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A STUDY OF OPERATIVE OUTCOMES OF AO TYPE B & C FRACTURES OF TIBIAL PLATEAU

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Abstract

Background: Anatomical restoration and stable rigid fixation of tibial plateau fractures with various fixation modalities among young population due to higher functional demand which is always challenging for operative surgeons. The main purpose of this study to see operative and functional outcomes among patients having intra-articular tibial plateau fractures.

Material and Methods: Twenty-two patients were prospectively studied to see functional outcomes by using Modified Rasmussen Criteria. There were fifteen males and seven female patients. Patients included were more than fifteen years of age group. Study group were classified according to AO/OTA classification. All patients had undergone internal fixation with suitable approach as earliest after anesthetic clearance.

Results: Mean age of duration was 38 years with follow up varies between six months to one year. Fall from height (36.26%) was the major etiological factor and next being motor vehicle (31.8%) road traffic accidents. According to AO/OTA classification eighteen (81.83%) patients having type B fractures while four (18.18%) patients having type C fractures. Results were assessed by using Modified Rasmussen Criteria. Among them,twelve (54.5%) patients having excellent results, seven (31.8%) patients having good results, two (9.09%) patients having fair results and one (4.6%) patient having poor results. None of the patients showed complications like non-union or any neurovascular damage.

Conclusion: Surgical modalities of fixation for tibial plateau fracture must needed to achieve anatomical articulation and stable rigid fixation with locking plates to restore articular congruency and with early knee mobilisation to get better functional outcomes.

Keywords: *AO TYPE B & C, Tibial plateau, Internal fixation , Rasmussen Score*

Introduction

Tibial plateau is the proximal portion of tibia which compose superior articular surface and constitutes major weight bearing area in the body and their fractures seriously damage the biomechanics and stability of knee joint[1].

Tibial plateau fractures occur in all age groups with approximately one percent (1%) in adults[2], but generally have a bimodal distribution within agiven population occurring in young adults as a result of high-energy trauma, and in the elderlyas a result of low-energy injuries. These types of injuries commonly associated with ligamentous rupture. Factors determining high energy tibial plateau fractures including the degree of articular step off, the extent and separation of condylar fracture lines, meta-diaphyseal dissociation, and the integrity of the soft-tissue coverage. Advancement in anatomic approaches and better implantation and surgical techniques with surrounding soft tissue coverage shows functional outcomes of tibial plateau fractures fixation[3-5].

Tibial plateau fractures classification based upon radiological appearance including Schatzkar's and AO/OTA classification systems. The AO/OTA classification signifies fracture geometry more precisely and more commonly used now a days[6,7]. Major aim of fixation is to restore articular surface and maintenance of mechanical axis. Newer techniques have been emerged for definitive fixation of both low-energy lateral tibial plateau fractures and high-energy medial and bi-condylar fractures.

The aim of this study to evaluate the fixation techniques and get idea of clinical and functional outcome using modified Rasmussen Criteria among AO type41 (B, C) tibial plateau fractures.

Material And Methods

This is a prospective observational study includes 22 patient's data with AO type 41(B, C) tibial plateau fractures in our institute with duration of follow up period ranging from six months to one year. Patients were selected on basis of history, clinico-radiological evaluation and functional outcomes.AO/OTA classification was used to classify these fractures and final functional evaluation done using Modified RASMUSSEN Criteria.

Inclusion Criteria

- Age group 18 years and above
- Closed proximal tibial intra-articular fracture

Exclusion Criteria

- Open fractures of tibial plateau
- Extra-articular fractures

On admission vitals of all patients measured and hemodynamically stabilized thorough clinical assessment needed to rule out any other associated injury. Patients were evaluated on basis of neurological status, vascular status and the local soft tissue condition. X-rays of knee antero-posterior and lateral view done to identify fracture morphology and wherever requires oblique views were done. CT scan were done wherever patient feasible to study particular fragments morphology. Primarily limb elevation with above knee splint given and locally glycerine $MgSO_4$ and ice application were used. Patient strictly observe for any compartment signs and vascularity. If local area shown signs of compartment syndrome then temporary external fixation should be used until swelling subsides and local soft tissue condition improved thereafter patients were posted for definitive fixation with locking plate on very next day.

