

## Original Research Article

# A prospective study of surgical management of dual plating of bicondylar tibial plateau fracture

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## ABSTRACT

**Background:** Tibial condyles with their articular surface forms major part of the knee joint, plays an important role in weight transmission and mobility. The proximal tibia fractures account for 1% of all the fractures. If these high velocity intra/peri articular fractures are not treated properly there will be high degree incidences of malunion, non-union, peri-op infections vs collapse of the medial condyle, ligamentous instability, malalignment of the axis, articular incongruity leading to post traumatic arthritis. Aim was to assess the anatomical reduction of articular surface of upper end of tibia and knee joint perfectly by operative treatment with internal fixation.

**Methods:** The study was done for a period of 1 years on 30 patients with bicondylar tibial plateau fractures diagnosed with Schatzker type V and VI. Age ranged from 20-60 years with majority being in 30-39 years range with a largely male preponderance. Patients were followed up to 12 months.

**Results:** Our study reported Honkonen Jarvinen clinical outcome to be 86% excellent, 11.7% good and 1.7% fair. The functional outcome was 81% excellent, 13% good, 5% fair and 1% poor. The Radiological outcome showed 79.2% excellent, 12% good, 0.70% fair results. Our study used Honkonen Jarvinen criteria for radiological, functional, clinical outcome which showed excellent to good result.

**Conclusions:** Dual plating is ideal for all bicondylar Tibial plateau fracture of Schatzker type V and VI with appropriate timing of surgery and understanding the anatomy, LCP system, appropriate technique with dual incision, the complication can be minimized, giving excellent to good results.

**Keywords:** Tibial plateau fracture, Internal fixation, Schatzker type

## INTRODUCTION

Tibial condyles with their articular surface forms major part of the knee joint, plays an important role in weight transmission and mobility. The proximal tibia fractures account for 1% of all the fractures, with increase in high velocity traffic accidents the incidence of proximal tibia fractures is also increasing.<sup>1</sup> The goal of treating these bicondylar tibial plateau fractures is to bring back the functional mobility to pre injury status. Hence near anatomical reduction of articular surface, maintenance of

mechanical axis and anatomical alignment has to be achieved with stable fixation and early mobilization.<sup>2</sup> If these high velocity intra/peri articular fractures are not treated properly there will be high degree incidences of malunion, non-union, peri-op infections, varus collapse of the medial condyle, ligamentous instability, malalignment of the axis, articular incongruity leading to post traumatic arthritis. If these bicondylar tibial fractures treated with single plate and lag screw there is high chance of varus collapse, loss of reduction and malunion. Hence a need for fixing both the condyles using separate plate has been

advocated, although locked plates have answered the medial collapse problems and locking plates are efficient in holding back coronal fragments. Our study is done to know the clinical outcome of intra and extra articular fracture of distal end of radius treated with open reduction and internal fixation by plating through a volar approach and to study the complications associated with this treatment modality.

## **METHODS**

This study is a clinical observational and prospective study conducted at Department of Orthopaedics at Great eastern medical school and hospital from January 2018 to January 2019. Informed consent was obtained for all the patients in study.

### ***Inclusion criteria***

Inclusion criteria were all skeletal mature patients with proximal tibia fracture schatzker type V and VI (>18 years), AO Muller type 41-C1, 41-C2, 41-C3 and Gustilo-Anderson type I and II compound proximal tibial fractures patients willing to participate in study.

### ***Exclusion criteria***

Exclusion criteria were tibialunicondylar plateau fractures {type I, II, III, IV type of Schatzker classification}, patients with Gustilo - Anderson Type 3 compound proximal tibial fractures, skeletally immature patients, patients with pathological proximal tibial fractures apart from osteoporosis and delayed presentation of fractures more than 2 weeks.

On admission, demographic data was recorded and a thorough history was taken to assess mode of injury and associated co-morbidities. General systematic and local examination were done to assess other associated injuries and open wounds followed by radiological evaluation in AP and lateral views.

