

A COMPREHENSIVE STUDY ON MANAGEMENT OF TIBIAL PLATEAU FRACTURES IN ADULTSAmardeep G¹, Ajith Kumar K. S², N. J. Mani³, Muraleedharan⁴, Gangadharan P⁵, Roney Thomas⁶**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: BACKGROUND: Tibial plateau fractures have proved to be fascinating therapeutic challenges during nearly two centuries of written experience. These are serious injuries that frequently result in functional impairment as they affect knee alignment, stability and movements. The principles of treatment of joint fractures included accurate reduction of articular surfaces with early movement of the joint. Our prospective study compared results of surgical vs. conservative management of tibial plateau fractures & evaluated that displaced fractures of the tibial plateau should be treated by surgical methods which give more stable fixation, better anatomical reduction & good results with minimal complication. **MATERIALS & METHODS:** In our series, 41 cases of tibial plateau fractures in adults treated by various methods [including conservative & operative methods] between February 2007 to August 2008 at our institution and followed up for a 12 months (average) with radiological & clinical evaluation. **RESULTS:** Functional evaluation of the knees of 20 tibial plateau fractures treated by surgical methods showed 91% good to excellent results and 9% poor to fair results. 22 tibial plateau fractures were treated by conservative methods showed 82.6% excellent to good results and 17.4% fair to poor results. **CONCLUSIONS:** Displaced tibial plateau fractures should be treated by surgical methods. It gives more stable fixation, better anatomical reduction & good results with minimal complication. The depressed plateau fractures had good results following elevation and bone grafting. **KEYWORDS:** Tibial plateau fractures, surgical, conservative.

INTRODUCTION: The fractures of proximal tibia particularly those that extended into the knee joint are termed as tibial plateau fractures.

Tibial plateau fractures have proved to be fascinating therapeutic challenges during nearly two centuries of written experience. More than thousand hundred articles, thesis and books have documented the trials and tribulations of treating these capricious joint fractures. These are serious injuries that frequently result in functional impairment as they affect knee alignment, stability and movements.¹

The principles of treatment of joint fractures that evolved included accurate reduction of articular surfaces with early movement of the joint. The indications for non-operative vs. operative treatment vary widely among surgeons as do the specific methods for many fractures configurations and concomitant lesions. The objectives of treatment of tibial plateau fractures is precise reconstruction of the articular surfaces, stable fragment fixation allowing early mobilization and repair of all concomitant ligamentous and other soft tissue lesions.²

Our prospective study compared results of surgical vs. conservative management of tibial plateau fractures & evaluated that displaced fractures of the tibial plateau should be treated by surgical methods which give more stable fixation, better anatomical reduction & good results with minimal complication.

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MATERIALS AND METHODS: In our series, 41 patients with 42 tibial plateau fractures (one had bilateral fracture) treated by various methods [including conservative & operative methods] between February 2007 to August 2008 at our institution and followed up for a 12 months (average) with radiological & clinical evaluation.

All patients with closed tibial plateau fractures above the age of 18 years were included in our study. All patients with age less than 18 years, open fractures, ipsilateral distal end femur fractures were excluded from the study.

Data was collected by detailed clinical history, physical examination followed by investigation.

The patients were first seen in the casualty, a thorough history was taken followed by general and local examination of the patients. Appropriate management of the associated injuries was undertaken by specialist of those fields. Intensive care was given to those who presented with shock, fat embolism and immediate resuscitative measure were taken. Once patient's general condition as fit relevant X-rays were taken. Higher investigations such as CT-scan were not done for tibial plateau fractures due to financial constraints.

X-rays were taken in two planes (anteroposterior and lateral).

All fractures were classified according to Schatzker's Classification.

The treatment method was based on the type of fracture, amount of displacement and depression of tibial plateau. Undisplaced fracture was treated with an above knee cast with knee in 15 degree of flexion. Minimally displaced fracture were reduced by traction and compression followed by above knee cast application. Patients with selected unstable lateral plateau, comminuted fractures in elderly osteoporotic patients and significant associated medical disease (cardiovascular, metabolic and neurological) were initially treated with skeletal traction and followed by cast application. During the period of traction patients were advised isometric quadriceps exercise and active ankle and toe movements. At 6 weeks, X-rays were repeated those cases showing union, cast was removed and non-weight bearing crutch walking was advised with active knee movements. At 3 months a repeat X-ray was done and based on clinical and radiological evidence of union, partial weight bearing was allowed which was gradually progressed to full weight bearing.