Surgical Indications

- Fracture of lateral condyle Tibia.
- lateral tilting of plateau >5º
- steps off > 3mm
- Condylar widening > 5mm
- Fracture of medial Condyle Tibia except fissures
- Articular depression > 4 mm
- Lateral tilted bicondylar Fracture
- When medial condyle is undisplaced see criteria for lateral condyle.
  When medial Condyle is displaced, operation is always recommended
- Metaphyseal-diaphyseal translation of >1 cm

Antibiotic prophylaxis (intravenous Cefazolin 2 g) was administered at the time of induction of anesthesia in the patients with closed fractures and it was continued for 24 h. Prophylaxis was continued for 72 hours. Surgeries were performed under fluoroscopic control to aid and assess the reduction. All the surgeries were performed under regional or spinal anaesthesia.

Treatment of choice depend upon fracture morphology, local soft tissue condition, patient factors and associated injuries.

Approaches

1] Antero-Lateral Approach

In supine with 30-degreeflexion, incision starts 2 to 3 cm proximal to the joint line, curved over Gerdy's tubercle and 3 cm below the tibial tubercle and can be extended as far as distally as needed plane dissected between the ilio-tibial band and tibialis anterior muscle. It is mainly used for

lateral condylar split, split depression & bicondylar proximal tibia fractures.

2] Medial Approach

In supine position, with externally rotated limb incision starts from 1-2 cm proximal to the joint line in the line of femoral epicondyle extends over the pes anserinus insertion bisecting the tibial crest and the posteromedial border of the tibia. During dissection care to be taken for important structures like Great saphenous vein and nerve. The plane of dissection takes place between the pes anserinus tendons down from the tibia. It is mainly used for isolated medial condylar and for medial half of bicondylar proximal tibia fractures.

3] Postero-Medial Approach

In supine- externally rotated with slightly flexion of knee. A longitudinal incision along the posteromedial aspect of tibia. Beginning 3 cm proximal to joint line and extend as far as needed with plane of dissection lies between pes-anserinus anteriorly and medial gastrocnemius and soleus posteriorly. It is mainly used for isolated posteromedial or coronal fractures. Great saphenous vein and nerve carefully dissected.

4] Minimal Invasive Antero-Lateral Approach:

It is mainly used for extra-articular fractures and where reduction and fixation of intra-articular element done without direct visualization of joint surface or where compromised local soft tissue condition.

Implant selection depends upon fracture geometry and surgeons experience and bone grafts were taken wherever needed. Post-operatively drain was kept minimizing wet dressing and closure done carefully. Patients were mobilized from very next day with continuous passive motion (CPM) to avoid stiffness and after 48 hours drain was removed with full knee mobilization protocol followed, gradually increased up to 90^{o} under supervision. All the patients were taught and advised to do static quadriceps and dynamic exercise. On sequential follow up, x-ray was done, and any signs of callus formation were observed. After six to eight weeks partial weight bearing allowed and after two to three months full weight bearing started depending upon fracture healing. Follow up interval routinely three months, six months and one year with detailed clinical, radiological and functional outcomes. All details studied using modified Rasmussen's score.

Results

In our study we have included twenty-two patients with minimum six month follow up and maximum follow up one year. Patients with more than fifteen years of age group included in this study. Mean age duration was 38 years where minimum age of patients was 24 years and maximum age of patients was 65 years. In this study fifteen (68.18%) patients were male and seven (31.81%) patients were female. In this study, right side predominance including thirteen (59.09%) patients and left sided were nine (9%) patients.

Depending upon mode of injury, seven (31.8%) patients having history of motor vehicle accidents, eight (36.26%) patients having fall from height, five (22.7%) patients having domestic fall and two (9.09%) patients having other mode of injuries. In this study high incidence of fractures were seen among labourers (54.54%) and less likely among employees (36.4%) which occupied around 92% which mentioned below table no.1,2.

Average time duration between injury and operation in our study is 3-4 days. Among 22 patients, fourteen patients were operated within 4 days as they were medically fit while six patients were delayed for more than 7 days due to traumatic soft tissue swelling and their comorbidity. Two patients had blister formation and initial treated in form of spanning external fixator.

In this study, fracture classified by using AO/OTA classification mentioned below in table no.3. Eighteen (81.83%) patients having AO/OTA type B fractures while four (18.18%) patients having type C fractures. Average time of mobilisation was 3-5 days while average time for partial weight bearing with support was ten weeks and average time for full weight bearing without support started by twelve weeks. In this study average time of radiological union between 10-12 weeks.