Once the diagnosis is confirmed and patient notified about the fracture and need for surgery. His consent is taken and pre op planning done.

Patients were received in the casualty and initially stabilised. Then intramuscular analgesics were given. The injured lower limb was immobilized in an above knee splint and anteroposterior, lateral, oblique X-rays (if required) were taken. Then with minimal traction an above knee slab was applied. Distally the slab was slit open for checking distal pulses. Three-dimension computed tomography was done to assess the fracture pattern. If required calcaneal pin traction was applied for soft tissue injury to heal. Adequate time was given for soft tissue to heal around (5–14 days). Clinical signs of soft tissue recovery included decreased swelling, absence of fracture blisters, wrinkling of skin around proximal tibia.

Complete blood count, ECG, blood urea and serum creatinine, FBS, HBA1C, HIV and HBSAG profiles, blood grouping was done ECG, 2D-ECHO Where necessary, were taken. Selection of appropriate sizes of LCP plates, posterior medial and medial plates and screws, with their corresponding instruments. Appropriate antibiotics and pre-anaesthetic medications were given.

**Surgical procedure:** Preoperatively IV antibiotics Inj cefepazone 1g and sulbactam 500 mg were given after test dose as prophylaxis. The patient in supine position with folded pillow under knee and a sand bag under ipsilateral gluteal region for anterolateral approach and a sand bag under contralateral hip with figure of four position of ipsilateral leg for posteromedial approach. First indirect fracture reduction was achieved with longitudinal traction, under C-arm guidance. Percutaneous K wires were used to hold the fragments in reduction. We typically fix medial tibial condyle first. If medial condyle is comminuted, we fix lateral condyle to achieve length. Through posteromedial approach to proximal tibia with approximately 6 cm incision over posteromedial border of proximal tibia. After opening subcutaneous fat, the long saphenous vein and saphenous nerve identified and preserved. Pes anserinus expansions identified. Tibia approached after incising pes anserinus longitudinally in the line of skin incision. The gastronemius muscle was gently freed from posteromedial surface by blunt dissection. The fracture fragments visualized, reduced under c arm guidance. If there was articular depression a bone punch was used to elevate the depressed portion and the void was filled with bone graft. The reduced fragments were fixed with 3.5 mm proximal tibia posterior medial locking plate. The lateral condyle fracture was approached antero laterally. "S" shaped incision was made starting 5 cm proximal to joint line curving the incision anteriorly over gerdy's tubercle and extend it distally 1cm lateral to anterior border of tibia. Joint capsule was incised. Tibialis anterior was elevated by blunt dissection. Under C arm guidance, fracture reduced and fixed with proximal tibia lateral locking compression plate. If depression was present in articular surface, elevation followed by bone grafting was done if necessary. A drain was kept for both wounds with help of Y connector.

### ***Post-operative protocol***

Well-padded sterile dressing was done. Knee was not immobilized. Drain was removed on 48 hrs. Post-operative period. Active knee mobilization was encouraged as much as the patient could tolerate. Suture removal was done on 12th post-operative day with advice to follow up for next 6 months. Patient was discharged with non-weight bearing crutch walking.

### ***Follow up***

Patient was reviewed in outpatient department every 4 weeks and X-rays were taken every month for first 6 months to assess union Partial weight bearing was started

after 8 weeks. Full weight bearing was allowed after radiological evidence of bony union was achieved. At every follow up, operative site was examined for wound dehiscence and radiological evaluation was done to assess fracture union and any loss of reduction and implant related failure After 6 months patients were reviewed every 2 months. Knee function was assessed and scored according to

**Sample size estimation**

Total no of cases studied were 30

Sample size =  $Z_{\alpha/2} \times P(1-P) / d$   $Z_{\alpha/2}$  = std normal variate at 95% 1.96 P=prevalence d=absolute error eg: Prevalence of tibia fractures=1%

5% error  $3.8416 \times 0.01 \times 0.99 = 0.038032 = 15.00025$

Minimum sample size required is 15. 30 cases have been selected for this study

Data were collected and saved in MS Excel spreadsheet & analysed by suitable SPSS software. An unpaired Student's t-test was used to test the significance of means of all qualitative parameters. Categorical parameters analysed by chi- square tests.

