ORIGINAL RESEARCH PAPER

Orthopaedics

VARIOUS MODALITIES OF TREATMENT OF PROXIMAL TIBIAL FRACTURES : A PROSPECTIVE LONGITUDINAL STUDY

KEY WORDS: Tibial plateau, Fracture, Articular

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ABSTRACT

Background: Tibial plateau fractures are one of the commonest intra-articular fractures. They result from indirect coronal or direct axial compressive forces. This makes about 1% of all fractures and 8% of the fractures in elderly. Nevertheless, tibial plateau fractures challenging remain because of their number, variety and complexity. With advancements the treatment of each fracture type is still not defined hence we have taken up this study to analyze various fracture patterns and its outcome. **Methods**: The study includes 40 patients having the fractures of the proximal tibial metaphyseal; metaphyseodiaphyseal with or without intra-articular extension (including upper third fractures of tibia), closed fractures, fractures with Open grade-I wounds (Gustillo Anderson Classification).The study excludes compound fractures having grade II and III (Gustillo Anderson) and Paediatric patients. The treatment method was based on the type of fracture, the amount of displacement , the amount of depression and surrounding skin condition of the tibial plateau.We used the Schatzker classification because it is closest to describing the specific fracture type and it is easy to apply. **Results:** In this study there were 40 patients with mean age of 39.18 (median 38.5 and min – max 25 to 55) with 25 male (62.5%) and 15 (37.5%) female with significant male preponderance. In this study road traffic accident was the commonest mode of injury (65%) and produced different types of fractures, followed by fall from height (22.5%), injury while playing sports (12.5%). **Conclusions:** The correct method of management of tibial condylar fractures depends on good clinical judgment. If rational treatment is to be instituted the surgeon must have sound knowledge of the personality of the injury and a clear understanding of the knee examination, imaging studies and must be familiar with variety of techniques available at present for treating tibial condyle fractures.

INTRODUCTION

Tibial plateau fractures are one of the commonest intra-articular fractures. They result from indirect coronal or direct axial compressive forces. This makes about 1% of all fractures and 8% of the fractures in elderly.

These fractures encompass many and varied fracture configurations that involve medial, lateral or both plateaus with varying degrees of articular depressions and displacements. Each fracture type has its own characteri- stic morphology and response to the treatment. It is essential to determine the force of injury since high- energy trauma is associated with considerable soft tissue and neurovascular damage. Apart from tibial plateau bony injury, meniscal tear and ligament injuries should also be assessed

High velocity injury sustained in automobile disasters and increase in road traffic accidents as a whole is creating an ever-growing problem. Since man has taken to traveling at high speeds in the sitting position with the loading edge composed of flexed hind limbs, when the machine in which the subject is traveling stops suddenly, most of the impact is taken at first upon the patella, then the tibia and femur in varying proportions and at various positions. The stationary lower limb may be struck by a moving object; this is the common pedestrian injury, the so called "bumper fracture", since the bumper of most vehicles being placed roughly at knee height. Thus road traffic accident is the main cause for tibial platue fracture as it is mentioned in different studies.1,2

Due to advancement, especially in orthopedic trauma a better understanding of biomechanics, quality of implants, principles of internal fixation, soft tissue care, antibiotics and asepsis have all contributed to the radical change. Thus we have advanced from the conservative approach to internal fixation in fractures as an acceptable mode of treatment. Nevertheless, tibial plateau fractures challenging remain because of their number, variety and complexity. With advancements the treatment of each fracture type is still not defined hence we have taken up this study to analyze various fracture patterns and its outcome.

METHODS

This prospective longitudinal study performed at Dr.B.R. Ambedkar Medical College and Hospital, Bangalore, Karnataka during 2nd November 2020 to 2nd February 2022. The study includes 40 patients having the fractures of the proximal tibial metaphyseal, metaphyseodiaphyseal with or without intra-articular extension (including upper third fractures of tibia), closed fractures, fractures with Open grade-I wounds (Gustillo Anderson Classification) as given in Table 1 and Figure 1.The study excludes compound fractures having grade II and III (Gustillo Anderson) and pediatric patients.

The patients were first seen in the casualty. The history was taken followed by general and local examination of the patient. 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. Higher investigations such as CT scan were done for tibial plateau fractures whenever necessary.

