

# Assessment of Functional Outcome of Bicolunar Dual Plating for Bicondylar Fractures of Tibial Plateau

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## ABSTRACT

**Introduction:** Operative treatment of bicondylar fractures of tibial plateau is challenging and controversial. **Aims:** The aim of this study is to reveal the functional outcome of it by using bicolunar dual plates and screws. **Methods:** This is a prospective hospital based interventional study carried out in the department of Orthopaedics of Nepalgunj Medical College Teaching Hospital. Thirty two Schatzker type V or AO (Association of Osteosynthesis) type 41 C1 & C2 fractures were treated between January 2016 and December 2019 with bicolunar dual plating. The functional clinical outcomes were analyzed and evaluated using modified Rasmussen score. **Results:** Thirty two patients were included in the study. Out of which twenty four were male and eight were female. Average age was 32.21 years, eighteen were right sided and fourteen were left sided. Duration of surgery was 106 mins (range 90-120 mins) and the average duration of hospitalization was 7.81 days (range 4-14 days). Five patients of impending compartment syndrome and three patients with common peroneal nerve palsy were managed conservatively and also were included in the study. Two patients with superficial wound infection needed minimal debridement. One patient had varus angulation of 10° at third follow up after he fell from bed but surgical intervention were not needed. All fractures united. The average time for fracture healing was 21.5 weeks (range 16-32 weeks). At the Eighteen months follow up, the average knee range of motion was 131°(range 110°-140°). The functional outcome were evaluated using modified Rasmussen scoring system, which was 27.34 (range 22-30). **Conclusion:** Bicolunar dual plating for bicondylar fractures of tibial plateau can provide excellent and stable fixation allowing early range of motion and gives excellent to good functional outcome.

**Keywords:** Bicolunar dual plating, Bicondylar fracture, Tibial plateau

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## INTRODUCTION

Tibial plateau fractures are increasing in incidence and constitute 1.2% of all fractures.<sup>1</sup>These fractures occurs by a combination of axial compression together with a valgus or varus force. It often occurs in elderly over sixty years due to fall at the same level but in young adult due to road traffic accidents and fall from heights.<sup>2</sup>For tibial plateau fractures Schatzker classification is the widely used to assess the initial injury, plan management and predict the prognosis. It classifies the tibial plateau fractures into six types: Type I-wedge shaped fracture of the lateral tibial plateau, Type-II-splitting and depression of the lateral tibial plateau, Type-III-pure depression of the lateral tibial plateau Type-IV-medial tibial plateau fracture with a

split or depressed component, Type-V-wedge fractures of both lateral and medial tibial plateau and Type-VI-transverse tibial metadiaphyseal fracture, along with any type of tibial plateau fracture.<sup>3</sup> Among them type V and VI are complex fractures which is very often associated with soft tissue injury, risk of wound dehiscence, difficulty in intraoperative reduction and difficulty in sufficient fixation of fractures. Another common classification is the AO (Association of Osteosynthesis) system which includes three main groups a) extra articular b) partial articular and c) complete articular fractures which is further divided into subgroups. However, there is no effective surgical management but the treatment options include screws, Iliarov ring fixation, Hybrid external fixation, bicolunar or dual buttress plating, unilateral locking plate etc.<sup>4</sup> This study

aims to evaluate the anatomical and functional outcome of bicolunar dual plating in bicondylar fractures of tibial plateau.

## METHODS

This was a prospective hospital based interventional study was carried out in the department of Orthopaedics of Nepalgunj Medical College Teaching Hospital, Kohalpur, from January 2016 to December 2019. Non-probability purposive sampling technique was used to scrutinize total thirty two patients ranging from age eighteen to fifty two years. Ethical permission was obtained from the Institutional review Committee of Nepalgunj Medical College Teaching Hospital Kohalpur. Informed consent was being pertained to maintain the confidentiality of the patients. Patients with close Schatzker type V fractures or AO type 41C<sub>1</sub> and 41 C<sub>2</sub>, age group 18-52 years and those patients willing to be involved in the study were included whereas Schatzker type I, II, III, IV and VI fractures or AO type 41 C<sub>3</sub>, old fractures at tibial plateaus, tibial plateau fractures with compartment syndrome, tibial plateau fractures with injuries to the knee stabilizers and patients with systemic illnesses were excluded from the study. All the patients were admitted from Emergency by the Orthopaedic surgeons, adequate x-ray imaging with Anteroposterior, lateral, oblique views and 3D CT scan of the knee joint were taken for proper diagnosis and to know the degree of comminution and articular involvement. MRI was also recommended to 12 patients who has been suspected for soft tissue injuries associated with these fractures. All the patients were explained well about the procedure. Fractures were graded preoperatively using the Schatzker's and AO classification of tibial plateau. The limb was elevated and calcaneal pin traction was applied on Bohler-Braun splint with 3-5kg of weight for minimum of 3 days for the resolution of oedema and the fracture blisters and appearance of skin wrinkles. No anterior knee spanning external fixator were used.

