



A SHORT-TERM PROSPECTIVE STUDY OF THE CLINICAL, FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF DISPLACED INTRA-ARTICULAR TIBIAL PLATEAU FRACTURES TREATED SURGICALLY BY DUAL INCISION AND DUAL PLATING.

Orthopaedics

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ABSTRACT

Displaced intra-articular tibial plateau fractures are seen with increasing numbers and severity due to a fast-paced modern lifestyle amongst the general population leading to a greater number of road traffic accidents. These fractures could be severely debilitating and could lead to a complete loss of knee joint function if not treated with the most efficient and appropriate operative techniques. In our present study, we have analyzed the factors that affect the outcome of displaced intra-articular tibial fractures treated surgically by dual incision and dual plating. The aim of this study is to establish the efficacy of dual plating in treating Schatzker type V and VI tibial plateau fractures, enabling a relatively stable and mobile knee joint for the patient post-operatively.

KEYWORDS

Displaced tibial plateau fractures, Schatzker classification, Honkonen Jarvinen criteria.

1. INTRODUCTION:

1.1 Tibial plateau fractures are intra-articular fractures of major weight bearing joint^[1]. Complex fracture patterns can be a great challenge to even the most experienced orthopaedic surgeons^[2]. Tibial plateau fractures represent approximately 1% of fractures in adults. These fractures occur most commonly in the 3rd to the 5th decade of life. In young adults, motor vehicle accidents, bumper strike injuries are common modes of injury as opposed to the occurrence in the elderly, in whom trivial falls are the more common mode of injury^[3]. Schatzker type V & VI fractures occur due to high velocity trauma. They contribute to 20-40% of tibial plateau fractures^[4]. In these fractures, local soft tissue injury, compartment syndrome, associated ligament instability have to be assessed for^[3].

1.2 The advantages of operative management are anatomic reduction, restoration of articular congruity alignment, and a stable fixation enabling early knee mobilization^[5]. Amongst a wide spectrum of operative management, dual plating via two incisions is a preferred technique as it has its own advantages when compared to other modalities of treatment such as isolated lateral locking plate, hybrid external fixator, Ilizarov, LISS. Hence, this prospective study is done to evaluate the efficacy of double plating in the management of Schatzker type V & VI fractures and evaluating their outcomes based on the Honkonen Jarvinen criteria (1992). Written consent was obtained from the patient for publication of his clinical and radiological data.

2. MATERIALS AND METHODS:

2.1 Our study is a prospective study conducted in the Department of Orthopaedics, Sree Balaji Medical College Hospital, Chromepet, Chennai, from January 2016 to December 2018 [36 months of study, in which the recruitment of patients was from January 2016 to December 2017 (24 months)], so that the minimum follow-up period was at least of 12 months. All the patients had given a written consent for publication of their clinical and radiological data and appropriate clearance was obtained from the institute's research and ethical committee.

2.2 Inclusion criteria:

Patients with high velocity tibial plateau fractures who are:

- 1) Both males and females in the age group between 26 to 45 years were included in the study.
- 2) The criteria of depression and or displacement of articular surface be greater than 2 mm.
- 3) Schatzker classification of tibial plateau fractures type V and VI alone were included.

2.3 Exclusion criteria:

Patients presenting with the following situations were excluded:

- 1) Open fractures.
- 2) Pathological fractures.
- 3) Previous knee fractures or those who had undergone procedures for IDK.
- 4) Associated neuro-vascular injury and / or head injury.

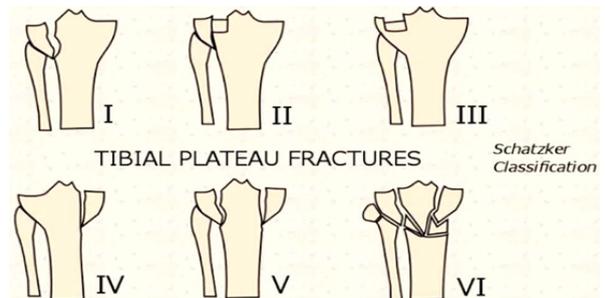


Fig. 1: Schatzker classification of tibial plateau fractures

3. MANAGEMENT PROTOCOL:

3.1 Pre-operative management:

Patients were received in the casualty and initially stabilized to achieve adequate haemostasis, following which intra-muscular analgesics were given. The injured lower limb was immobilized in an Above Knee splint and then Antero-posterior, Lateral and Oblique view x-rays were taken.