In this study we have studied clinical and functional outcomes by using Modified Rasmussen Criteria which mentioned below in table no 4. Twelve (54.5%) patients having excellent results, seven (31.8%) patients having good results, two (9.09%) patients having fair results and one (4.6%) patient having poor results (figures 1 and 2).

In this study post-operative complications were seen with wound infection seen in two (9%) patients, knee stiffness seen in one (4.5%) patient while implant prominence seen in one (4.5%) patient.(table 5)

Discussion

Any intra-articular joint fractures are serious injuries which is associated with significant morbidity and

hampers quality of life. Tibial plateau intra-articular fractures were most common injuries occurred due to motor vehicle accidents, fall from height and domestic fall. Sometimes it may be associated with other fractures. Non-operative treatment options are limited to undisplaced fractures that allow early partial weight bearing and mobilisation. Experimental studies shown that the anatomical reduction and articular realignment that determine the final functional outcome. For that reason, open anatomical reduction with internal fixation with locking plate remains the gold standard for intra-articular fractures.

Biggi et al[8] studied that mean age of duration was forty-three years among them sixty one percent patients having history of motor vehicle road traffic accidents. Meridian at al[9] also studied that mean age of duration was fifty-one year with twenty three percent patients having road traffic accidents while mean age of duration in this study was thirty-eight years which shown that thirty one percent patients having similar history which signifies that motor vehicle road traffic accidents are major cause of tibial fractures due to incidence were high among male labourers. So high velocity trauma leads to severe intra-articular comminution.

According to meridian et al[9], average duration of hospital stay was 19 days while in this study average duration was 10 days. Recently, advancement in surgical techniques, better implantation and anatomical reduction leads to early knee mobilisation to avoid knee stiffness which reduces incidence of hospital stay.

F. biggi et al[8] had observed that internal fixation with locking plates and MIPO technique for tibia fractures in 44 patients with excellent functional outcome and wound complication was 9.09 % and ideal to attain stable fixation without compromising surrounding soft tissues. InMardian et al[9] study they found 6% of complication rate with good functional outcome. In this study wound complications were almost similar (9%) to other studies with average range of functional movements of 134°. Now a days, improvised surgical skills and proper sterilisation techniques for wound care are minimise complication rates.

Meridian et al[9] studied that better ROM was seen with type B fractures (126 °) compared to type C fractures (118 °) while our study shown that ROM with type B fractures (136 °) and with type C fractures (130 °)

Jain et al[10] found that excellent anatomical restoration and rigid fracture fixation enables the facilitation of early knee motion and thus achieving optimal knee function with acceptable functional outcome (84%). Biggi et al[8] studied that excellent functional outcome with rigid fixation and optimal knee functional with acceptable functional outcome (94%).

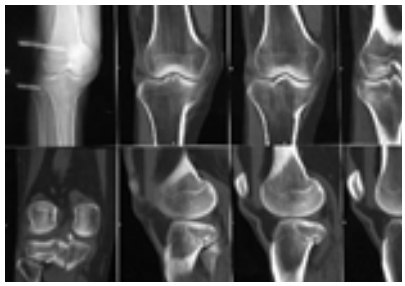
In this study, final outcomes were shown satisfactory result with Rsamussen score 26 while Biggi et al shown 27 and Jain et al shown 26. Overall complication rate was 18.08% which involves the early- late infection, knee stiffness implant prominence. No significant angular deformity or mon union was noted during this study.

In this study,we may think that our fixation modalities require further research due to limited sample size with shorter duration of follow up and MRI were not done so ligamentous injuries cannot be ruled out.

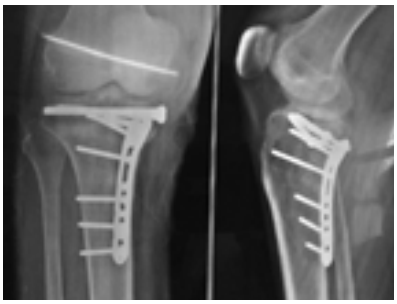
Figures

Figure 1: (a,b) preoperative x ray and CT scan (c) post operative x ray at final follow up (d,e,f) functional range of motion at final follow up

(a)



(b)



