

## Original Article

# Role of Ilizarov Fixator as early definitive management of Bicondylar Tibial Fractures

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The tibial plateau fractures had been one of the periarticular fractures with the suboptimal outcome even with the best treatment modalities. Open reduction and locking plate fixation even though being the gold standard of treatment are met with severe soft tissue complications. External fixation using fine wires and circular fixator has the advantage of closed reduction, minimal soft tissue stripping and angular stability. We studied the outcome of tibial plateau fractures treated with Ilizarov fixator in our institute. Fifteen patients with mean age of 39.87 years were undertaken for the study. All the fractures united with the mean union time of 14.3 weeks. At the final follow up outcome was assessed using the ASAMI Score which was found to be excellent in 11 cases (73%), good in 3 cases (20%), fair in 1 case (6%) with no poor outcomes. It can be concluded that circular external fixator can safely be used for early definitive management of bicondylar tibial fractures.

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**Key words :** Bicondylar Tibial Fracture, Ilizarov Fixator.

The tibial plateau fractures had been one of the periarticular fractures with the suboptimal outcome even with the best treatment modalities. This is attributed to the periarticular location, high energy trauma and soft tissue compromise. The prevalence of tibial plateau fracture is around 1-2% of all long bone fractures<sup>1</sup> among which many are open and also have concomitant injuries like meniscal injuries, cruciate and collateral ligaments injuries, compartment syndrome and distal femoral fractures<sup>2</sup>. The tibial plateau fractures have bimodal age distribution with high energy trauma being the cause in younger age and low energy in the elderly. Schatzker et al. classified it in 1979, and it is the most commonly used classification<sup>3</sup>. Schatzker type V and VI are bicondylar fractures and have worse outcomes.

The treatment aims to obtain a stable, aligned, painless mobile joint and prevent post-traumatic osteoarthritis<sup>4</sup>. It is achieved through the principles of anatomical reduction of articular segment and restoration of length and mechanical axes. Open reduction and fixation with locking

plates are most commonly followed surgical modalities and provides a stable construct. This treatment modality has the inherent disadvantage of excessive soft tissue dissection, which often results in complications such as skin necrosis, infection, hardware prominence and knee stiffness.

External fixator has been used in open fractures and fractures with compromised soft tissue status to allow the soft tissue to heal as a part of "span, scan, fix" concept<sup>1</sup>. External fixation using fine wires and circular fixator has the advantage of closed reduction, minimal soft tissue stripping and angular stability. We studied the outcome of tibial plateau fractures treated with Ilizarov fixator in our institute.

### MATERIALS AND METHOD

This study was conducted in a tertiary care institution where 15 tibial plateau fractures treated with Ilizarov technique between 2014 to 2018 were evaluated for outcome analysis using the Association for the Study and Application of the Method of Ilizarov (ASAMI) scoring system<sup>5</sup> (Table 1).

### Inclusion and Exclusion Criteria :

Inclusion criteria included skeletally mature patients with Schatzker type V and VI tibial plateau fractures treated with Ilizarov external fixator and a minimum follow up of 6 months.

Patients with following were excluded from the study: concomitant bony injury in ipsilateral or contralateral lower

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limbs, pathologic fractures, any neurological or muscular conditions which impair rehabilitation.

**Operative Technique :**

All cases were executed under spinal anaesthesia in the supine position. The fracture was reduced by manual traction, pointed reduction forceps and using the cortical window as necessary to get a congruous joint surface under image intensifier. A three ring Ilizarov construct was applied in all cases. The first ring parallel and one tsun below the knee joint line, the second ring distal to the fracture and the third ring above the ankle. Olive wires from opposite directions were passed to approximate the tibial condyles and were fixed to the first ring after tensioning using dynamometer. Basic principles of Ilizarov technique such as passing wires through safe zones and adequate divergence were followed. The rings were fixed to each other using connecting rods, maintaining the axes and joint angles.