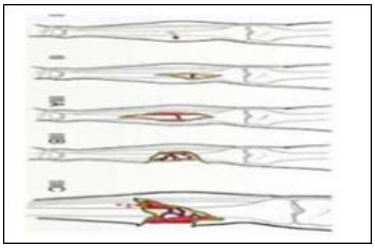
The treatment method was based on the type of fracture, the amount of displacement , the amount of depression and surrounding skin condition of the tibial plateau. We used the Schatzker classification as shown in Figure 2 because it is closest to describing the specific fracture type and it is easy to apply.4,5 Based on fracture pattern surgical or conservative treatment was done for all type of fracture. 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 done under C-arm image intensifier control. Fractures were fixed either with

percutaneous technique or by open reduction and internal fixation. The fixation devices consisted of T Buttress plate, Hockey plate, 4.5 mm cortical screws and 6.5 mm cannulated, non-cannulated cancellous screws and external fixator as required as given in Figure 3. Bone grafts were used in depressed and comminuted fractures. The source of bone graft was ipsilateral iliac crest.

Table 1: Gustilo-Anderson open fracture classification

Gustilo grade	Definition
I	Open fractures have clean wound less than 1 cm long.
II	Open fractures wound, the laceration is more than 1cm long but is without extensive soft tissue damage, skin flaps,or avulsions.
IIIA	Open fractures have extensive soft-tissue lacerations or flaps but maintain adequate soft-tissue coverage of bone and adequate periosteal coverage.
IIIB	Open fractures have extensive soft-tissue loss with periosteal stripping and bone exposure. They usually are massively contaminated.
IIIC	Open fractures with an arterial injury that requires repair regardless of the size of soft tissue wound.

Figure 1: Gustilo open fracture classification.

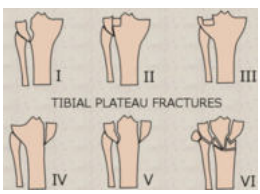


Postoperatively patients were immobilized with an above knee posterior slab or a compression bandage for 3 weeks. The sutures were removed on the 12th post-operative day. Antibiotics were given until suture removal by 5 days of intravenous and 7 days of oral. The patients was advised static quadriceps exercises for initial 3 weeks followed by passive range of motion with protected knee brace and non-weight bearing crutch walking upto 6 weeks, after 11 weeks knee mobilization and weight bearing crutch walking initiated. An immediate postoperative X-ray was also done later on repeated at 6 weeks, 3 months and 6 months.

The first follow up was done at 4 weeks, during which the surgical scar was inspected and range of movements noted. The second follow up done at 8 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.

Figure 2: Schatzker classification of tibial platue fracture.



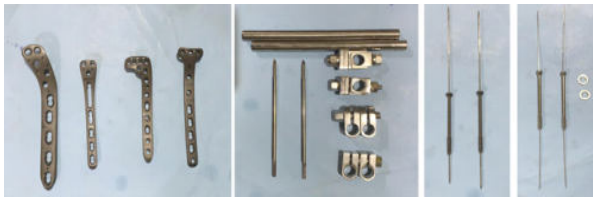


Figure 3: Anatomical lock plates with sleave, T-Buttress plate, Hockey plate & L Buttress plate, Shans pin with AO clamp & rod.

RESULTS

In this study there were 40 patients with mean age of 39.18 (median 38.5 and min – max 25 to 55) with 25 male (62.5%) and 15 (37.5%) female with significant male preponderance. In this study road traffic accident was the commonest mode of injury (65%) and produced different types of fractures, followed by fall from height (22.5%), injury while playing sports (12.5%).

There is no significant association of injury to proximal tibia fractures. We had associated injuries of 3 calcaneum fractures. 7 distal radius fractures, 13 facial laceration, 3 galleazzi fracture, 7 clavicle fracture, 2 proximal phalanx fracture and 2 patients with rib fractures. Majority of the patients came with closed injury. Closed being 35 (87.5%) and open being 5 (12.5 %). Patients with open injury had Gustillo Anderson Type 1 fractures. All the fractures in this study is classified according to Schatzker's classification system which is shown in Table 2.

All the patients were treated surgically. The treatment according to classification as shown in Table 3. Most of the patients were operated by indirect open reduction percentage being 55%, followed by percutaneous CC screw 25%, followed by MIPPO 20%. Arthrotomy or visualization of joint surface was not done in any of the patients.

Table 2: Patient distribution according to Schatzker's classification.

Injury Type	No of Patients	Percentage
1	8	20
2	3	7.5
3	2	5
4	7	17.5
5	8	20
6	12	30
Total	40	100.0

On follow up 26 (65 %) patients did not have any complains of pain, 10 (25%) had complains of occasional pain and 4 (10%) had complains of stabbing pain. On follow up 24 (60%) patients could walk normal distance for age, 14 (35%) patients could walk more than 60 mins, 2 (5%) patient could walk between 15-60 mins (40 mins). Normal knee extension was seen in 32 (80%) patients and less than 10 degree of lack in extension was seen in 8 (20%) patients. On follow up 26 (65%) patients had normal range of motion, 13 (32.5%) patients had 120 degrees of motion, 1 (2.5%) patient had 90 degrees of motion. The one patient with 90-degree knee flexion was 72 year old and had type II fracture and was non-compliant for physiotherapy. On follow up 32 (80%) patients had no instability, 8 (20%) patients had abnormal instability in 20 degrees flexion. In 65% of the patient's union was between 10-14 weeks and in 35% percent of the patients union was between 15-18 weeks.