**RESULTS**

This study included 30 patients with tibial plateau fractures diagnosed with Schatzker type V and VI. Most of the patients in our study are males in the age group of 30-40 years.

**Table 1: Demographic distribution in study.**

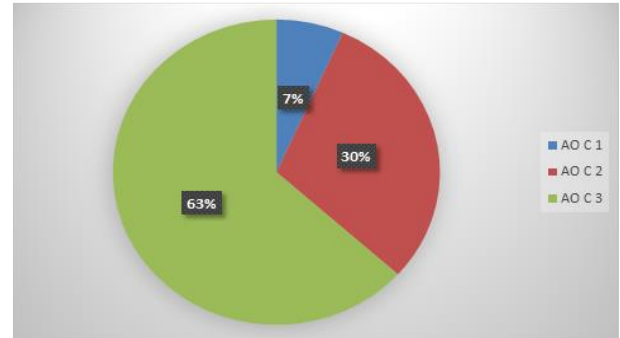
Age (In Yrs.)	Frequency	Percentage
20-29	4	13.3
30-39	14	46.7
40-49	7	23.3
50-59	5	16.7
Total	30	100.0
<b>Gender</b>		
Male	22	73
Female	8	27
<b>Side</b>		
Right	9	30
Left	21	70
<b>Fracture type</b>		
Type V	11	36.6
Type VI	19	63.3

From the above data it shows that type V and VI tibial plateau fracture is common in age group of 30-39 yrs. of age group. Most of the fractures on the left side compared to right side.

**Table 2: RTA vs. FALL.**

Mode of injury	RTA	Fall from height
20-29	6	0
30-39	14	0
40-49	7	0
50-59	2	1

Most common mode of injury was RTA, most common among males in the age group of the 30-39 years of age group.



**Figure 1: Incidence according to AO classification.**

**Table 3: Honkonen Jarvinen criteria (1992) clinical outcome criteria.**

<b>Extension lag 0 degrees</b>	1	None	
	2	1-5	
	3	6-10	
	4	>10	
<b>Flexion Range (degrees)</b>	1	>130.	
	2	110 - 129°	
	3	90 -109°	
	4	>90°	
<b>Thigh Atrophy (cm)</b>	1	None	
	2	>0 to 1	
	3	>1 to 3	
	4	>3	
<b>Stability mediolat</b>	1	Normal	
	2	Mediolateral	Stable in extension Instability in flexion
		Anteroposterior-Grade 1 instability (Lachman or drawer test )	
	3	3° to 10° instability in extension.	
Anteroposterior-Grade 2 instability			
4	Mediolateral>10° instability		
	Anteroposterior-grade 3 instability		

Time of surgery: the average period from day of injury to surgery was 5.3 days with a range between 3 to 9 days.

Most common complication is knee stiffness among 4 patients which was overcome with strict physiotherapy regimen, two patients had superficial wound infection which was given treated with wound debridement and antibiotic prophylaxis according to culture sensitivity. One patient had skin necrosis, split skin grafting was done. Which improved with regular saline dressing.

Table to be added table 9: components of clinical outcome criteria. Honkonen Jarvinen criteria was used for evaluating clinical, functional and Radiographic results HJ clinical outcome.

None of the patients had extension lag. The average knee flexion was 125.9° with range from 95° to 135°. The reason for fair range of motion in two patients was poor adherence to physiotherapy.