Then, with minimal traction, an Above Knee slab was applied. Distally, the slab was slit open to check for distal pulses. Three Dimensional Computed Tomography was done to assess the fracture geometry pattern and then classified as per Schatzker classification. MRI was done as a routine to establish any meniscal, cruciate or ligamentous injury in order to document and address arthroscopically at a later date.

Surgery was delayed until full recovery of soft tissues (swelling, blisters, abrasions etc.), which usually took about 3 to 10 days.

3.2 Surgical procedure:

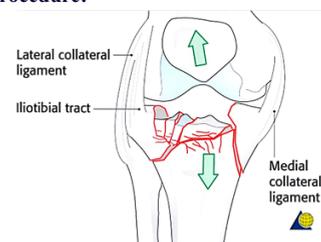


Fig. 2a: Ligamentotaxis – helps to achieve preliminary reduction of the main fracture fragments and helps to maintain length during the operation. It is also used pre-operatively to maintain provisional reduction.

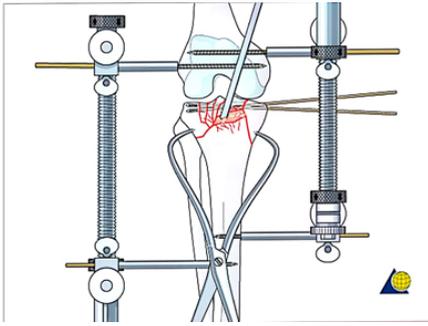


Fig. 2b: Reduction and bone grafting – the depressed fragment is elevated and the sub-articular defect packed with bone graft. The fracture fragments are provisionally held in position by a pointed reduction clamp.

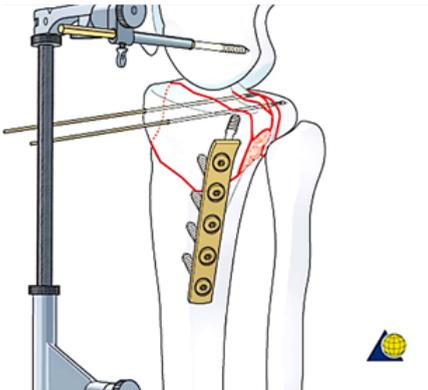


Fig. 2c: Medial column fixation – this is usually carried out first and the plate is secured with bicortical screws. Care is taken to ensure that their placement shall not later interfere with the antero-lateral plate fixation.

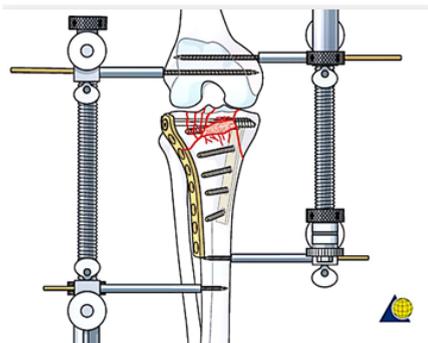


Fig. 2d: Lateral column fixation – the contoured buttress plate is inserted above the periosteum deep to the muscle cover. The proximal most screw may be used for the lag effect.

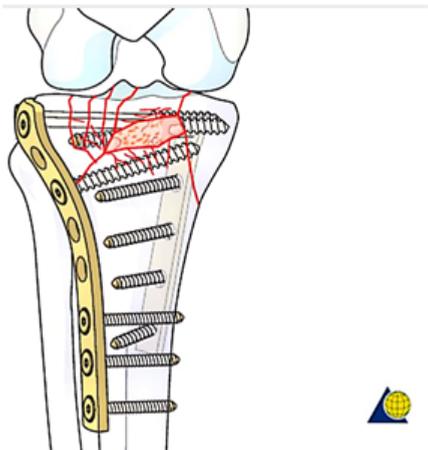


Fig. 2e: Final osteosynthesis (if well aligned, fixator is removed).



Fig. 2f: Intra-op picture showing postero-medial plating in progress.



Fig. 2g: Intra-op picture showing antero-lateral plating in progress.