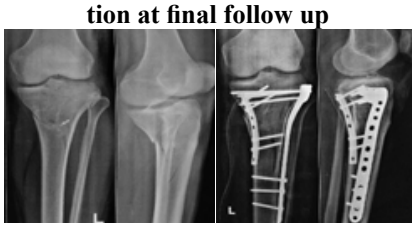
(c)

(d)

(e)

(f)

Case 2: (a) preoperative x ray (b) post operative x ray at final follow up (c,d,e) functional range of motion at final follow up



(a) (b)

(c) (d)

(e)

Tables

Table No. 1 Based Upon Mode of Injury

Mode of Injury	No. Of Cases	Percentage (%)
Motor vehicle accident	7	31.8
Fall from height	8	36.36
Domestic fall	5	22.7
Others	2	9.09

Table No. 2 Depending Upon Occupation

Occupation	No. Of Cases	Percentages (%)
Labourer	12	54.54
Employee	8	36.46
Household	2	9.09
Total	22	100

Table No. 3
AO/OTA Classification

Fracture Type	Sub Type	Male	Female	Total	Percentage (%)
41 B1	B1.1	2	1	3	13.64
	B1.2	1	1	2	9.09
	B1.3	2		2	9.09
41 B2	B2.1	1	2	3	13.64
	B2.2		3	3	13.64
	B2.3	3		3	13.64
41 B3	B3.1	1	1	2	9.09
	B3.2				
	B3.3				
41 C1	-	1	1	2	9.09
41 C2	-	2		2	9.09
41 C3	-				
Total		13	9	22	100

Table No. 4 Modified Rasmussen Clinical Outcome

Outcome	No. Of Patients	Percentage (%)
Excellent	12	54.5
Good	7	31.8
Fair	2	9.09
Poor	1	4.6

Table No. 5 Complications Seen During Study

Complications	No. of cases	Percentage (%)
Wound infection	2	9
Knee stiffness	1	4.54
Implant prominence	1	4.54
Total	4	18.08

Conclusion

To fulfil the higher functional demand of the younger population and the fact kept in mind that tibial plateau is major weight bearing joint of our body, surgical treatment must need. Proper radiological views were used to classify fracture patterns and morphology and that will be helpful for selection of proper approach and implants in plan of treatment. The main aim of surgical treatment is to rigid fixation of bone with locking plates with reconstruction of articular congruency restoration of depressed segment with bone graft wherever needed. Early knee mobilisation protocol followed to obtain maximum clinical and functional outcomes.

References

1. Leadbetter GW, Hand FM. Fractures of the tibial plateau. J Bone Joint Surg. 1940;22(3):559-68.
2. Albuquerque PR, Hara R, Prado J, Schiavo l, Giordano V, Pecegueiro do Amaral N. Epidemiological study on tibial plateau fractures at a level I trauma centre. Acta OrtopedicaBrasileira. 2013;21(2):109-15.

3. Honkonen SE. Degenerative arthritis after tibial plateau fractures. J Orthop Trauma 1995;9(4):273–7.
4. Wasserstein D, Henry P, Paterson JM, et al. Risk of total knee arthroplasty after operatively treated tibial plateau fracture: a matched-population-based cohort study. J Bone Joint Surg Am 2014;96(2):144–50.
5. Weigel DP, Marsh JL. High-energy fractures of the tibial plateau. Knee function after longer follow-up. J Bone Joint Surg Am 2002;84-A (9):1541–51.
6. Schatzker J, McBroom R, Bruce D. The Tibial plateau fracture: the Toronto experience 1968-1975. Clin Orthopaed Related Res. 1979; 138:94-104.
7. Marsh JL, Slongo TF, Agel J, Broderick JS, Creevey W, DeCoster TA et al. Fracture and dislocation classification compendium-2007: orthopaedic trauma association classification, database and outcomes committee. J Orthop Trauma. 2007;21(10): S1-133
8. Biggi F, Di Fabio S, D'Antimo C, Trevisani S. Tibial plateau fractures: internal fixation with locking plates and the MIPO technique.
9. Märdian S, Landmann F, Wichlas F, Haas NP, Schaser KD, Schwabe P. Outcome of angular stable locking plate fixation of tibial plateau fractures Midterm results in 101 patients. Indian J Orthop 2015; 49: 620-9.
10. Jain RK, Shukla R, Baxi M, Agarwal U, Yadav S. Evaluation of functional outcome of tibial plateau fractures managed by different surgical modalities. Int J Res Orthop. 2016 Mar 21;2(1):5-12.