Surgical method of treatment was mainly based on the type of fracture, amount of displacement, depression and the degree of instability. The patients were taken up for surgery at the earliest possible time depending on their medical condition, skin condition and the amount of swelling. All surgeries were done under C-arm image intensifier control. Fractures were fixed either with percutaneous technique or by open reduction and internal fixation, with or without bone grafting. The fixation devices consisted of T-buttruss plate, L-buttruss plate, 4.5 mm cortical screw and 6.5mm canulated cancellous and non canulated cancellous screws.

Bone grafts were used in depressed and comminuted fracture. The source of bone graft was ipsilateral iliac crest. Most of the type IV, V & VI (Schatzker's Classification) (8 patients) were treated with bicolumnar plating. 2 patients with type VI fracture and 1 patient with associated fracture shaft of tibia which was treated with hybrid fixator.

Post-operatively patients were immobilized with above knee posterior plaster slab or a compression bandage. Antibiotics were given post operatively. The sutures were removed on the tenth post-operative day. The patients were advised quadriceps exercises, knee mobilization and non-weight bearing crutch walking on discharge. An immediate post-op X-ray was also done.

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X-rays taken. Once the union of the fracture was confirmed clinically and radiologically, fixator was removed and advice of initial non weight bearing was given, followed by full weight bearing.

FOLLOW UP: The first follow-up was done at 2 weeks, during which the surgical scar was inspected and the range of movements were noted. The second follow-up was done at 6 weeks during which X-ray was taken to look for signs of union. The third follow-up was done at 3rd month during which one more X-ray was taken and a clinical evaluation of the union done. Based on 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, 12 months and 18 months during which anatomic and functional evaluation done using the Rasmussen's clinical assessment.^{3,4} The post traumatic osteoarthritis was assessed on the most recent radiograph taken with patients standing.

OBSERVATION & RESULTS: The youngest patient in the study was 18 years and the oldest 70 years. 44% of the patients were below 35 years and 44% were between 36-55 years and 12% were above 55 years of age.

In this study 80% were males and 20% were female patients.

In this study, 54% of patients' sustained injury on the right side and 44 % on the left side and 2% had bilateral tibial plateau fractures

The mode of injury was grouped into 5 categories: Road Traffic Accidents, fall from height, fall from surface, sports injuries and others

Classification-SCHATZKER:

Type	Male	Female	Total	Percentage
1	8	2	10	23.8
2	6	0	6	14.28
3	2	0	2	4.76
4	8	2	10	23.8
5	6	4	10	23.8
6	4	0	4	9.52

Table 1

ASSOCIATED INJURIES: In this study 17% of the patients had associated skeletal injuries., 1 patient had associated fracture shaft of tibia which was treated with hybrid fixator. 3 patients had fracture shaft of femur, 1 had fracture distal end of radius, 1 had posterior fracture dislocation of hip, 1 patient had spine injury. 1 patient had bilateral calcaneal fracture

RESULTS: This study group consists of 41 patients with 42 tibial plateau fractures (one patient had bilateral fracture) of which Functional results were assessed by Rasmussens Clinical scoring.

COSERVATIVE RESULTS: 22 fractures by conservative methods.

Type	1	2	3	4	5	6	Total	Percentage
Excellent	4	4	0	5	1	1	15	16.18
Good	0	1	0	0	3	0	4	18.18
Fair	1	0	0	2	0	0	3	13.63
Poor	0	0	0	0	0	0	0	0

Table 2

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SURGICAL RESULTS: 20 fracture were treated by surgical methods.

Type	1	2	3	4	5	6	Total	Percentage
Excellent	5	0	1	2	1	1	12	60.0
Good	0	1	1	1	1	2	6	30.0
Fair	0	0	0	0	1	0	1	5.0
Poor	0	0	0	0	1	0	1	5.0

Table 3

COMPLICATIONS:

Early Complications: In this study 3 patients with tibial plateau fracture had Compartment Syndrome, among these one had Type 2 fracture, one had Type 4 fracture and the last one had Type 5 fracture. One patient had Popliteal Artery injury with a Type 5 fracture. One patient with Common Peroneal nerve injury had Type 4 fracture. One patient had Fat Embolism. 1 patient presented with post-operative wound infection.

