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Assessing the functional and Radiological outcome in surgically treated closed tibial plateau fractures in adults: A case series of 40 cases

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Abstract

Introduction: Knee being one of the major weight bearing joints of the body, fractures around it will be of paramount importance. This study is to analyze the functional outcome of CRIF or ORIF with or without bone grafting in tibial plateau fractures in adults.

Materials and Methods: 40 cases of tibial plateau fractures treated by various modalities were studied from 1-8-2013 to 31-8-2015 and followed for a minimum of 6 months. Fractures were evaluated using Modified Rasmussen's Clinical, Radiological grading system.

Results: The selected patients were evaluated thoroughly and after the relevant investigations, were taken for surgery. The fractures were classified as per the SCHATZKER'S types and operated accordingly with CRIF with Percutaneous cannulated cancellous screws, ORIF with buttress plate/LCP with or without bone grafting.

Immobilization of fractures continued for 3 weeks by POP slab. Early range of motion was then started. Weight bearing up to 6-8 weeks was not allowed. The full weight bearing deferred until 12 weeks or complete fracture union. The knee range of motion was excellent to very good, gait and weight bearing after complete union was satisfactory, knee stiffness in 3 cases, wound dehiscence and infection in 1 case and non-union in none of our cases was noted.

Conclusion: Functional outcome is better in operatively treated tibial plateau fractures in adults, because it gives excellent anatomical reduction and rigid fixation to restore articular congruity and early motion thereby preventing knee stiffness.

Keywords: Tibial plateau fractures, schatzker classification, open reduction, internal fixation, closed reduction, modified Rasmussen criteria

Introduction

Tibial plateau fractures are one of the commonest intra-articular fractures. This makes about 1% of all fractures and 8% of the fractures in elderly. Most injuries affect lateral tibial condyle (55 to 70%) and isolated medial condyle fractures occur in 10 to 23% whereas the involvement of bicondylar lesions is found in 10 to 30% of the reported series ^[1].

We have advanced from the conservative approach to internal fixation in fractures as an acceptable mode of treatment. Nevertheless, tibial plateau fractures remain challenging because of their number, variety and complexity. Despite a plethora of articles, written in the past 50 years that have addressed the problems of classification and results of various treatments, the optimal method of management remains controversial ^[2].

Aims & Objectives

1. To evaluate the Functional outcome in tibial plateau fractures treated with CRIF, ORIF.

2. To assess and compare Functional vs Radiological outcomes after surgery.

Materials and Methods

During this study 40 patients were treated for tibial plateau fractures in which all patients were treated by internal fixation, out of which, 14 with Percutaneous cancellous screw fixation method, 10 with ORIF with buttress plate, 13 with ORIF with buttress plate and bone grafting and 3 with Locking compression plate.

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The inclusion criteria

- 1. Patient who has been diagnosed as Closed, Unstable tibial plateau fracture
- 2. Age group of 35–70 years of both sexes.

The exclusion criteria

- 1. Skeletally immature individuals.
- 2. Open fractures of tibial plateau.
- 3. Fractures associated with knee dislocation.
- 4. Patients with associated ipsilateral femur, tibia and foot fractures.
- All patients are selected on the basis of history, clinical examination and radiography.
- The Schatzker's classification was used to classify these fractures. The patients were followed up for an average period of 6 months.

Fractures will be defined as unstable if any of the following are present:

Depression > 4mm

Displacement >10mm

Instability >10 °

- All cases will be treated with open reduction and internal fixation.
- Fixation can be done by Cannulated cancellous screw fixation, AO type T or L-plate, Locking Compression Plate.
- Follow up and assessment will be performed using modified Rasmussen's Clinical and Radiological criteria.

Management

The patients were first seen in the casualty. Concerned specialists undertook appropriate management of the associated injuries. Intensive care was given to those patients who presented with shock and immediate resuscitative measures were taken. Once the patient's general condition was fit, relevant X-rays were taken and the degree of instability graded. The patients were taken for surgery at the earliest possible time depending on their medical condition, skin condition and the amount of swelling. All surgeries were fixed either with percutaneous technique or by open reduction and internal fixation. The fixation devices consisted of T Buttress plate, L Buttress plates, 4.5 mm Cortical screws and 6.5 mm Cannulated and Non-cannulated Cancellous screws.

Bone grafts, Bone graft substitutes were used in depressed and comminuted fractures. The source of bone graft was ipsilateral iliac crest.

Postoperative protocol

Postoperatively patients were immobilized with an above knee posterior slab or a compression bandage for 3 weeks. The sutures were removed on the 12thpostoperative day. Antibiotics were given till suture removal by 5 days of

intravenous and 7 days of oral. The patients were advised static quadriceps exercises for initial 3 weeks followed by passive range of motion with protected knee brace and non-weight bearing crutch walking up to 6 weeks. After 6 weeks knee mobilization and weight bearing crutch walking was advocated. An immediate postoperative X-ray was also done, later on repeated at 6 weeks, 3 months and 6 months.

