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The functional outcome of operative management of displaced tibial plateau fracture

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Abstract
With improvement in imaging modalities like CT and MRI complex fracture patterns and soft tissue injuries were recognized. CT has been shown to help surgical planning and to lead to more reliability in classifying the fracture and deciding on a treatment plan. Patients were informed about the study in all respects and written informed consent will be obtained. The follow up period was 6 weeks, 3 months, 6 months, 41/2 months, 6 months, 9 months, 1 year and 2 years. In the present study on evaluation of the type of plates used, we found that of the 50 cases in the study, single plate was used in 34 patients (68%) and double plate used in 16 patients (32%). In the present study on evaluation of the final outcome of the fracture according to lysholm scoring scale most patients had excellent results (24 patients, 48%). Post-operative rehabilitation protocol in terms of non-weight bearing and achieving satisfactory range of motion needs to be strictly adhered to, in order to obtain optimal functional results. In our study we found that proximal tibial locking plates provides complete union and early mobilisation to attain better functional outcome.

Keywords: Functional outcome, operative management, displaced tibial plateau fracture

Introduction
The principles and techniques of treating tibial plateau fractures have evolved over last 50 years.
In decades of 1950s, 60s, and 70s they were treated none operatively and favourable outcome were published using techniques like traction, cast bracing, spica casting.
Apley controlled deformity using longitudinal traction, encouraged early knee motion and reported satisfactory results [1]
Lansinger *et al*. in a 20 year follow up of patients originally reported by Rasmussen, showed that non operative treatment for fractures with less than 10 degrees of coronal instability resulted in favourable outcomes [2, 3]
Duwelius and Conolly treated patients with closed reduction with or without percutaneous pin fixation and mobilized them early in the cast brace and reported an89% rate of good or excellent clinical results [4]
With improved methods of internal fixation, operative reducing tibial plateau fractures become common in 1980s, these techniques had advantages of reducing the articular surface, aligning the limb, and mobilizing the knee early after injury with less encumbering external devices
The Schatzker classification defined pathoanatomy and suggested treatment strategies and this classification still remains the cornerstone for treatment strategies [5].
The AO/OTA Classification also defines the fracture patterns. With improvement in imaging modalities like CT and MRI complex fracture patterns and soft tissue injuries were recognized. CT has been shown to help surgical planning and to lead to more reliability in classifying the fracture and deciding on a treatment plan.
MRI assesses the location of fracture lines and the degree of articular displacement and also identifies occult facture areas better than plain films and has been found to be equivalent to traditional two dimensional CT. MRI provides additional information about injuries to the soft tissue structures of the knee that is not obtained with other imaging modalities.
However, whether MRI should be a routine part of evaluating tibial plateau fractures or whether it should be used instead of CT scanning is controversial.

CT scans better visualize the fracture anatomy than do MR images but MRI demonstrates associated soft tissue injuries, particularly those of the menisci and ligaments that are not visualized on CT. When tibial plateau fractures were assessed with both techniques, CT was found to be sensitive and specific in identifying ligament injuries because most of them had at least small bony avulsions, but MRI was necessary to detect meniscal injuries[4].

Arthroscopic techniques to assess and direct fracture reduction have been used by some surgeons for a wide range of fracture patterns for more than two decades.

Plates and screws are the most frequent implants used to stabilize tibial plateau fractures.

Common plate application is done for the anterolateral proximal tibia where it is used as buttress and to substitute for the damaged lateral cortex that occurs with lateral split depression plateau fractures. The 3.5 mm implants and screws are the most common size, having largely supplanted the 4.5 mm implants that are common in the past the 3.5mm implants are less bulky and easier to fit on the bone, and the smaller 3.5 mm screws allow more screws to be placed closer to the articular surface to support reduced fragments [5].

Posteromedial plates serve a different mechanical function than anterolateral plates. In this area, the plate must function as an antiglide device to resist shearing forces.

Methodology

This study was a retrospective and prospective study done on 50 consenting cases of closed displaced tibial plateau fractures who were admitted in Kodagu Institute of Medical sciences and treated with 3.5 mm lateral locking plate with or without posteromedial plate and have come for follow up during the study period chosen based on the inclusion and exclusion criteria

Patients were informed about the study in all respects and written informed consent will be obtained. The follow up period was 6 weeks, 3months, 6months, 41/2 months, 6 months, 9 months, 1 year and 2 years.

Patients subjected to surgery were followed up at regular intervals with clinical and radiological data. Assessment was done based on a performa containing all necessary information regarding.

- Personal details: age, sex, address and occupation
- Investigative modalities
- Type of fractures: SCHATZKER'S CLASSIFICATION
- Surgical procedure carried out
- Duration of hospital stay
- Initiation of mobilization
- Physiotherapy
- Range of movements achieved post operatively by way of periodic follow-up
- Development of intra-operative and post-operative complication as listed below

Early

- Compartment syndrome
- Vascular injuries (anterior tibial artery)
- Swelling and wound healing problems
- Wound infection / Dehiscence-Superficial or deep
- Deep vein thrombosis
- Nerve injuries (lateral popliteal N)
- Limb length discrepancy

Late

- Knee stiffness
- Knee instability
- Angular deformities
- Late collapse
- Mal-union, non-union
- Osteoarthrosis
- Hardware breakage

Investigations

- Routine blood investigations.
- ECG.
- Chest screening.
- Plain radiographs of knee joint-AP and lateral views in doubtful fractures → 15° of AP oblique views inclined caudally.
- CT and MRI scans.

Observation of the treatment outcome of tibial plateau fractures were made under complications and functional outcome.