### Operative procedure:

Patients were operated on a radiolucent table under regional or general anaesthesia with a knee flexion of 15-20°. Tourniquet was used for all the surgeries. We fixed the medial plateau first but if there were severe comminution on the medial side then only we did lateral plateau fixation first. A sand bag was placed under the contralateral hip before posteromedial fixation and was removed during anterolateral fixation. A curvilinear incision 1 cm posterior from posteromedial border of proximal tibia was made curving along the distal portion of the pes anserinus tendons. The saphenous vein and nerve were identified and retracted anteriorly. The deep fascia was incised to reveal the pes anserinus and the medial gastrocnemius muscle. The gutter was created between the pes anserinus tendons by retracting it anteriorly and the medial gastrocnemius and popliteus muscle by retracting it posteriorly. T-butress plates were used after proper reduction and temporary fixation with k-wires. Wound was closed in layers with drain in situ.

Simultaneously after the posteromedial fixation initial sand bag was removed from the contralateral hip and it was placed

beneath the ipsilateral hip. Another curvilinear anterolateral incision was made over the proximal lateral tibia over Gerdy's tubercle. The fascia was divided longitudinally extending proximally and distally. Exposure of the lateral surface of proximal tibia was performed with a periosteal elevator. Sub meniscal arthrotomy was done in depressed articular surface where needed. Reduction was done by longitudinal traction by the assistant. Temporary Kirschner wires were used to maintain the reduction which was confirmed using image intensifier. Kirschner wires were placed in such a way that later on it was replaced by the screw hole of desired precontoured locking plates. Wound closed in layers with drain in situ. Knee was immobilized in a long knee brace for two weeks and knee range of motion were encouraged from the 3<sup>rd</sup> postoperative day.

The clinical results were evaluated using the modified Rasmussen clinical score, the patients were asked regarding the degree of pain, distance that they are able to walk, getting up from the floor and squat or to do activities of daily living, total range of motion, stability in flexion and extension and the power of quadriceps. The scores were graded as poor (<20), fair (20-23), good (24-27) and excellent (28-30).

## RESULTS

Our study comprised of 32 patients with Type V Schatzker or AO 41 C<sub>1</sub> and C<sub>2</sub> tibial plateau fractures, including twenty-three 41 C<sub>1</sub> cases (71.87%) and nine C<sub>2</sub> cases (28.12%) with an average age of 32.21 years (ranging from 18-52 years). Among them 24 were male and 8 were female patients.

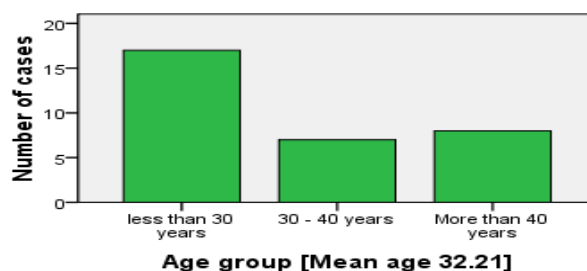


Figure 1: Total number of cases showing in different age group

All the injuries were a result of fall from height 14 (43.75%) cases, road traffic accident 7 (21.87%) cases, automobile pedestrian accident 5 (15.62%) cases and sports related injuries 6 (18.75%) cases. Five (15.62%) patients with impending compartment syndrome were immediately addressed with cold packs and elevation in Bohler Braun splint with bed end raise. Vigorous monitoring was done but fortunately they were not needed emergency fasciotomy. 3 (9.37%) Patients with common peroneal nerve palsy were identified during admission at emergency and were given foot drop splints which were recovered at around four months of follow up.

