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**Arohi Sharma**  
Department of Orthopaedics,  
Grant Government Medical  
College and Sir J.J. Group of  
Hospitals, Mumbai,  
Maharashtra, India

**Dr. Ujwal Ramteke**  
Department of Orthopaedics,  
Grant Government Medical  
College and Sir J.J. Group of  
Hospitals, Mumbai,  
Maharashtra, India

**Nikita Shetty**  
Department of Orthopaedics,  
Grant Government Medical  
College and Sir J.J. Group of  
Hospitals, Mumbai,  
Maharashtra, India

**Nadir Shah**  
Department of Orthopaedics,  
Grant Government Medical  
College and Sir J.J. Group of  
Hospitals, Mumbai,  
Maharashtra, India

**Ayush Singh**  
Department of Orthopaedics,  
Grant Government Medical  
College and Sir J.J. Group of  
Hospitals, Mumbai,  
Maharashtra, India

**Jitsen Manna**  
Department of Orthopaedics,  
Grant Government Medical  
College and Sir J.J. Group of  
Hospitals, Mumbai,  
Maharashtra, India

**Correspondence**  
**Dr. Ujwal Ramteke**  
Assistant Professor -Department  
of Orthopaedics, Grant Medical  
College and JJ Hospital, JJ  
Marg, Byculla, Mumbai,  
Maharashtra, India

## A study of functional outcome of tibial condylar fractures treated with articular reconstruction

**Arohi Sharma, Dr. Ujwal Ramteke, Nikita Shetty, Nadir Shah, Ayush Singh and Jitsen Manna**

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### Abstract

**Objective:** The goal of this study it to access the functional and radiological outcome of articular reconstruction as a treatment modality for depressed tibial condylar fractures, using autogenous iliac bone graft as a “filling agent”

**Material and Method:** 36 patients involved in this study had post traumatic, closed tibial condylar fractures, Shatzker types II, III, V, VI (articular depression). All patients were maintained in skeletal traction until skin condition improved following which the patients underwent surgical intervention. Articular reconstruction was done by creation a cortical window, elevating the depressed articular fragment through the window and filling up the void with autogenous iliac crest bone graft. The reconstruction was stabilized with locking plates. Patients were started with static quadriceps exercise and controlled passive movements immediately post operatively. Weight bearing was delayed for 10- 12 weeks in all patients. Clinical and radiological assessment was done on each follow-up.

**Result:** Out of the 36 patients, 28 patients had excellent and good results whereas 8 patients had poor results. Poor results were due to knee stiffness, short walking distance, incapacitating pain and decreased range of motion. 4 patients with poor results had anterior cruciate ligament laxity, reducing their clinical grading.

**Conclusion:** Stable fixation with near normal articular reconstruction and striving to achieve a functional range of motion gives good results in depressed tibial condylar fractures in absence of infection and associated ligamentous injury.

**Keywords:** Minimally invasive percutaneous plate osteosynthesis, locking plate, tibial condyle fractures, articular reconstruction

### Introduction

Tibial plateau fractures are joint lesions that require anatomical reduction of joint surface and functional restoration of mechanical axis of a lower limb. Tibial plateau fractures are a risk to the functional integrity of the knee. They are the result of axial compressive forces alone or combined with Varus or valgus stress on the knee joint [1]. Tibial plateau fractures are one of the commonest intra articular fractures. They result from indirect coronal or direct axial compressive forces. This makes about 1% of all fractures and 8% of the fractures of the elderly. Most injuries affect lateral tibial condyle (55-70%) and isolated medial condyle fractures occur in 10-23% whereas the involvement of bicondylar lesions is found in 10-30% of the reported case series [2]. Over the years many classifications of the tibial condyle fractures have been developed. All classifications are based on fracture location and displacement. In 1956, Hohl and Luck proposed a classification that include non-displaced, local depression, split depression and split fractures [3].

Muller AO classification adopted by the orthopedic trauma association uses an alpha numerical system according to the common principles of AO method: Type A- extra articular, type B-partially articular, type C-complete articular fractures with detachment of the fragments from the diaphysis. Each group is further subdivided (1, 2, 3) describing the degree of fragmentation and more detailed characteristics. The Schatzker classification divides tibial plateau fractures into six types: lateral plateau fracture without depression (type I), lateral plateau fracture with depression (type II), compression fracture of the lateral (type IIIA) or