Complication	Surgery	Conservative
Compartment syndrome	2	1
Nerve Injury	0	1
Arterial injury	1	0
Fat Embolism	0	1
Wound infection	1	0

Table 4

Late Complications: In this study 4 patients had Instability at knee. 1 patient had knee stiffness and 1 patient with mal-union. No cases of Non-union were recorded

Complication	Surgery	Conservative	Total
Instability	2	2	4
Stiffness	1	0	1
Malunion	1	0	1
Nonunion	0	0	0

Table 5

DISCUSSION: The management of tibial plateau fractures has always been a subject of debate. High energy intra-articular fractures of the tibial plateau cause ongoing management problems for today's orthopedic surgeon.⁵

When reviewing previous studies it is apparent that results are reported collectively without regard to the severity of fracture type. Comparison of contemporary retrospective studies is difficult. However it is possible to separate out these injuries that are described as severe or complex. The result of non-operative management of these injuries has historically been unsatisfactory.^{6,7,8,9}

In patients with undisplaced, stable fractures and in those patients who are strongly contra-indicated for surgery may be treated by conservative means. With careful selection of cases fairly satisfactory percentage of good to excellent results can be obtained by conservative means.

Severe or complex tibial plateau fractures are more commonly seen in the younger age group

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due to high energy trauma. Closed treatment of these injuries had little success in reducing depressed or displaced fracture fragments. This necessitates open treatment in most displaced and unstable fractures, or by hybrid fixation by using limited internal fixation combined with Ilizarov external fixation.

It is extremely important to do a stable fragment fixation and ligament repair in order to regain the complete range of motion.

This study group consists of 41 patients with 42 tibial plateau fractures (one patient had bilateral fracture) of which 20 fracture were treated by surgical methods and 22 by conservative methods. These patients were followed up for an average period of 12 months. 44% patients were between 18-35 years and 44% patients were between 36-55 years and 12% of patients were above 55 years of age respectively. The average age was 41 years. Porter¹⁰ in 1970 reported an average age of 47 years in his study of 68 cases. Bowes and Hohl⁸ in 1982 and Duwelius and Connelly¹¹ in 1988 average age group of 48 yrs.

This study had an 80% male preponderance and remaining 20% were females. Most of the studies by, Marwah et al and Duwelius and Connelly¹¹ showed a male preponderance.

There were five groups based on mechanism of injury. 51% of the case were due to RTA, 20% were due to fall from height, 14% due to fall from level surface, 4% due to sports injuries, 10% due to other injuries. In 1984 Blokker et al.¹² reported 54% of their cases due to RTA, 26% due to fall and 10% due to sports injuries. Chaix et al¹³ in 1982 reported 71% of their cases due to RTA, 16% due to fall from height and 12% due to fall from level surface and 1% due sports injuries.

CONSERVATIVE TREATMENT AND RESULTS: The results of functional evaluation of 23 fractures were treated by conservative methods showed 68 %excellent, 18% good results and 13% fair results. These results were better than study done by Duparc and Ficat¹⁴ where they got excellent to good results in 62% patients. These were comparable to study done by Apley¹⁵ in 1979 reported 80% good results by traction immobilization methods. In 1981 DeCoster et al⁷ reported 61% of good to excellent results following conservative management. Their method of management was mainly by functional cast bracing. DeMorgues and Chaix¹³ in 1969 reported 75% of good to excellent results after cast brace treatment of bicondylar and compression fractures. Post traumatic osteoarthritis changes were seen in 18% patients. These changes were more commonly seen among high velocity trauma in type IV, V and VI fractures. These results were comparable to the study done by Rinopoli and Agletti¹⁶ in 1977. Jensen¹⁷ and group reported 12% incidence of secondary osteoarthritis in conservative treatment.

Average time of union of those fractures managed conservatively was 14 weeks, average time of hospitalization was 21days. The duration was slightly higher than those patients managed surgically because few patients managed by skeletal traction method. Most of the patients managed conservatively were discharged with in a week's time after application of above knee cast.

SURGICAL TREATMENT AND RESULTS: Results of functional evaluation of the knees treated by surgical methods showed 90% excellent to good results and 5% fair & 5% poor results. Chaix et al¹³ reported 86% good to excellent results by surgical means of treatment. Burri et al¹⁸ reported 89% acceptable results of fractures treated by experienced surgeons with accurate reconstruction of articular surface, rigid external fixation and early mobilization. Roberts in 1968 got 67% good to excellent results but they were mainly split compression fractures Jensen¹⁷ et al reported 54%

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excellent to good results with surgical management. They advocated that meniscectomy at the time of surgery and post-operative immobilization was responsible for poorer functional results.

The common complication encountered in surgical group was infection. The rate of infection was 5%. Infection which was not controlled with antibiotics alone & was treated with implant removal after which infection was controlled. There were no incidences of delayed infection.