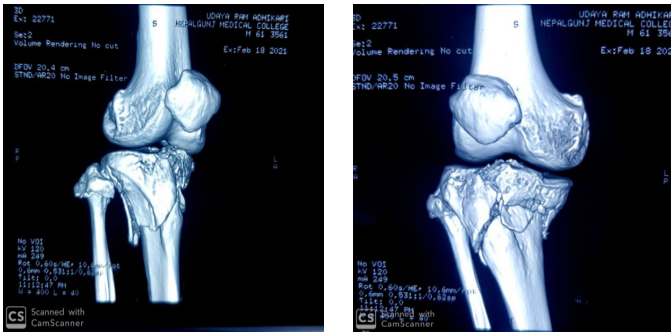
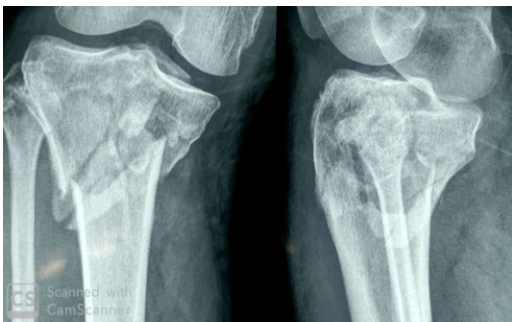


Fig: i Fig: ii  
**Figure 2: Preoperative 3D CT view**

We found 2 (6.25%) obese patients with superficial wound infection which were resolved by minimal debridement and intravenous antibiotics but they needed prolong hospital stay of 9 and 14 days. Out of 32 patients, all other regained good range of motion except 1(3.12%) patient, who had fallen accidentally from a two tier bed occurring secondary fracture displacement in the form of Varus angulation of 10° on 3rd follow up i.e., 16 weeks after surgery, but no secondary surgery were planned.



**Figure 3: Pre-operative X-ray in AP and Lateral View**

All patients underwent surgery within 48-72 hours of injury. They were fixed with dual bicolumnar plating, which consists of a combination of precontoured anterolateral buttress locking plate and posteromedial buttress locking plate of 4.5mm system. The average operation time was 106 mins (range 90-120 mins) and the average duration of hospital stay was 7.8 days (range 4-14 days). Postoperatively Knee movement was started from the 3rd day. Partial weight bearing was started after 8 weeks and full weight bearing at 16 weeks.

	Minimum	Maximum	Mean	Std. Deviation±	P value
Time for fracture healing in weeks	16.0	32.00	21.50	4.39	0.85
Range of motion in degree	0-1 10	140	5.25	1.54	

P = ≤ 0.05

**Table I: Association between time of fracture healing and range of motion**

All were followed up for at least 18 months. The average

range of knee motion was 131.09°. The range of movement varied from 110°-140°. 29 patients (90.62%) had no lack of extension, but 2 patients (6.25%) had lack of extension of 10° and 1 patient (3.12%) had lack of extension of 5°. 8 patients (25%) had knee range of motion of at least 140°. 7 Patients (21.87%) had range of motion of 135°, 8 Patients (25%) had 130°, 5 patients (15.62%) had 125°, 2 patients (6.25%) had 120°, 1 patient had 115° and 1 patient (3.12%) had range of motion of 110°. Hospital stay varied from 4-14 days (mean 7.8 days). All our patients had union in 21.5 weeks (range from 16-32 weeks). Hence, the range of motion and time for fracture healing was insignificant association between these two variables. Functional outcome of our patients was graded by using the six parameters of modified Rasmussen scoring system like pain, walking capacity, knee extension, Range of motion, Stability of knee joint and power of the quadriceps. Out of 32 bicondylar fractures of tibial plateau 15 patients (46.87%) had excellent outcome, 13 patients (40.62%) had good outcome, 3 patients (9.37%) had fair outcome and 1 patient (3.121%) had poor outcome.

Time for fracture healing in weeks	Complications				
	Secondary displacement	ICS	CPN	Wound dehiscence	No complication
16	0	2	2	0	5
2	0	1	0	1	5
24	1	2	1	2	9
32	0	0	0	0	2