central (type IIIB) plateau, medial plateau fracture (type IV), bicondylar plateau fracture (type V), and plateau fracture with diaphyseal discontinuity (type VI) [4]. About 50% of tibial plateau fractures are associated with meniscal injuries, while ligament injuries can be found in up to 25% of cases [5-7]. Mechanical studies have shown a significant elevation in joint contact pressure when there is articular step off or incongruity > 3mm, joint irregularity < 1.5mm, is not associated with significant increase in contact pressure. Therefore, it appears that the joint is able to compensate for small degrees of incongruity [8]. Rasmussen and associates [9] demonstrated a high correlation with post traumatic osteoarthritis with residual condylar widening or significant incongruity between the tibial plateau surfaces and the femoral condyles. Malalignment of the tibial condyles in relation to the tibial shaft also affects outcome. Kettle Kamp and colleagues [10] have suggested the ability to maintain the correct mechanical axis of the knee strongly correlates with the development of osteoarthritis. The methods of fixation that have been used to address these fractures which include closed reduction and cast bracing, open reduction and internal fixation, circular frame application, percutaneous screw fixation, ligamentotaxis, wire guided cannulated screw, minimal invasive plating techniques, and various other techniques are used with open approaches in conjugation with the open techniques to treat these fractures [11].

#### Materials and Method

This prospective study was conducted at Grant Medical College and JJ Hospital which consisted of 36 patients with tibial condylar fractures, Schatzker Type 2, 3, 5, 6 (articular depression) operated from the year Jan 2015 to Jan 2016.

**Inclusion criteria:** Patients with closed unstable tibial plateau fracture.

#### Exclusion Criteria

- Skeletally immature individuals
- Open fractures
- associated knee dislocation

- associated ipsilateral femur, tibia and foot fractures
- Fractures were defined unstable if any of the following are present:
  - Depression more than 4mm
  - Displacement more than 10mm
  - Varus valgus opening more than 10 degree

All patients were admitted and maintained on skeletal traction until skin condition improved. The radiographic evaluation involved plain X-rays with Anteroposterior, Lateral and traction views. CT with 3D reconstruction was used to define the fracture geometry. The patient was taken up for surgery for surgery once the soft tissue edema and blisters resolved with appearance of skin wrinkles (mean duration 5 days). Preoperative antibiotic (1.5gm cephalosporin intravenous) was administered in all cases 1 hour prior to skin incision as a single dose. The operative procedures were performed in a standard operating room under regional or general anesthesia under tourniquet control. Standard anterolateral or posteromedial side or both depending upon the fracture configuration was used along with sub meniscal arthrotomy. Sub meniscal arthrotomy was performed to visualize the articular surface. All patients operated had articular reconstruction done through cortical window, elevation of the depressed articular surface through the window and filling up the void with autogenous iliac bone graft intraoperatively, fluoroscopy and direct visualization were used to achieve articular reduction. Fixed angle locking plate, Cannulated cancellous screws and locking compression plate was used for fracture fixation. Post-operative all patients were started on injectable cephalosporin and aminoglycoside for 48 hours. All patients were started on static quadriceps exercises and passive knee range of motion (ROM) on day 1 post operatively. Controlled passive mobilization (CPM) was used to achieve at least 90 degree of flexion. Patients were kept non-weight bearing on operated side for 12 weeks postoperatively which was average time period for radiological signs of union. At 6-month follow-up, patient was assessed by the Rasmussen grading system.



**Fig 1:** X-ray right knee AP view and lateral view preoperative



**Fig 2:** X-ray right knee AP view and lateral view immediate postoperative



**Fig 3:** X-ray right knee AP view and lateral view 6 weeks postoperative



**Fig 4:** Intraoperative plating with locking plate



**Fig 5:** range of knee motion on follow-up at 3 months

**Observation and Results**

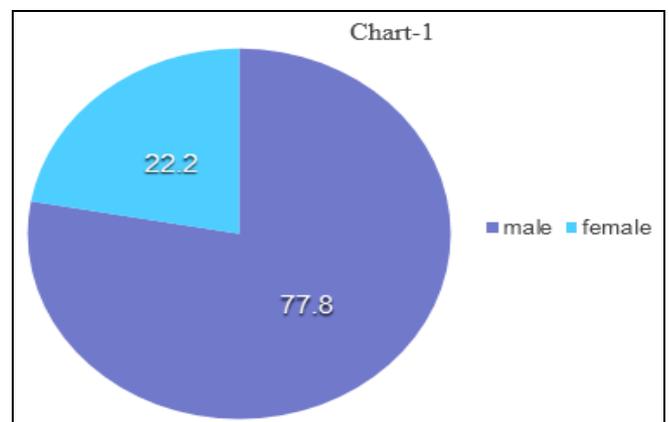
The goal of this study was to assess the functional and radiological outcome of articular reconstruction as a treatment modality for depressed tibial condylar fractures.

