair group, good group and excellent group but this was not statistically significant.

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