Follow up protocol

The First follow up was done at 2 weeks, during which the surgical scar was inspected and range of movements noted.

The Second follow up done at 6 weeks during which an X-ray was taken to look for signs of fracture union and loss of reduction if any.

The Third follow up was done at 3 months during which one more X-ray was done and a clinical evaluation of union done. Based on the clinical and radiological signs of union patients were allowed partial weight bearing and gradually progressed to full weight bearing.

The patients were then followed up at 6 months, during which time the anatomic and functional evaluation was done using the modified Rasmussen clinical and radiological criteria.

Instruments used in proximal tibial fractures

The various instruments required are -

- 1. Reduction clamps (pointed) for reducing the fracture site
- 2. Periosteum elevator for elevation of periosteum
- 3. Screw drivers for 4.5mm cortical screws, 4mm and 6.5mm cancellous screws
- 4. Hand drill, Power drill
- 5. Drill bit of 3.2mm for drilling the bone
- 6. Tap of different sizes ie., 4.5mm and 6.5mm tap.
- 7. Depth guage for measuring the appropriate size of screws.
- 8. Bone grafting set (mallet, osteotomes)
- 9. Bone impaction set

Implants used in proximal tibial fractures

- 6.5 mm Cancellous bone screw with 8mm spherical head and 3.5 mm hexagonal recess, thread length 16mm, with 4.5mm shaft, 3mm core, 3.2 mm drill bit and 6.5 mm tap.
- 2. 4mm Cancellous bone screw, with 6mm head, 2.5 mm hexagonal recess, core diameter 1.9mm, 1.7mm pitch, 2.5mm drill bit and 4mm tap.
- 3. 4.5 mm Cortical bone screw, with 4.5mm shaft, 3mm core, 3.2mm drill bit and 4.5mm tap.
- 4. K-wires

Buttress Plates

T Buttress plate

L buttress plate with right and left offset.

Locking Compression Plates: with Locking screws 4.5mm for Proximal Tibia.







Indirect depth gauze

Cannulated Screw fixation over K-wires



Wound closure

Sex incidence

Highly significant association of this study with male patients.

Table 1: Frequency of Sex incidence

Sex Of The Patient	No Of Patients	Percentage
Male	28	70%
Female	12	30%
Total	40	100%

AGE Incidence

Highly significant association fracture in the 3^{rd} and 4^{th} decades.

Fable 2: Frequency of Age incidend

Age of the patient	Frequency	Percentage
<35	6	15%
35-45	9	22.5%
45-55	14	35%
55-70	11	27.5%
Total	40	100%

Mode of Injury

In this study mode of injury is highly associated with road traffic accident which accounts for about 60%.

Side of Injury

In our study, there was left sided predominance, compared to the right side.

Type of fracture

Schatzker's classification

In our study, the majority of the fractures were found to be of type II fracture types i.e. Cleavage combined with Depression fractures.

Table 3: Free	juency of	Type of	Fracture
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Schatzker type of fracture	No. of cases	Percentage
TYPE I	7	17.5%
TYPE II	10	25%
TYPE III	8	20%
TYPE IV	4	10%
TYPE V	4	10%
TYPE VI	7	17.5%
Total	40	100%

Methods of treatment

14 cases were managed with Percutaneous cannulated screws, 10 were managed with Buttress plate, 13 by Buttress plate along with Bone graft and 3 cases with Locking plate.

Table 4: Frequency of methods of treatment

Methods of treatment	No. of cases	Percentage
PCCS	14	35%
ORIF with BP	10	25%
ORIF with BP + BG	13	32.5%
ORIF with LCP	3	7.5%
Total	40	100%

Pccs – Per Cutaneous Cannulated Cancellous Screw Orif – Open Reduction Internal Fixation Bp- Buttress Plate Bg-Bone Graft Lcp –Locking Compression Plate

Complications

All fractures united within expected time, not a single nonunion was noted in our series. The cases with wound infection also had stiffness of the knee joint

Table 5: Frequency of Complications

Complication	No. Of Cases	Percentage
Knee Stiffness	5	12.5%
Varus/Valgus Deformity	1	2.5%
Infection, Wound Dehiscence	3	7.5%
Normal	31	77.5%
Total	40	100%

Associated ligamentous injuries

MCL injury was the most commonly associated ligament injury in our series followed by ACL, LCL.

All the ligamentous injuries were managed conservatively by a Brace. The patient's function and outcome were good even without addressing these injuries.