Joint stiffness seen in one patient which accounted for 5%. Secondary osteoarthritis seen in two patients who accounted for 10% of surgically managed patients. Lachiewicz and Funcknik¹⁹ reported 10% moderate to severe incidence of osteoarthritis in their study of 43 patients over an average follow up period of 2.7 yrs. Jenson et al¹⁷ reported 22% incidence of osteoarthritis in their study of 109 fractures of all varieties followed up over a period of 6 yrs. They attributed this to high percentage to meniscectomy done at the time of surgery. Rinopoli and Agletti¹⁶ reported 31 % of osteoarthritis in patients treated with surgical methods. They observed that arthritis was more frequent in biocondylar fractures, varus deformity and unstable knee in extension. In our study incidence of secondary osteoarthritis was more common in type IV, V and VI fractures.

Malunion was seen in only one patient who had postoperative wound infection who was treated by implant removal and conservative management.

The average time of union of fracture was 17 weeks; the average period of hospitalization was 17 days. De Boek et al²⁰ reported an average stay in hospital of 15 days after operative treatment of displaced tibial plateau fractures.

COMPARATIVE RESULTS OF CONSERVATIVE AND SURGICAL METHODS OF TREATMENT:

Functional evaluation of the knee joint revealed 65.2% excellent results and 17.4% good results by conservative methods and 63.4% excellent results and 32% good results by surgical treatment. Functional results after stratification of fractures in to low velocity injuries (type 1, 2, 3) and high velocity injuries (type 4, 5, 6) showed that conservative treatment results were comparable to surgical treatment in low velocity injuries. In high velocity injuries surgical treatment produced fairly better results than the conservative group.

Infection was seen only in one patient which accounted for 2.5% of the study group. The risk of infection can be reduced by better aseptic precautions, OT disciplines, meticulous soft tissue handling and by use of less bulky implants.

There was no difference in the incidence of instability between the two methods of treatment. There was slightly higher incidence of stiffness seen in surgically.

The correct method & management of tibial condyle fractures depends on good clinical judgment. If rational treatment is to be instituted the surgeon must have a sound knowledge of the anatomy and a clear understanding of the knee examination imaging studies and must be familiar with variety of techniques for treating tibial plateau fractures.

CONCLUSION:

1. Displaced fractures of the Tibial plateau especially those belonging to type IV, type V & type VI tibial plateau fractures should be treated by surgical methods.
2. The depressed plateau fractures had good results following elevation, bone grafting and stable fragment fixation.

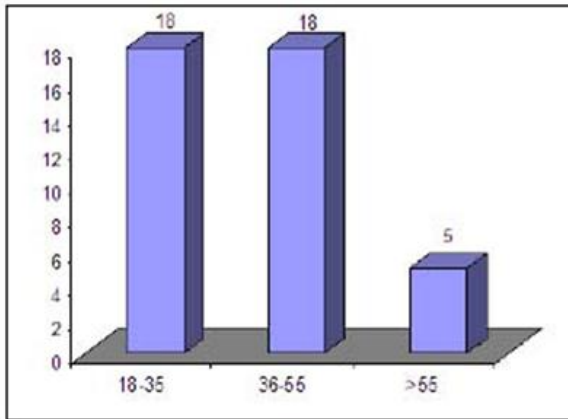
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3. The main objective of surgical treatment include precise reconstruction of articular surface and elevation of depressed bone fragment, bone grafting and stable fragment fixation allowing early mobilization.
4. Conservative treatment is reliable alternative modality of management in low velocity fractures, especially in osteoporotic bones and in patients with significant associated medical disease (cardiovascular, metabolic and neurological).

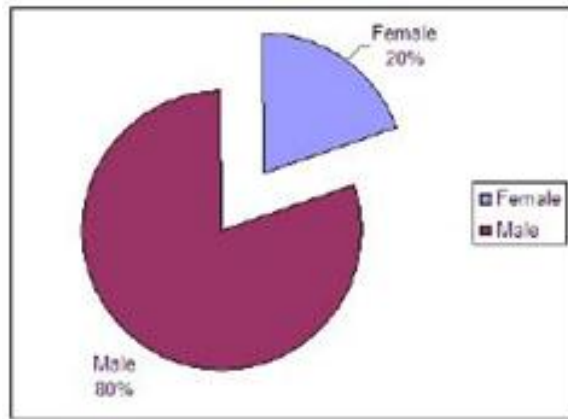
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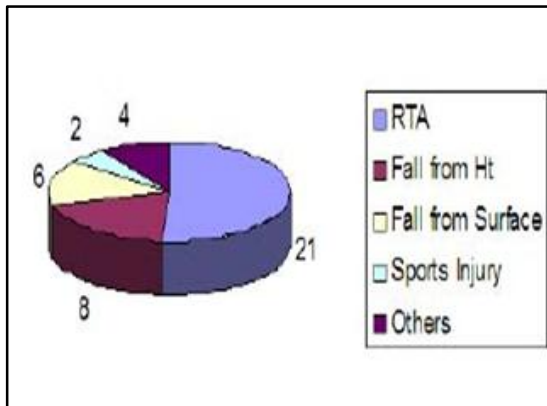
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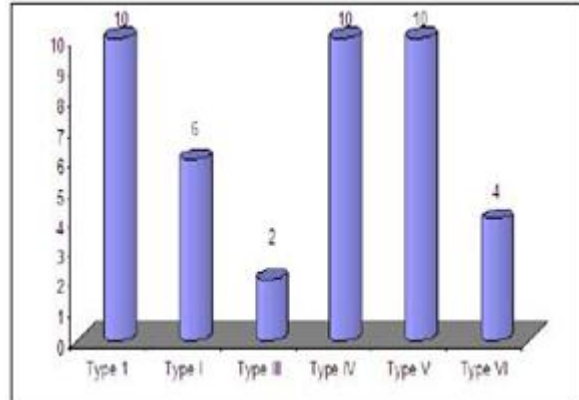
Age Group Distribution



