

## Functional and Radiological Outcomes after Operative Intervention for Tibial Plateau Fractures.

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### ABSTRACT

**Background:** Outcomes and complications following surgical treatment of tibial plateau fractures have been widely reported. Objective of the study was to evaluate the functional and radiological outcomes and to what extent surgical treatment can achieve optimal knee function. **Methods:** This is a prospective study and retrospective review of patients treated with standard surgical principles and approaches for tibial plateau fractures between 2014 & 2016. Patients completed 7 months followup period and evaluated clinically and radiologically with modified Rasmussen's criteria. **Results:** 30 patients were operated as per the SCHATZKER'S types with CRIF/ORIF with percutaneous cannulated cancellous screws, ORIF with buttress plate, locking plates with or without bone grafting. The knee range of motion was excellent to very good, gait and weight bearing after complete union was satisfactory. 7 cases gave excellent results, 12 cases came out with good results, and fair in 9 cases and 2 cases had poor results due to severity of injury and nonunion in none of our cases, with mean radiological and clinical rasmussen's score of 6.8 & 24.43 respectively. **Conclusion:** Surgical management of tibial plateau fractures will give excellent anatomical reduction and rigid fixation to restore articular congruity, facilitate early motion and reducing post traumatic OA and hence to achieve optimal knee function and patient satisfaction.

**Keywords:** Tibial plateau, Buttress plate, rasmussen's criteria, bone grafting, schatzker types.

### INTRODUCTION

The incidence of tibial plateau fractures 10.3 per 1000000 population, Conservative management is not often feasible so the majority of the fractures are treated operatively. The objective of surgical treatment is joint reconstruction, rigid fixation, and axial alignment. In general the complication rate after tibial plateau fractures is high such as infection deep and superficial, soft tissue damage, DVT, leading to failure of surgical procedure. Objective of this study was to evaluate the functional and clinical outcomes after surgical fixation of tibial plateau with standard approaches, principles and careful preoperative templating.

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### MATERIALS AND METHODS

All patients treated surgically for tibial plateau fractures between 2014 & 2016 at Chalmeda anand Rao institute of medical sciences, Karimnagar Included patients were

1. Closed Tibial plateau fractures as per Schatzker's classification Type I – Type V
2. Age group 20-70 years of both sexes.

Excluded were

1. Open fractures
2. Patients with other fractures in the same extremity
3. Medically unfit for surgery.

#### Study Design

Prospective study for retrospective review and followup. Clinical and radiological outcomes were studied in all patients at followup. The base line characteristics consisted of patient demographic and fracture classification, complication and additional damage. Post-surgical followup

consisted of functional, radiological, clinical outcomes.

**Table 1: demographic patient data.**

Patients, total, N 30  
 Male/ Female, N 24/6  
 Age, surgery, yrs mean (range) 35.86 (30-60)  
**Schatzker classification** \*n  
 Type I 10  
 Type II 6  
 Type III 1  
 Type IV 5  
 Type V 8  
 Associated injury, n 0

**Operative Procedure**

During the study period the department standard guidelines on treatment of tibial plateau fractures as mentioned in [Table 2] with 4 experienced trauma surgeons performed all of the procedures. The choice of surgical procedure and the use of bone grafting were at the discretion of individual surgeons.

**Table 2: Treatment.**

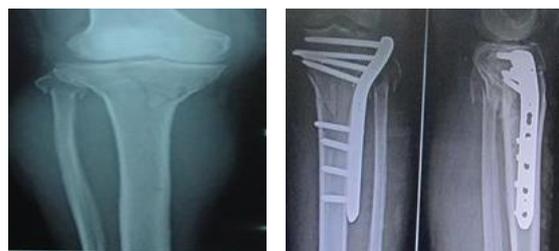
Treatment	Number of patients	Percentage
Percutaneous C.C screw	6 ( Type I)	20
ORIF with CCS	8 ( Type I & II )	26.67
ORIF with Buttress Plating	13 ( Type II , IV & V)	43.33
ORIF with Buttress plating and Bone grafting	2 ( Type II,III)	6.67
ORIF with CCS with Bone Grafting	1 ( Type II )	3.33
Total	30	100

In present study, majority of cases treated with ORIF with buttress plating of Type II fractures followed by ORIF with CC screw fixation of type I fractures.as mentioned in [Table 2].

After careful preoperative templating drawing fracture line and landmarks on the patient. Incisions were given as per the type of fracture orientation of percutaneous, minimal approaches like anterolateral & posteromedial incisions. For percutaneous lateral and central incisions over the knee given, periosteum elevated and canal was drilled with 11mm cannulated reamer and 7.3mm screws were introduced from lateral side under C-ARM guidance. For plating procedures incisions given through anterolateral and posteromedial for minimal invasive locking and buttress plates. Bone autograft chips were prepared from ipsilateral iliac crest. Autograft chips were introduced and stamped into place between fractures under C-ARM guidance. All patients were immobilised in a stable knee brace with ability to control range of motion. They started physiotherapy the first day after surgery by attending a post-operative rehabilitation protocol. patients were kept non-weight bearing for six weeks.