**Table 4: Functional and radiological outcome criteria.**

Functional outcome criteria	1	2	3	4
<b>Walking</b>	Normal	Slight limp	Severe limp or stick	Wheel chair
<b>Stair climbing</b>	Normal	Impaired	One at a time	Unable
<b>Squatting</b>	Normal	Impaired	< 90°	Unable
<b>Jumping</b>	Normal	Impaired	Only with aid of uninjured leg	Unable
<b>Duck walking</b>	Normal	A few steps	One step	Unable
<b>Radiological outcome criteria</b>				
<b>Plateau tilting (degrees)</b>	None	1-5	6-10	>10
<b>Varus/Valgus tilt</b>	None	1-5	6-10	>10
<b>Articular step off ( mm)</b>	None	1-3	4-6	>6
<b>Condylar widening (mm)</b>	None	1-5	6-10	>10
<b>Degeneration (relative narrowing of joint space )</b>	None	< 50%	> 50%	Obliterated

**Table 5: Clinical and functional outcome results.**

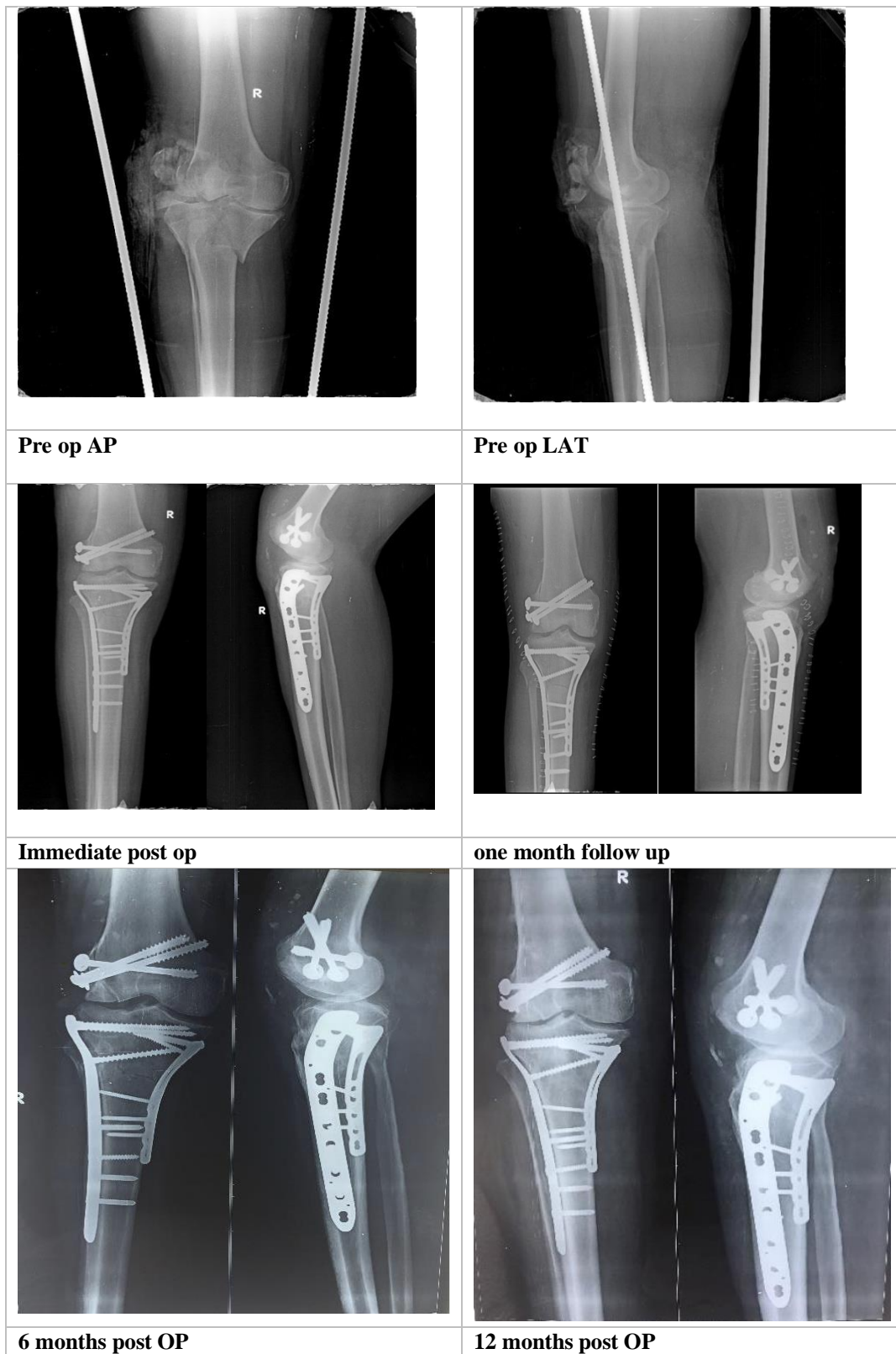
Clinical outcome results	Excellent	Good	Fair	Poor
	N (%)	N (%)	N (%)	N (%)
<b>Extension lag</b>	30 (100)	-	-	-
<b>Knee flexion</b>	20 (66.6)	8 (26.6)	2 (6.6)	-
<b>Thigh atrophy</b>	27 (90)	3 (10)	-	-
<b>Instability</b>	27 (90)	3 (10)	-	-
<b>Mean%</b>	86.7	11.7	1.7	
<b>Functional outcome Results</b>				
<b>Walking</b>	26 (100)	-	-	-
<b>Stair climbing</b>	28 (93.3)	2 (6.6)	-	-
<b>Squatting</b>	23 (76.6)	7 (23.3)	-	-
<b>Jumping</b>	20 (66.6)	6 (20)	3 (10)	1 (3.3)
<b>Duck walking</b>	20 (66.6)	5 (16.6)	4 (13.3)	1 (3.3)
<b>Mean%</b>	81	13	5	1