Tibial plateau fractures are more common in the active age group (31-50 years) due to high-energy trauma. Closed reduction internal fixation of these injuries has had little success in reducing depressed or displaced fracture fragments, this necessitates open treatment in most displaced and unstable fractures. Reconstruction of the articular surface and a stable fixation is extremely important in order to regain the complete range of motion.

**Sex Distribution**

**Table 1:** Sex Distribution (n=36)

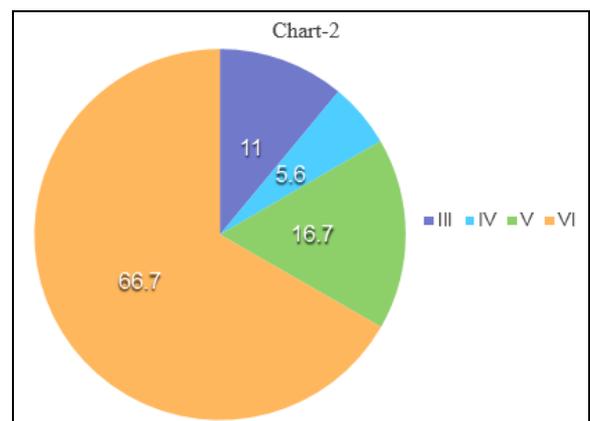
Sex	Group
Female	8 (22.2%)
Male	28 (77.8%)
Total	36(100%)



**Fig 6:** pie chart for sex distribution

Out of the 36, patients 8 were females (22.2%) and 28 were males (77.8%).

**Type of Fracture**



**Fig 7:** pie chart for morphology of fracture

**Table 2:** Morphology of fractures Schatzker type

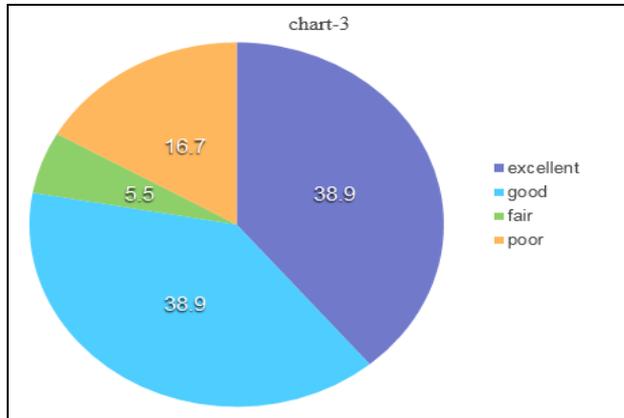
Type	Patients
3	4 (11%)
4	2 (5.6%)
5	6 (16.7%)
6	24 (66.7%)

In our study, 4 patients had type III (11%), 2 patients had type IV (5.6%), 6 patients had type V (16.7%) and 24 patients had type VI (66.7%).

### Grading Of Results

**Table 3:** Evaluation of results

Grade	Poor	Fair	Good	Excellent
Percentage	6 (16.7%)	2 (5.5%)	14 (38.9%)	14 (38.9%)



**Fig 8:** pie chart for evaluation of result

The result was divided into excellent, good, fair and poor depending on the clinico-radiological finding. 14 (38.9%) patients had excellent result, 14 (38.9%) had good result, 2 (5.5%) patients had fair result and 6 (16.7%) patients had poor result.

Factors such as side of injury and sex of the patient did not have any significant effect on the end result. Out of the 36 patients, 20 (55.6%) patients were due to motor vehicle accidents and 16 (44.4%) due to fall from height. Injuries due to fall had a relatively better end result. Stable fixation and early ROM on CPM machine improves the health of articular cartilage, promoted regeneration and prevents stiffness. 4 (11.1%) patients had wound gaping out which 2 (5.6%) were associated with post-operative wound infection which healed on debridement and secondary suturing. 2 (5.6%) patients had post-operative knee stiffness. Poor results were closely related to post-operative infection, wound gaping, knee stiffness and incapacitating pain.