Departmental protocol for antibiotics and postoperative analgesia was followed. Check X-rays were taken, and necessary adjustment in the fixator construct was carried out to correct any residual malalignment. The patients were started on a gradual range of

Variables	Score
<b>Bone Results :</b>	
Union without infection	30
Nonunion or infection	0
<b>Radiologic results :</b>	
Good joint line	10
Malalignment <2 mm	8
Malalignment 2–4 mm	6
Malalignment >4 mm	0
<b>Knee range of motion :</b>	
>130 degrees	10
110 degrees–130 degrees	8
80 degrees–109 degrees	6
<80 degrees	4
<b>Leg length discrepancy :</b>	
No leg discrepancy	10
<1 cm	8
1–2 cm	6
2–4 cm	3
>4 cm	1
<b>Pain :</b>	
Absent	10
After sport activity	9
After long walking	8
Weather related only	7
After short walking	4
Mild activity related	2
Night pain at rest	1
<b>Sporting activity :</b>	
Full return to previous sport activity	10
Decreased sport performance	8
Poor sport performance	4
No sport ability	0
<b>Subjective patient satisfaction :</b>	
Full satisfaction	10
Mild dissatisfaction	8
Medium dissatisfaction	4
Dissatisfaction	0
Excellent: score = 80–90; good score = 70–79; fair score = 59–69; poor score <59	

motion exercises of knee and ankle and non-weight bearing crutch walking from the second post-operative day. The weight bearing was increased progressively as tolerated by the patient. Wounds were managed as per the needs. Patients were trained on pin tract care. After the healing of soft tissue injuries, patients were discharged and followed up at two weekly intervals. Follow up radiographs were taken as needed. After clinico-radiological evidence of healing, the frame was dynamized. Painless full weight bearing with dynamized fixator was taken as criteria for frame removal. The patients were assessed at final follow up using the ASAMI score.

**RESULTS**

Fifteen patients (11 male, 4 female) with a mean age of 39.87 years (range 24–58 years) were undertaken for the study. The mean follows up duration was 18.6 months (range 6–34 months). The mean injury to surgery interval was 4.3 days, and the fixator removal was done at an average of 13.2 weeks (range 10–16weeks). All the fractures united with the mean union time of 14.3 weeks. The average duration of full weight bearing was 16.47 weeks

Table 2 — Analysis of Outcome and Results

Age	Sex	Schatzker Type	Open/Close	Injury Surgery Interval (in days)	Fixator Removal (in weeks)	Union Time (in weeks)	Full Weight bearing (in weeks)	Follow up duration (in months)	Arc of Motion (in degrees)	ASAMI Score	Outcome	Complications
58	F	V	Open	4	14	15	17	34	120	79	Good	pin tract infection
45	F	VI	Close	6	12	14	16	23	130	84	Excellent	
42	M	V	Close	2	13	14	16	23	120	85	Excellent	pin tract infection
24	M	VI	Close	3	15	15	17	29	150	88	Excellent	
32	F	VI	Close	4	14	16	18	21	140	83	Excellent	pin tract infection
28	M	V	Open	7	15	15	17	30	130	81	Excellent	
32	M	VI	Close	3	13	15	17	12	150	83	Excellent	
24	M	VI	Close	2	16	16	18	18	160	86	Excellent	pin tract infection
49	M	VI	Close	5	14	13	15	9	130	82	Excellent	
56	M	V	Close	10	12	13	18	6	120	75	Good	pin tract infection
44	M	V	Close	3	13	15	16	18	150	78	Good	
27	M	V	Close	2	10	10	12	10	130	82	Excellent	pin tract infection
55	M	VI	Open	5	14	16	18	17	100	62	Fair	pin tract infection
24	M	VI	Close	3	12	15	17	14	160	84	Excellent	pin tract infection
58	F	V	Close	6	11	13	15	15	130	86	Excellent	

(range 12-18 weeks) (Table 2).

Superficial pin tract infection was observed in 8 cases which resolved with aggressive pin tract care and oral antibiotics. Two cases needed retensioning of loose wires. There was no deep infection, such as septic arthritis or osteomyelitis. Iatrogenic neurovascular injuries were not observed in any of the cases. There was no equinus deformity.