**Table II: Distribution of postoperative complication according to time taken for fracture healing**

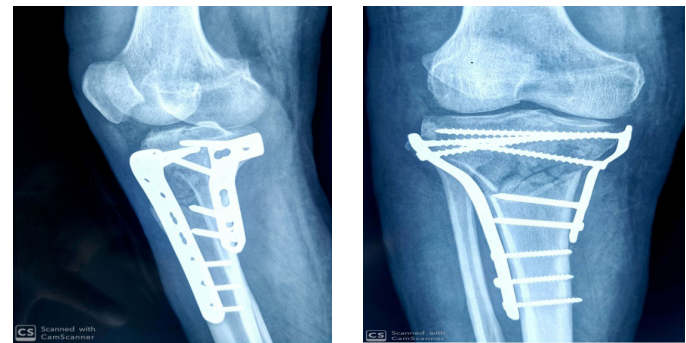


Fig. iii. Lateral view Fig iv. AP view

**Figure 4: X rays showing the post-operative status**

**Modified Rasmussen scoring system**

Pain	Points
None	6
Occasional Pain	5
Stabbing pain in certain positions	3
Constant Pain after activity	1
Significant rest pain	-3
<b>Walking capacity</b>	
Normal walking capacity (in relation to age)	6
Walking outdoors (>1h)	5
Walking outdoors (<15 min-1h)	3
Walking outdoors (<15 min)	1
Walking indoors only	0
Wheelchair / bedridden	-3
<b>Knee Extension</b>	
Normal	4
Lack of extension (<100)	2
Lack of extension (>100)	0
Lack of extension (>200)	-2
<b>Total range of motion</b>	
Full	6
At least 120°	5
At least 90°	3
At least 60°	1
≥ 60°	-3
<b>Stability</b>	
Normal stability in extension and 200° of flexion	6
Abnormal instability 200° of flexion	4
Instability in extension (<100)	2
Instability in extension (> 100)	0
<b>Power of quadriceps</b>	
Grade 5	2
Grade 3-4	1
Grade <3	2
Maximum	30
Excellent	28- 30
Good	24-27
Fair	20-23
Poor	<20

**DISCUSSION**

Treatment of complex tibial plateau fracture is still controversial and there is no consensus about the optimal surgical technique despite of improved surgical techniques and variety of fixation system.<sup>5</sup> A bicolunar dual plating

technique using posteromedial approach combined with an anterolateral approach has been suggested by several authors.<sup>6</sup> The Canadian Orthopedic Trauma Society reported 20% deep wound infection in the patient treated with bicolunar dual plating osteosynthesis.<sup>7</sup> Uhl et al<sup>8</sup> reported high rates of skin infection and osteomyelitis in 42% and 23% of patients treated with dual plates. Barei et al (2004) reported of 8.4% deep infection rate in 83 patients treated with bicolunar plating for bicondylar fractures of tibial plateau.<sup>9</sup> In our study 6.25% of cases had superficial infection but no patient had significant deep infection and they were not required implant removal prior to bony union. Literature shows around 20% of patient are likely to develop wound infection requiring unplanned secondary procedures.<sup>10</sup> A prolonged duration of surgery and a prolonged use of tourniquet are related to an increased risk of surgical site infection after bicolunar dual plating of the tibial plateau.<sup>11</sup> In our study average operation time was 106 mins (range 90-120 mins) which may be one of the important reasons for the low surgical site infection rates.

Yoo et al reported the inability of the single lateral locked plate to fix posteromedial fragments, requiring additional medial plate.<sup>12</sup> Chang et al reported that the single lateral locking plate takes less surgical time, less skin necrosis but higher rate of loss of reduction.<sup>13</sup> We did bicolunar dual plating using locking plates and screws of 4.5mm on anterolateral side and 3.5 mm on posteromedial side in all our cases regardless of any age. There were no loss of reduction or fracture displacement except in one case who had a Varus angulation of 10° on 16 weeks of follow up, after he fell from the bed, but no secondary surgery were planned to him. Literature shows that loss of reduction is common about 30-79% in age group more than 60 years due to premature weight bearing, osteoporosis, comminution and significant initial displacement.<sup>14</sup> There have been various devices which advocates for good fixation such as intramedullary nailing and condylar bolts<sup>15</sup>, single locking plate, Ilizarov fixators or hybrid constructs also have been used in bicondylar tibial plateau fractures.<sup>16</sup>

**LIMITATIONS**

Our study has some limitations such as small sample size (n=32), though sample size above 30 is considered and statistically adequate. However, the follow up is short term (18 months) and the maximum age of the patient is 52 years. Long term follow up may reveal post traumatic arthritic changes whereas including geriatric population more than 60 years in the study may reveal the cases of implant failure or the need of other supplementary fixation devices; further prospective randomized control trials are needed to confirm the value of this operative procedure.

**CONCLUSION**

Bicondylar fractures of tibial plateau are challenging and difficult to manage. Bicolunar dual plating through medial and lateral approaches is encouraging with minimal complications. The functional outcome of dual plating at 18 months of follow up is excellent to good according to Rasmussen criteria in most

of the cases. Bicolunar plating may be considered as one of the best option for bicondylar fractures of tibial plateau.

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