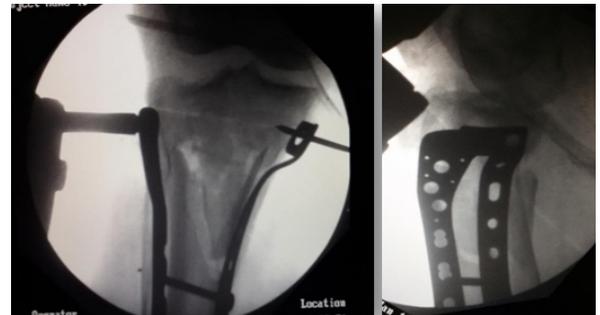


Fig. 2h: Intra-op C-arm guided targeting of the screws after drilling and tapping.

Pre-operatively, I.V. antibiotics (cefoperazone + sulbactam 1.5 gm) were started after test dose on induction of anaesthesia.

The patient was placed in supine position, with a folded pillow under the injured knee, and a sand bag under the ipsilateral gluteal region for the antero-lateral approach, and a sand bag under the contra-lateral hip with figure of four position of ipsilateral leg for postero-medial approach. A radiolucent operating table is mandatory. Femoral distractor, if and when needed, was used. First indirect fracture reduction was achieved with longitudinal traction under C-arm guidance. Per-cutaneous K-wires were used to hold the fragments in reduction. We typically fixed the medial tibial condyle first. If medial condyle was comminuted, we fixed the lateral condyle to restore the original length of the proximal tibia, anatomical relationship of the joint surfaces and to align rotation.

A postero-medial approach to the proximal tibia with an approximately 6 cm incision over the postero-medial border of the proximal tibia was made. After opening subcutaneous fat, the long saphenous vein and saphenous nerve were identified and preserved. Pes anserinus expansions were then identified. Tibia approached after incising the pes anserinus longitudinally in the line of skin incision. The gastrocnemius muscle was gently freed from postero-medial surface by blunt dissection.

The fracture fragments were visualized and reduced under C-arm guidance. For any articular depression, a bone punch was used to elevate the depressed portion and the void was filled with native bone graft. The reduced fragments were fixed with 3.5 mm proximal tibial T or L Buttress Plate Or Recon Plate and screws, after contouring.

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 was reduced and fixed with Proximal Tibia Lateral Locking Compression Plate. If depression was present in articular surface, elevation was followed by autologous iliac bone grafting. A drain was kept for both wounds with help of a Y-connector.

3.3 Potential complications:

- a) Articular damage.
- b) Vascular and nerve injury (peroneal nerve).
- c) Compartment syndrome.

Care is taken to observe for all these complications during surgery, and mandatorily, we do not close the fascia in order to prevent compartment syndrome.

3.4 Post-operative protocol:

Well-padded sterile dressing was done. Knee was not immobilized. Drain was removed on POD # 2. Active knee mobilization was encouraged as early as the patient could tolerate and co-operate. Suture removal was done on POD # 12. Patient was discharged with advice of non-weight bearing crutch walking.

3.5 Follow-up:

Patients were reviewed in our Out Patient Department at an interval of every 2 weeks for the first 6 weeks, and X-rays were taken at every visit for checking implant position. Toe-touch weight bearing was started after 8 to 10 weeks. Thereafter, x-rays were taken on a monthly basis until features of radiological consolidation were evident, and clinically the fracture site became painless. After this, full weight-bearing was

permitted. After 6 months, patients were reviewed every 3 months for a minimum of 12 months.

3.6 Assessment:

The clinical, functional and radiological assessment was done based on the Honkonen Jarvinen Criteria (1992) at the end of 12 months from the time of surgery.