### Discussion

In our study, after evaluating a results, treatment of Tibial condyle Fractures requires following considerations. We evaluated each fracture radiologically for displacement of fragments and preoperatively decided about type of plate and number of screws. This preoperative planning helped us a lot while operating in theatre. We classified the fractures according to Schatzker's classification [12]. Patients with tibial spine and tibial tuberosity avulsion fractures are not included in this study as they require classic O. R. I. F. We initially assessed ligamentous instability under anaesthesia. We found three in type IV, one in type V and three in type VI associated ligamentous injuries. We agree with Rasmussen<sup>13</sup> that ligamentous injuries occur in 10%-33% of Tibial Plateau fractures. All ligament injuries treated conservatively. We agree with Schatzker *et al.* [15] that younger patients mainly get split fractures (type I, IV) and elderly patients, joint depression type of. Fractures (type II, III, V, VI). This is because of dense cancellous bone and high energy injury in

young patients which develops split type of fracture. This is due to associated osteoporosis which leads to comminuted and depression type of fractures. We agree with Mason Hohl *et al.*, [16] that males are more prone to get tibial condylar fractures because they are mainly involved in road traffic accidents or occupational accidents. We used esmarch bandage to help in reduction, which we found very helpful to decrease displacement. Large pelvic clamps also used sometimes to held the reduction. C-arm used for assessing the reduction and we found it very convenient and accurate. Our aim during surgery was to get anatomical reduction. Only in 2 patients (13.33%), there was articular step of 5 to 10 mm left. Those patients were operated after 2 weeks because of poor skin condition. We still got a good range of motion at 6 weeks.

According to William J. Mills *et al.*, [17] anatomic reduction of the metaphysis is not necessary to get good functional outcome. Instead early range of motion should be started after giving adequate, stability and alignment with fixation. We also agree Shatzker *et al.* [16] that early motion is necessary in order to obtain good result. Stiffness is usually the result of immobilization. In surgically treated patient mobilization should begin within 5 to 7 days. [18] This, however, should not be carried out at the expense of the reduction or at the expense of wound healing. If any doubt exists as to the stability of fixation, then mobilization should begin either in traction and be continued in a cast brace or begin in a cast brace from the start of motion post operatively. We also found that, mechanism of injury determines the type of fracture. In case of simple falls, mainly type I or type II fractures were found commonly. In case of motorcycle accidents, mainly type IV fracture pattern found. In case of dashboard type of injury and fall from height, type V and type VI found commonly. We operated 24 out of 30 patients within 2 days of injury. For 6 patients we had to wait up to two weeks for oedema to subside, soft tissue injury to heal skin condition to improve. We also recommend the use of temporary knee spanning external fixator in such conditions. We used iliac crest bone graft whenever required. We used it in 19 of 30 patients (69.23/0), all of them were of joint depression type. We put the bone graft through same incision after elevating the depressed fragment with periosteum elevator. Alternative to bone grafting, Tricalcium Phosphate paste can be used to avoid donor site morbidity [19]. We have not used intra-operatively arthroscopic evaluations for the reduction or to repair any meniscal injury. According to series of Lobenhoffer and Schulze, [20] arthroscopic reduction had no advantage over reduction under fluoroscopic control. Average hospital stay was 5.5 days and this resulted in reduced expense to the Patient. We started immediate active and passive knee range of motion exercises on 5th day. In few cases where preoperative swelling or skin conditions was bad, we delayed it for two weeks. We agree with Bailey *et al.* [21] that early range of motion exercises is necessary in order to obtain good results.

We also found that after achieving anatomic reduction, the lateral radiograph shows the lateral plateau higher than the medial plateau, as we found in normal lateral radiograph.

### Conclusion

In our prospective study of 36 cases of Tibial condyle fractures treated ORIF with plating, following conclusions we have drawn.

1. Peak age group for Tibial Plateau Fractures is 30-40 years, which are mainly involved in road traffic

accidents.

2. Vehicular accidents giving rise to indirect trauma due to abnormal loading is the main mechanism of injury.
3. Younger patients have more chances of split fractures while older patients have more chances of depression fractures of Tibial Condyle. Comminution was more common in older age group because of osteoporosis.
4. Soft tissue injuries are commonly seen in high energy pattern of Schatzker type, especially those having direct injury.
5. Tight esmarch bandage used for exsanguination helps in reduction.
6. Evaluation of reduction under arthroscopy does not have any significant advantage over fluoroscopic control.
7. No incidence of wound complications. This can be attributed to the smaller incision, shorter surgical and tourniquet time.
8. Early knee mobilization is very important to get good outcome.
9. Reduced hospital stay and expense to the patient.
10. Finally, we conclude with, in view of the excellent results obtained with this technique, we advise stable fixation with near normal articular reconstruction to achieve a functional range of motion in a case of depressed tibial condylar fractures in absence of infection and associated ligamentous injury.

#### Declaration

Conflicts of interest: None declared

Funding: None

Ethical approval: not required

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#### Abbreviations

ORIF (Open reduction and internal fixation), MIPPO (Minimally invasive percutaneous plate osteosynthesis)

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