**Figure 1: Picture showing Anterolateral approach, Figure 2: Fixation with Locking compression plate**



Pre operative

Post operative

**Outcome Measurements**

**Radiological Outcomes:** Fracture classification was performed according to SCHATZKER classification. The fractures were assessed preoperatively using CT. Scanning Articular depression and condylar widening were evaluated using x rays as described by Rasmussen. For this assessment one x ray was taken six weeks post-operatively and another was taken at the time of follow up. Valgus/Varus malalignment was evaluated as described by Browner et al. A Valgus/varus malalignment >5° was considered significant. At follow-up, the X-rays were obtained as bilateral weight-bearing X-rays.

**Table 3: Radiographic assessment using modified RASMUSSEN's criteria.**

Articular depression	Points
None	3
<5 mm	2
6-10 mm	1
>10 mm	0
Condylar widening	
None	3
<5 mm	2
6-10 mm	1
>10 mm	0
Varus/valgus angulation	
None	3
<10°	2
10-20°	1
>20°	0
Osteoarthritis	
None/no progress	1
Progression by 1 grade	0
Progression by >1 grade	-1
Maximum score	
Excellent	9-10
Good	7-8
Fair	5-6
Poor	<5

Patient-Reported Outcome Measurements

**Table 4: Clinical assessment was done using Modified Rasmussen criteria**

Pain	Points
None	6
Occasional	5
Stabbing pain in certain positions	3
Constant pain after activity	1
Significant rest pain	-3
Walking capacity	
Normal walking capacity for age	6
Walking outdoors (>1 h)	5
Walking outdoors (15 min-1 h)	3
Walking outdoors (<15 min)	1
Walking indoors only	0
Wheelchair/bedridden	-3
Knee extension	
Normal	4
Lack of extension (<10°)	2
Lack of extension (>10°)	0
Lack of extension (>20°)	-2
Total range of motion	
Full	6
At least 120°	5
At least 90°	3
At least 60°	1
<60°	-3
Stability	
Normal stability in extension and 20° flexion	6
Abnormal stability in 20° flexion	4
Instability in extension (<10°)	2
Instability in extension (>10°)	0
Power of quadriceps	
Grade 5	2
Grade 3-4	1
Grade <3	0
Maximum score	30
Excellent	28-30
Good	24-27
Fair	20-23
Poor	<20

**Objective Outcome Measurements**

Knee range of motion(ROM)was evaluated using active extension and flexion of the knee with patient lying supine on the examination table.patients were asked to do maximal flexion and extension and the angle was measured with goniometer.

**RESULTS**

A total of 30 patients were enrolled in this study. The mean age at the time of surgery was 35.86.The mean follow up time was 7 months.

**Radiological Outcomes**

Post-operatively 28 patients achieved anatomical joint reduction and alignment. At the time of follow-up anatomical joint reduction and alignment achieved in 23 cases .At follow up one case presented with Varus deformity>50.mean Rasmussen functional and radiological score was 24.43 and 6.8. Respectively

**Objective Outcomes**

Mean knee flexion range was 120with a range of 115-1400.The mean movement deficit was 10.00and five patients were presented with knee stiffness in the initial follow up period and were improved after physiotherapy and monthly follow up.



**Preoperative x-ray & Postoperative x-ray**



**Post operative range of motion(Flexion)**



**Post operative range motion(Extension)**

**Table 5: Clinical and Radiographical results**

Clinical results	Number of patients	Percentage
Excellent	7	23.33
Good	12	40
Fair	9	30
Poor	2	6.67
Total	30	100

**Table 6: Patient Reported Outcomes**

Complications	Number of patients	Percentage
Infection and wound dehiscence	3	10
Varus deformity	1	3.33
Knee stiffness	5	16.67
Normal	21	70
Total	30	100

All fractures united within expected time except 3 patients with infection, not a single case of non-union was noted in our series.

**DISCUSSION**

In present study, the indications for the surgery were the same standard indications as for the tibial plateau fractures. 3 mm depression was considered as an indication for surgery in our series.

In present study, the majority of the fractures were found to be of type I (33.33%) and type V fractures (26.67%). Lateral condylar and bicondylar fractures we found to be more common than medial condylar fractures. Marwah V et al.9 and Ruslan GS et al.[10] stated the same in their studies. [Table 6] We didn't have any type VI fracture.

**Table 6:**

Studies	Commonest type of fractures
Marwah V et al. <sup>[9]</sup> and Ruslan GS et al. <sup>[10]</sup>	Schatzker type I (35%)
Present study	Schatzker type I (33.33%)

Lee et al. demonstrated results with no loss of reduction, nonunion and infection developing in only 5% of patients in his comparison. Cole et al.<sup>[11]</sup> demonstrated 4%. In Ricci et al.<sup>[12]</sup> study, [Table 7] no complications noted. Present study showed 30% of complications with knee stiffness in 16.67%, infection in 10%, Varus deformity in 3.33%.