4 RESULTS:

Table 1: Age distribution table:-

Age (in years)	No. of patients		Sample total	Sample percentage
	Male 'n'	Female 'n'		
26 – 30	12	3	15	46.88
31 – 35	4	2	6	18.76
36 – 40	3	1	4	12.50
41 - 45	5	2	7	21.86
Total n, percentage	24 (75%)	8 (25%)	32	100%

Table 2: Womac score:-

Outcome 'n' percentage	Womac score	'n'	Percentage
Excellent n = 25 Percentage = 78.13%	0 – 4	6	18.75
	5 – 9	10	31.25
	10 – 14	9	28.12
Good n = 7 Percentage = 21.87%	15 – 19	4	12.50
	20 – 24	2	6.25
	25 – 29	1	3.13
	Total	32	100%

Table 3: HJ clinical outcome:-

Criteria	Excellent 'n', percentage	Good 'n', percentage	Fair 'n', percentage	Poor 'n', percentage	Total 'n'
Extension lag	27 (84.38%)	5 (15.62%)	–	–	32
Knee flexion	12 (37.49%)	19 (59.38%)	1 (3.13%)	–	32
Thigh atrophy	25 (78.13%)	6 (18.74%)	1 (3.13%)	–	32
Instability	23 (71.87%)	6 (18.74%)	3 (9.39%)	–	32
Rounded Mean percentage	68%	28%	4%	0%	100%

Table 4: HJ functional outcome:-

Criteria	Excellent 'n', Percentage	Good 'n', percentage	Fair 'n', percentage	Poor 'n', percentage	Total
Walking	32 (100%)	–	–	–	32
Stair climbing	29 (90.7%)	3 (9.3%)	–	–	32
Squatting	30 (93.8%)	2 (6.2%)	–	–	32
Jumping	30 (93.8%)	1 (3.1%)	1 (3.1%)	–	32
Duck walking	29 (90.7%)	1 (3.1%)	1 (3.1%)	1 (3.1%)	32
Rounded Mean percentage	93.8%	4.2%	1.2%	0.8%	100%

Table 5: HJ radiological outcome:-

Criteria	Excellent 'n', Percentage	Good 'n', percentage	Fair 'n', percentage	Poor 'n', percentage	Total
Plateau tilt	27 (84.4%)	2 (6.2%)	3 (9.4%)	–	32
Varus / valgus tilt	26 (81.4%)	4 (12.4%)	2 (6.2%)	–	32
Articular step-off	23 (72%)	7 (21.8%)	2 (6.2%)	–	32
Condylar widening	29 (90.7%)	2 (6.2%)	1 (3.1%)	–	32
Joint space narrowing	25 (78.2%)	7 (21.8%)	–	–	32
Mean percentage	81.3%	13.7%	5%	–	100%

Table 6: Consolidated HJ criteria outcome:-

Criteria	Excellent	Good	Fair	Poor	Total
Clinical outcome Mean percentage	68%	28%	4%	0%	100%
Functional outcome Mean percentage	93.8%	4.2%	1.2%	0.8%	100%
Radiological outcome Mean percentage	81.3%	13.7%	5%	0%	100%
Consolidated outcome Mean percentage	81.03%	15.3%	3.4%	0.27%	100%

4.1 In the 24 months recruitment period, we were able to recruit 32 patients conforming to our inclusion criteria and the male to female ratio was 3:1. Maximum recruits were in the age group of 26 to 30 years contributing to 46.88% (n = 15) of the sample total. The mode of injury was road traffic accidents in 87.5% (n= 28) of cases, while fall from a significant height contributed to 12.5% (n = 4). With regard to sidedness of the injury, 78.13% (n = 25) had injured their right tibia, and 21.87% (n = 7) had injured their left tibia. 37.5% (n = 12) had a fracture geometry conforming to Schatzker type V, and the remaining 62.5% (n = 20) had Schatzker type VI fracture pattern. The average time delay between injury and surgery was 4.6 days (range: 3 to 9 days).

4.2 All patients underwent surgery via the antero-lateral and postero-medial approaches. The lateral plateau was plated using a LCP, while the medial plateau was plated using a T or L buttress plate or recon

plates. 59.38% (n = 19) of the cases had metaphyseal defects, which were then bone grafted from the ipsi-lateral iliac crest. The average operating time was 70 minutes (range: 56 to 85 minutes). The average blood loss was 112 ml (range: 75 to 135 ml). The average time for radiological union was 13 weeks (range: 11.8 to 16.2 weeks). Our average follow-up period was 16.4 months (range: 12 to 35 months).