The average thigh atrophy was 0.09 cm with range from 0–1 cm. There was grade I antero posterior instability in 4 patients

All 30 patients were able to walk excellent. 28 patients had excellent stair climbing function but it was impaired in 2 patients due to pain. 23 patients were able to squat well while it was impaired in 7 patients due to pain. 20 patients were able to jump normally and it was impaired due to pain in 6 patients. 3 patients were able to jump only with the aid of an injured leg. 1 patient was not able to jump. 20 patients were able to duck walk normally and 5 patients

were able to keep only a few steps. 4 patients were able to keep only one step 1 patient was unable to do. Graph to be added graph 8: functional outcome results

HJ Radiological outcome 26 patients scored excellent and 4 patients had scored well with <5° plateau tilt compared to opposite side. All 30 patients had excellent results with no varus /valgus tilt. 22 patients did not have any articular step off. 8 patients had 1-3 mm articular step. 21 patients had no condylar widening. 9 patients had condylar widening of 1-5 mm. 20 patients did not have any joint space narrowing, 10 patients had 50% joint space narrowing.



**Figure 2: Radiological photographs case no 1 clinical and radiological pictures.**

## DISCUSSION

High energy intra-articular fractures involving the tibial plateau still remain a challenge to orthopaedic surgeons. Road traffic accident is the most common cause of these

fractures. In order to reconstruct the stable and painless mobile knee, still needs an expertise and sufficient technical knowledge. These fractures still are challenge for reduction in order to maintain the articular congruity, prevent varus collapse, and prevent the early onset of the

secondary osteoarthritis in these complex tibial plateau fractures. Operative treatment remains the optimum treatment for early mobilization, various methods of fixation have been described like external fixation, hybrid fixator, plating through a single midline incision, plating using Mercedes Benz incision. Historically using a poor technique to fix these high-velocity fractures using dual plates fixation using the single incision like Mercedes Benz incision is associated with the many complications this has led to Ilizarov, hybrid external fixator system being employed to treat these fractures. The use of the laterally applied LCP which acts as a fixed angle device were associated with the complication like varus collapse of the medial fragment, as they were stabilised by screws. This raised the question of sustainability of the fixation by isolated lateral plating which further paved way for the dual plating via two incision technique.