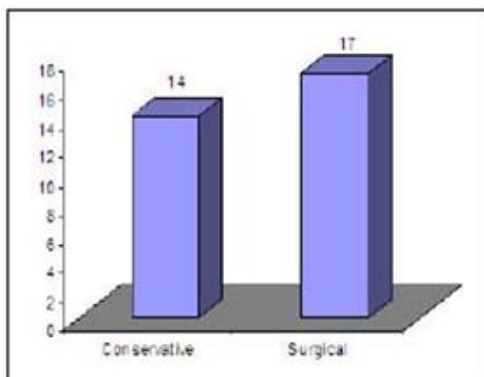
Sex Ratio



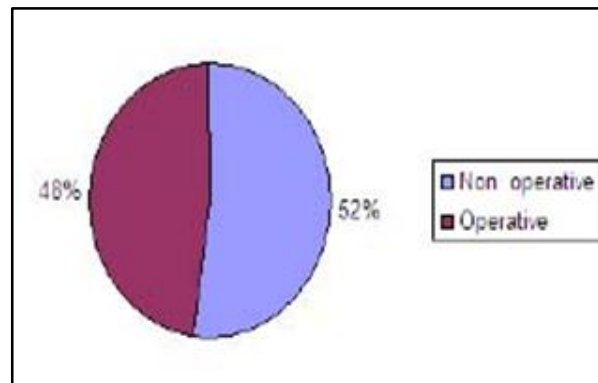
Mode of injury



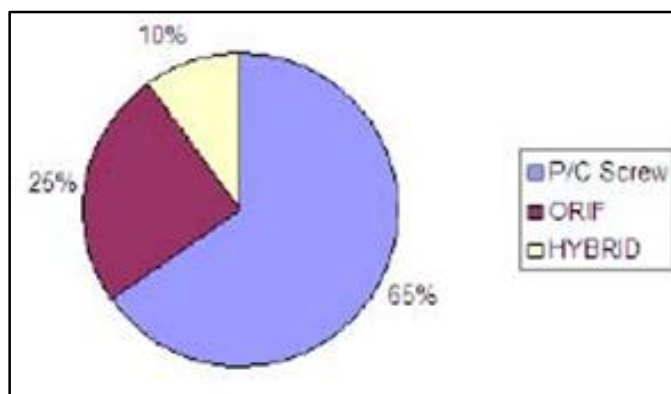
Type of fractures



Mode of treatment



Method of surgical fixation



Complications

AUTHORS:

1. Amardeep G.
2. Ajith Kumar K. S.
3. N. J. Mani
4. Muraleedharan
5. Gangadharan P.
6. Roney Thomas

PARTICULARS OF CONTRIBUTORS:

1. Senior Resident, Department of Orthopaedics, Baby Memorial Hospital, Calicut, Kerala.
2. Senior Resident, Department of Orthopaedics, Baby Memorial Hospital, Calicut, Kerala.
3. Senior Consultant & HOD, Department of Orthopaedics, Baby Memorial Hospital, Calicut, Kerala.

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4. Consultant, Department of Orthopaedics, Baby Memorial Hospital, Calicut, Kerala.
5. Consultant, Department of Orthopaedics, Baby Memorial Hospital, Calicut, Kerala.
6. Consultant, Department of Orthopaedics, Baby Memorial Hospital, Calicut, Kerala.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Ajith Kumar K. S,
 # HF-49, Hutha Colony,
 Bhadravathi, Shimoga-577301,
 Karnataka, India.
 E-mail: dr.ajithkumar01@gmail.com
 drajithkumar79@gmail.com

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