4.3 The Womac score primarily assesses pain stiffness and the clinical function of the knee with features of osteoarthritis. It is gauged in a scale between best / excellent 0 and worst / poor 96. In our study, 78.13% (n = 25) recruits had excellent Womac scores of between 0 and 14, while 21.87% (n = 7) had Womac scores between 15 to 29 corresponding to good outcomes. Our average Womac score was 7.7. Our consolidated HJ criteria outcome, which included the results of clinical, functional and radiological outcomes, was excellent in 81.03%, good in 15.3 %, fair in 3.4%, and poor in 0.27% of cases.

4.4 In 12.5% patients (n = 4), complications like superficial infections which settled with I.V. antibiotics and regular wound dressings were seen. In 6.25% patients (n = 2), there was implant screw loosening which required replacement. In 2.85% patients (n = 1), knee flexion less than 100° was seen. Hence, the overall complication rate was 21.6% (n = 7). All of the patients were walking without any aid at a mean period of 5.8 months from the day of surgery (range: 4.5 to 6.2 months). The average time required for the patients to get back to their old job was 6.3 months (range: 5.5 to 8.2 months).

DISCUSSION:

Complex tibial plateau fractures still remain a challenge to most Orthopaedic surgeons, with road traffic accidents being the commonest mode of injury leading to these high velocity fractures. To reconstruct a stable painless mobile knee is a difficult task requiring adequate expertise and technical knowledge.

Historically, due to poor technique of fixation with dual plates with single midline incision or Mercedes Benz incision, alternate methods of fixation with Ilizarov ring fixation hybrid external fixation were being employed.

Single incision technique had high incidence of wound breakdown and infection^[6].

With the advent of isolated lateral plating with locking compression plate the spectrum has shifted towards locking plate with medial fragment being stabilized by screws passed through lateral plate. Varus collapse in these patients raised the question of its sustainability and the reason found to be inadequate fixation of postero-medial fragment. This has paved way for dual plating via two incision technique.

A double incision Double plating technique is recommended by the Association for Osteosynthesis/Association for the Study of Internal Fixation for the treatment of complex tibial plateau fractures^[9].

Locking plates provide fixed angle stability and we hypothesized that using lateral locking plates instead of buttress plate may help to prevent secondary loss of reduction and alignment. If secondary loss of reduction occurs, osteoarthritis will occur even if primary X-ray was satisfactory^[8].

In our study, males outnumbered females in the ratio 3:1. This is explained by more active life style of males and higher chance of road traffic accidents. This is in accordance with the series of 14 patients reported by **Eggli et al**, in which 10 were male and 4 were female^[11].

All 32 patients sustained road traffic accident. Distribution of incidence between sides were near equal. We had 12 Schatzker Type V and 20 Schatzker Type VI with preponderance of the latter.

Our study series had a 78.13% (n=25) excellent and 21.87% (n=7) of good outcomes as per the Womac score system.

Our study reported Honkonen Jarvinen Clinical outcome to be 68% excellent, 28% good and 4% fair. The functional outcome was 93.8% excellent, 4.2% good, 1.2% fair and 0.8% poor. The radiological outcome showed 81.3% excellent, 13.7% good, 5% fair results.

As this is a short term study, the results may also vary with further follow-up.

Bone grafts were used in 26 (81.25%) of 32 patients after elevation of depressed articular surface. The mean time of union was 12.9 weeks ranging from 11 to 16 weeks. Bone grafting did not contribute to faster healing as metaphyseal defects heal well without bone grafts. In the report published by **Eggli et al**, bone grafting was employed in 11 of 14 patients^[11].

Knee flexion of 95° and 100° was noted in two patients and physiotherapy was encouraged. Superficial infection occurred in 3 patients and healed with debridement, wound dressing and intravenous antibiotics. Occasional pain in 4 patients was managed with analgesics.

There were no associated injuries in our patients.

CONCLUSION:

- From our study we conclude that,
- High velocity tibial plateau fractures have excellent to good clinical, functional and radiological outcome.
- Early mobilization of the joint provides for good range of motion .
- Postero-medial plating provides a buttress to postero-medial fragment and thereby prevents varus collapse.
- The patients with good soft tissue cover should undergo anatomical reduction and rigid fixation immediately without deferring time.
- The shortcoming of this study is that the follow-up period was relatively short with a range of 12 to 35 months. Late complications therefore could not be assessed.

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