**Table 6: Comparison with other studies.**

Authors	Results
Barei et al <sup>6</sup>	75% satisfactory
Prasad et al <sup>2</sup>	80% satisfactory
Rohra et al <sup>7</sup>	85% satisfactory
<b>Our study</b>	82.32% excellent to good results

A two incision double-plating technique is being recommended by the Association for osteosynthesis/Association for the Study of Internal Fixation for the treatment of bicondylar tibial plateau fractures.<sup>3</sup> In our study males predominate the female with the ration of 3.75:1, which shows the more active life style involving the high velocity injury. Which are in accordance with the series of 14 patients reported by Egli et al in which 10 were male and 4 were female (Table 1).<sup>3</sup> Among 30 patients most common mode of injury being the road traffic accident, left side being more commonly involved than right side, we had 19 schatzker type VI and 11 schatzker type, When AO classification was considered most common type was AO 41C3 followed by AO41C2, and AO41C1 (Table 2 and Figure 1). Our study used Honkonen Jarvinen criteria for radiological, functional, clinical outcome which showed excellent to good result (Table 3). Our study reported Honkonen Jarvinen clinical outcome to be 86% excellent, 11.7% good and 1.7% fair. The functional outcome was 81% excellent, 13% good, 5% fair and 1% poor. The Radiological outcome showed 79.28% excellent, 20.72% good, 0.70% fair results (Table 4 and 5).

Most common complication encountered in the study was the knee stiffness (13.3%) in 4 patients associated with poor compliance with protocols and follow up, further superficial wound infection noticed in two patients (10%) who were taken up for wound debridement. Skin necrosis was another complication noticed in 1 (3%) our study which was dealt with regular saline dressing, skin grafting was done (Figure 2). One implant has been removed at the end of study with complete union, we noticed knee

stiffness has predominately affects outcome than the wound infection or the skin necrosis, there was no cases of non-union and all fractures had either united or were uniting by the end of 1-year follow-up. There were also no cases of implant related failures like screw back out or implant breakage.

Tul B Pun et al in his study reported the outcome of 17 tibial plateau fractures.<sup>9</sup> of which were managed by dual plating and 8 managed by hybrid ex fix. Based on Honkonen Jarvinen criteria all patients could walk, climb stairs, jump, 90% could squat, 50% could duck walk. 85% had plateau tilt <2 mm. No major infection.<sup>8</sup> Ebrahim Ghayem Hassankhani et al in his study reported 22 patients with tibial plateau fractures treated with dual plating. The outcome was assessed based on knee society score. 86. 4% had excellent.<sup>9</sup> 1% had good, 4. 5% had fair and no one showed poor results.<sup>9</sup> Neogi et al in their study have shown that the dual plating for bicondylar tibial fracture has better outcome than a single lateral locking plate as dual plating gives better anatomical reduction of the proximal tibia (Table 6).<sup>10</sup>

#### Limitations

Small sample size is one of limitations followed by short term study.

#### CONCLUSION

From present study high velocity tibial plateau fracture have excellent to good clinical, functional and radiological outcome. Early mobilisation of the joint provides good range of motion. Posteromedial plating provides a buttress to posteromedial fragment and thereby prevents varus collapse. The patients with good soft tissue cover should undergo anatomical reduction and rigid fixation immediately without deferring time. This is a short term study and need long term follow up to predict the further outcome.

We conclude that dual plating is ideal for all bicondylar tibial plateau fracture of Schatzker type V and VI with appropriate timing of surgery and understanding the anatomy, LCP system, appropriate technique with dual incision, the complication can be minimized, giving excellent to good results.

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*Ethical approval: The study was approved by the institutional ethics committee*

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