Results

Table 1: Tegner Activity Scale of Cases

Type	Frequency	Percent
Level 0	1	2.00
Level 2	4	8.00
Level 3	27	54.00
Level 4	16	32.00
Level 5	2	4.00
Total	50	100.00

In the present study on evaluation of the level of activity regained we found that of the 50 cases in the study most patients had regain upto level 3 of activity (27 patients, 54%)

Table 2: Range of Movement of Cases

Range of movement	Frequency	Percent
<90 degree	3	6.00
91-100 degree	8	16.00
101-110 degree	9	18.00
111-120 degree	14	28.00
121-130 degree	16	32.00
Total	50	100.00

In the present study on evaluation of the range of motion following surgery, most patients had a good range of motion of $121\text{-}130^0$ (16 patients, 32%).

Table 3: Type of Surgical Plate Placed during Surgery

Type	Frequency	Percent
Single	34	68
Double	16	32
Total	50	100

In the present study on evaluation of the type of plates used, we found that of the 50 cases in the study, single plate was used in 34 patients(68%) and double plate used in 16 patients (32%)

Table 4: Lysholm grading of Cases

Grade	Frequency	Percent
Poor	1	2.00
Fair	10	20.00
Good	15	30.00
Excellent	24	48.00
Total	50	100.00

In the present study on evaluation of the final outcome of the fracture according to lysholm scoring scale most patients had excellent results (24 patients, 48%).

Discussion

In this study most of the patients has reached upto level of 3 according to Tegner activity scale 27(54%), level 4 16(32%), level 24(8%), level5 2(4%), level0 1(2%).

In this series we studied 50 cases of Tibial plateau fractures based on Schatzker treated with single, dual plate, out of these 34(68%) were treated with single plate, 16((32%) were treated with dual plate.

In our study as a protocol the medial plate was used posteromedially, and not medially due to delicate soft tissue sleeve and to minimize infection.

As a protocol, the patient after anasthesiaa in the operating room, was imaged under C-arm guidance in three planes with mild traction.

Those fractures, which had a coronal plane fracture of medial condyle was fixed with a reconstruction or semitubular plate posteromedially and not medially first.

Then fracture was exposed through anterolateral incision and fixed with 3.5mm precontoured low profile locking pate with the screws engaging the already reconstructed medial condyle.

In patients with coronal split in the lateral condyle which was encountered in only one patient in our series.

This fracture was managed by reducing it by reflecting and retracting the soft tissue sleeve posteriorly during anterolateral exposure.

However lot of authors recommend the posterolateral approach to manage this fragment, we have no experience with this approach and fixation.

In the study on evaluation of the final outcome of the fracture according to lysholm scoring scale most patients had excellent results (24 patients, 48%).

Various modalities are being used in the treatment of proximal tibial fracture ranging from cast immobilization to operative options like Plate and screws, Lag screw alone, External Fixation, Intramedullary Nailing.

The fracture of proximal tibia which extend into the knee joint can produce major disability. At the University of Iowa authors began treating tibial plateau fractures with early application of a cast brace. They encouraged early motion, weight bearing to tolerance and unrestricted activities using crutches or other supports only when necessary lead to improved knee function [6].

During the 1980s the AO/ASIF group started to work on new plate design to minimize disadvantages of plating with respect to cortical perfusion. To overcome the negative effects of compression forces on the periosteum, a new generation of plates were created. The key to these internal fixators is the locking mechanism of the screws in implant, which provides angular stability and technical details ensures that compression forces on the bone surface are not necessary to gain stability to bone implant construct and also provides excellent holding force even in osteoporotic bone [7].

Stannard JP, Wilson TC, Volgas DA, Alonso JE in Birmingham, Alabama (USA) in the year 2003 showed in their preliminary study that the LCP technology offers improved fixation stability in osteoporotic bone and for comminuted and periarticular fractures [8]

Testsutaro S, Shimpei H, Toyohiro, Noribumi K, Keiji S in 2005 conducted a study for proximal tibial fractures in 20 cases in a Japanese hospital, LCP were applied and treatment outcome was examined. In this study good treatment outcome was obtained [9].

Apley, reported satisfactory percentage of good to excellent results of fractures of the lateral tibial condyle treated by skeletal traction and early mobilization.

Hohl and luck reported 227 cases of tibia plateau fractures of all types treated by conservative (81%, cast and traction) and surgical (19%) methods. Local depressions treated conservatively had 75-87% excellent and good result. Post traumatic osteoarthritis correlated with residual depression, varus and valgus deformity. There was no significant functional difference between the groups [10].

Duparc and Ficat, published 159 cases of tibial plateaus fractures of all types treated by conservative (46%) and surgical (54%). This short term study, evaluated by Hohl and Luck method reported excellent to good outcome in of 62% of cases treated by conservative methods and 84% treated by surgical methods. Incidence of osteoarthritis correlated with poor results due to malalignment, residual step off and instability was reported [11].

Robert's, reported 100 cases of tibial condyle fractures undisplaced 39%, local compression 26%, split compression (35%) treated by conservative and surgical methods. He observed excellent to good results in 72% of undisplaced fractures mainly treated by conservative methods. 80% of local compression fractures treated mostly by traction mobilization methods and 81% split compression fractures mostly treated by surgical methods. He advocated early mobilization preservation of menisci and repair of torn ligaments for best results [12].

Conclusion

Displaced tibial plateau fractures are best managed operatively. Optimal knee function is achieved by accurate anatomical reduction and secure fixation followed by early mobilisation to attain functional arc of motion. For displaced fractures open reduction and internal fixation is mandatory

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