At the end of 6 months, all patients had knee motion in the range of more than 120 degrees except one where it was 100 degrees.

At the final follow up outcome was assessed using the ASAMI Score which was found to be excellent in 11 cases (73%), good in 3 cases (20%) fair in 1 case (6%) with no poor outcomes.

#### DISCUSSION

Irrespective of the technique, treatment of tibial plateau fractures is aimed at joint congruity and restoration of axes. Open reduction and internal fixation with locking plates have been the gold standard in achieving this. However, due to the subcutaneous location and associated soft tissue injury, this treatment modality is met with some severe wound-related complications such as wound dehiscence, implant prominence and flap necrosis. Owing to the extensive dissection of already compromised soft tissue and periosteal stripping, the biology is disturbed significantly increasing the risk of infection and non-union.

Circular external fixator has been used to treat such fractures since long and have shown promising outcomes<sup>4-7</sup>.

The average time interval for the union was 13.2 weeks in our study. The similar duration was reported by Dendrinis *et al*<sup>6</sup> (14.4 weeks), and Pirwani *et al*<sup>8</sup> (14.6 weeks). All 15 fractures united in our study. Similar reports



Fig 1 — Pre-operative X-rays



Fig 2 — Postoperative X-rays and Clinical picture



Fig 3 — X-rays after fixator removal

have been mentioned in the study of 46 cases by Ferreira *et al*<sup>9</sup> with mean union time of 3.9 months. Non-unions commonly reported with internal fixation in proximal tibia are rare with this technique owing to the preservation of biology. Bove *et al*<sup>10</sup> in their comparative study have reported one case non-union with the circular fixator.

The mean injury to surgery interval in our study was 4.3 days (range 2-10days). Healing of soft tissue takes days and even weeks in tibial plateau fractures leading to delay in internal fixation<sup>1</sup>. This problem is not encountered if Ilizarov fixator is used as definitive fixation.

The average duration for fixator removal was found to be 13.2 weeks. The duration to return to preinjury level was 16.4 weeks (range 12-18 weeks). Debnath *et al*<sup>11</sup> reported this to be 17.4 weeks, and in the study by McKee *et al*<sup>12</sup>, the duration of fixator removal was reported as 16 weeks.

Owing to the biomechanical properties of Ilizarov fixator, the patients are started on early weight-bearing, which is not done with the use of internal fixation. Axial micromotion allowed by Ilizarov fixator also has a positive impact on healing. Due to less soft tissue, dissection mobilisation exercises are relatively pain-free as compared to internal fixation. In terms of the range of knee after the surgery, we have found a minimum range of 120 degrees in 14 cases

and around 100 degrees in one open fracture.

The outcomes measured in terms of ASAMI Score was found to be excellent to good in 93% of cases with no poor outcomes. Catagni *et al*<sup>5</sup> in their study of hybrid Ilizarov fixator for tibial plateau reported 96% excellent and good results. Outcomes, as measured with other scoring system, has also been comparable. El-Gafary K *et al*<sup>13</sup> reported 76.7 % good to excellent results using the Knee Society Score. Debnath *et al*<sup>11</sup> reported excellent to a good outcome in 96.7% of cases using the Honkonen & Jarvinen criteria<sup>14</sup>. Singh H *et al*<sup>15</sup> reported 85% excellent or good functional result at a mean 24 weeks follow-up.

Several comparative studies are comparing internal fixation with circular external fixators and have reported similar outcomes in both treatment modalities. Hall *et al*<sup>16</sup> reported a shorter hospital stay and a marginally faster return of function. Bove *et al*<sup>10</sup> have reported a reduced risk of infection, early mobilization, restoration of the normal lower extremity alignment, versatility, and improved union rate in patients with multiple traumatic injuries, infection, and soft tissue injuries.

This study is limited by its sample size and lack of comparison with plate fixation. Further elaborate studies are warranted.

### Conclusion :

Circular external fixator has shown promising results in term of clinical, functional and radiological parameters as an early definitive management of bicondylar proximal tibial fractures and has less soft tissue complications.

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Fig 4 — Knee motion after removal of fixator

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