**Table 7:**

Studies	Complication
Lee et al.	5%
Cole et al. <sup>[11]</sup>	4%
Ricci et al. <sup>[12]</sup>	0%
Present study	30%

In present series we have not formulated any criteria as to particular method of fixation for particular type of fracture. So each case was individualized and treated accordingly as it needed. Six cases in which five type I were treated with percutaneous cancellous screw fixation. The split fracture, of >3 mm displacement was treated by ORIF. Bone grafting was included along with ORIF with buttress plate and screw in type II and III wherever necessary.

The period of immobilization was standardization to 4 weeks for all type of fracture. We also found that good range of movement at the knee was achieved in cases where knee mobilization was started early. Early movements were possible in cases where congruous articular surface and rigid fixation was achieved. Delay in mobilization resulted in periarticular scarring and loss of movements. Thus in our study a direct relationship between congruous articular surface, early physiotherapy and resultant range of motion at the knee was found.

The major problem faced by us during the study was knee stiffness and infection, table no: 8 stiffness was due to prolonged immobilisation. The infection might be attributed to nosocomial infection.

**Table 8:**

Complication	Percentage
Knee stiffness	16.67%
Infection	10%
Varus deformity	3.33%

Lachiewicz and Thomas<sup>13</sup> had stated that patients immobilized for > 3 wks had mean range of movements 14° less than those immobilized for shorter periods. Rasmussen and Drennan et al.<sup>[14]</sup> [Table 9] considered 6 wks to be upper limit of knee mobilization for restoring normal range of movements. In our study patients mobilized after 6 weeks had fair range of movements between 70 and 110°.

**Table 9:**

Studies	Immobilization period after surgery
Lachiewicz and Thomas <sup>13</sup>	>3 weeks mean range
Rasmussen and Drennan et al. <sup>14</sup>	6 weeks post operatively normal range of movements
Present study	Fair range of movements after 6 weeks

In spite of all these associated bony fractures, ligament injuries and complication, we are able to achieve 23.33% excellent result, 40% good result (overall 63.33% acceptable result) with our standard surgical methods. In addition we have 30% fair and 6.67% poor result in terms of functional outcome. These results are comparable and on par with other documented standard studies like Hitin Mathur et al.<sup>[15]</sup> who had 36.67% excellent and 53% good functional results with only 3 patients having unacceptable results.

The mean Rasmussen's functional score was 24.43 and mean Rasmussen radiological score was 6.8 which correlated well with the study of Hitin Mathur et al.<sup>[15]</sup> [Table 10] with mean Rasmussen's functional score of 25.062 and mean radiological score of 7.3. Moreover, clinical evaluation did not correlate with the follow up radiographs.

**Table 10:**

	Functional score	Radiological score
Hitin Mathur et al. <sup>[15]</sup>	25.062	7.3
Present study	24.43	6.8

We have employed conventional techniques though we had satisfactory results with the standard conventional methods. Probably, if we were less invasive at surgery, still more rigid in fixation and further aggressive in physiotherapy, we would not even have had these complications (stiffness & infection) and at the same time would have achieved these goals much earlier.

Number and percentage of cases, with various Schatzkar type of fracture, reported in various studies as been compared with our present study tabulated in [Table 11]

**Table 11: Schatzkar type of fracture reported in various studies.**

Type of fracture (Schatzkar classification) <sup>[3]</sup>	Schatzkar et al. <sup>[5]</sup>	Albuquerque et al. <sup>[6]</sup>	Manidakis et al. <sup>[7]</sup>	Present study
lateral plateau fracture without depression (I)	4 (6)	20(8.4)	31(24.8)	10 (33.33%)
lateral plateau fracture with	18 (25)	84(35.1)	42(33.6)	6 (20%)

depression (II)				
compression fracture of the lateral/central plateau (III)	25 (36)	21(8.8)	21(16.8)	1 (3.33%)
medial plateau fracture (IV)	7 (10)	28(11.7)	9(7.2)	5 (16.67%)
bicondylar plateau fracture (V)	2 (3)	38(15.9)	6(4.8)	8 (26.67%)
plateau fracture with diaphyseal discontinuity (VI)	14 (20)	48(20.1)	16(12.8)	0%
Total	70	239	125	30

### CONCLUSION

Surgical treatment when indicated is advantageous to get a stable knee. The surgical management of tibial plateau fractures is challenging and gives excellent anatomical reduction and rigid fixation to restore articular congruity, facilitate early knee motion and reducing post traumatic osteoarthritis and thus achieving optimal knee function with careful preoperative templating and following standard principles and approaches and timely follow up.

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