Grading Criteria

Table 6: Modified Rasmussen criteria for clinical assessment

Pain	6
None	U
Occasional	5
Stabbing pain in certain position	3
Constant pain after activity	1
Significant rest pain	3
Walking Capacity	
Normal walking capacity for age	6
Walking outdoor more than one hour	5
Walking outdoor 15 mins-1 hr	3
Walking ourdoor< 15 mins	1
Walking indoor only	0
Wheel chair or bed ridden	3
Knee Extension	
Normal	4
Lack of extension <10 ⁰	2
Lack of extension $>10^{0}$	0
Lack of extension $>20^{\circ}$	2
Total Range of Motion	
Full	6
Atleast 120 ⁰	5
Atleast 90 ⁰	3
Atleast 60 ⁰	1
$< 60^{\circ}$	3
Stability	
Normal stability in Extension and 20 ⁰ Flexion	6
Abnormal in stability in 20 ⁰ Flexion	4
Instability in Extension <10 ⁰	2
Instability in Extension >10 ⁰	0
Power of quadriceps	
Grade 5	2
Grade 3-4	1
Grade < 3	2
Maximum score	30
Excellent	28-30
Good	24-27
Fair	20-23
Poor	<20

Table 7: Modified Rasmussen criteria for radiological assessment

Articular depressions	
None	3
<5mm	2
6-10 mm	1
>10 mm	0
Condylar widening	
None	3
<5mm	2
6-10 mm	1
>10 mm	0
Valgus / Varus angulation	
None	3
$< 10^{0}$	2
100 - 200	1
>20 °	0
Osteoarthrosis	
None / No progress	1
Progression by 1 grade	0
Progression by > 1 grade	1
Maximum score	10
Excellent	9-10
Good	7-8
Fair	5-6
Poor	<5

Clinical Evaluation

The mean Rasmussen Functional score at final follow up was 25.062 (range 15-30).

Table 8: Clinical Assessment

Clinical Result	No. Of Cases	Percentage
Excellent	19	47.5%
Good	16	40%
Fair	3	7.5%
Poor	2	5%
Total	40	100%

Radiological Evaluation

The mean Rasmussen Radiological score at final followup was 7.68 (range 0-9).

Table 9: Radiological Assessment

Radiological Evaluation	No. Of Cases	Percentage
Excellent	5	12.5%
Good	27	67.5%
Fair	5	12.5%
Poor	3	7.5%
Total	40	100%

Table 1): Ra	smussen	's	grading
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Criteria	Excellent	Good	Fair	Poor
Pain evaluation	18	13	9	0
Walking capacity	18	14	6	2
Extension lag	19	14	5	2
Range of movement	21	10	5	4
Stability	25	15	0	0
Functional Results	19	16	3	2
Radiological Results	5	27	5	3

• It was also noted that Clinical results had no significant association with follow up Radiographs (Chi square test, p value = 0.176)

Discussion

Aim of study is to assess functional outcome and radiological outcome in operatively treated tibial plateau fractures in 40 cases. The analysis of the results were made in terms of - age of the patient, sex distribution, mode of injury, side of fracture, analysis of the types, modalities of treatment, complications, associated injuries and the functional outcome. In this series we studied 40 cases of tibial plateau fractures treated only by surgical methods. Different authors use different criteria for the surgical management of these fractures. Seppo E, Honkonen conducted 130 tibial plateau fractures taking into consideration the following for the surgical management: -

Condylar widening of > 5mm

Lateral condyle step of f > 3mm

All medial condylar fractures

In our study, the indications for the surgery were the same standard indications as above and 3mm depression was considered as an indication for surgery in our series ^[3].

In our series we have not formulated any criteria as to particular method of fixation for particular type of fracture. So each case was individualized and treated accordingly as it needed. Most of the type I, some type II were treated with Percutaneous cancellous screw fixation. The split fracture, of >3mm displacement was treated by ORIF. Bone grafting was included along with ORIF with Buttress plate/LCP and screws in type II, III, IV, V and VI wherever necessary.

The major problem faced by us during the study was Knee stiffness and Infection, hence immobilization was more in these patients for stiffness. The infection might be attributed to nosocomial infection.

Inspite of all the associated Ligament injuries and Complications, we were able to achieve 47.5% excellent result, 40% good result (Overall 87.5% acceptable results). In addition we have 7.5% fair and 5% poor results. These results are comparable and on par with other documented standard studies.

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Study	Satisfactory Results		
Rambold, 1992	93%		
Seppo E, 1993	86%		
Joseph Schatzker, 1986	86%		
Our Study, 2018	87.5%		

Conclusion

The conclusions of these studies are

- 1. Displaced condylar fractures of tibial plateau those belonging to Schatzker' stype I and II, the treatment of choice is closed reduction internal fixation/Open reduction internal fixation with Cannulated Cancellous screws. Results are excellent to good by this method.
- 2. The main aim of surgical treatment include accurate reconstruction of the articular surface with elevation of the depressed bone fragment, bone grafting, stable fragment fixation allowing early range of movement.
- 3. Schatzker's type III managed operatively with ORIF with Buttress plate and bone grafting gives good to fair results.
- 4. In Schatzker's type IV fractures which were managed by ORIF and Buttress plating had fair to good results.
- 5. In high velocity injuries belonging to Schatzker V and VI which were managed with Buttress plate/LCP, number of good to fair results were seen.

Functional outcome is better in operatively treated tibial plateau fractures in adults, because it gives excellent anatomical reduction and rigid fixation to restore articular congruity and early motion thereby preventing knee stiffness.

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