Table 3: Tratement according to Schatzker's classification.

Injury classification	CC screw	T-buttress plate	Anatomical plate	Plate +external fixator	Dual buttress plate	Total

I	6	2	0	0	0	8
II	1	2	0	0	0	3
III	0	2	0	0	0	2
IV	3	4	0	0	0	7
V	2	2	2	0	2	8
VI	0	3	3	0	6	12
Total	12	15	5	0	8	40

Table 4: Comparison between injury classification and radiological score.

Injury classification	Rasmussen's radiological score			Total
	Excellent	Good	Fair	
1	8	0	0	8
2	2	1	0	3
3	1	1	0	2
4	4	3	0	7
5	6	2	0	8
6	8	3	1	12
Total	29	10	1	40
	(72.5%)	(25%)	(2.5%)	(100%)

Table 5: Comparison between injury classification and clinical score.

Injury classification	Rasmussen's clinical score			Total
	Excellent	Good	Fair	
I	7	1	0	8
II	1	1	1	3
III	1	1	0	2
IV	7	0	0	7
V	5	3	0	8
VI	6	3	3	12
Total	27	9	4	40
	(67.5%)	(22.5%)	(10%)	(100%)

Table 4 and Table 5 presented the comparison injury classification and radiological score, comparison between injury classification and clinical score.

DISCUSSION

The management of tibial plateau fracture has always been a subject of debate because of their variety and complexity. Despite many advances in the care of intraarticular fractures, tibial condylar fractures continue to be a difficult surgical problem.

When reviewing previous studies, it is apparent that results are reported collectively without regard to the severity of the fracture type. A comparison of contemporary retrospective studies is difficult. However it is possible to separate out these injuries that are described as "severe or complex". The results of the non-operative management of these injuries have historically been unsatisfactory.[4,6,7]

The factors determining prognosis in the high-energy proximal tibia fractures are: the degree of articular depression, the extent and separation of the condylar fractures, diaphyseal-metaphyseal comminution and dissociation, the integrity of the soft tissue envelope, and the associated ligamentous injuries.

If we take age into consideration, in our series the youngest patient is 25 years and oldest is 55 years of age with 80% in the age group of 31-50 years showing that majority of the patients fall in the age group of active earning people with average age being 38.3 years. To add to it being the most active group they are usually under time constraint making their driving to be more rash increasing the chances of road traffic accidents and subsequent proximal tibial fractures. Similar results have also been found by Porter in 1970 reported an average age of 47 years in his study of 68 cases.[8] Duvelius and Conolly in 1988 and Bowes and Hohl in 1982 and reported average age group of 48 years.[9,10]

This study had male preponderance. The reason could be males being the earning member of the family causing the need to travel more, thereby increasing the chances of accidents. Females usually are at home and travel only for social purposes thereby decreasing the incidence of accidents among them. All the studies by Duvelius and Conolly, Marwah et al and Bowes and Hohl showed a male preponderance.[9-11]

In our study, 22 patients sustained injury to the right and 18 patients to the left. The difference between them being negligible there is no specificity to a particular side towards injury. Rasmussen reported the fractures were equally distributed in the right and left knee that is 131 on right and 129 on left.[1]

Road traffic accident was the commonest mode of injury (65%) and produced different types of fractures, followed by fall from height (22.5%), injury while playing sports (12.5%). Chaix et al in1982 reported 71.6 of their cases were due to road traffic accidents 16% due to fall from height, and 1% due to sports injuries.[2] Blokker et al in 1984 reported the most common mechanism of injury were motor vehicle accidents 43.7%.[6] Rasmussen reported most common cause was by road traffic accidents that is 45% of the cases.[1] Lansinger reported 31% of the patients injured due to direct trauma, 33% due to fall from height and 45% were injured in road traffic accidents.[12]

All the fractures in this study are classified according to Schatzker's classification system. Hence our findings differ from the findings in literature given below, the possible explanation could be poor safety precautions by citizens and weaker bone structure. Studies done by Hohl in 1991 reported 50-70% injuries affecting lateral condyle, isolated medial condyle lesions in 10-23% and bicondylar, lesions found in 10-30%.[10] Rasmussen reported 70% of the injuries affecting lateral condyle, 12% affecting medial condyle and bicondylar lesions in 18%.[1] Lansinger reported 70% affecting the lateral condyle, 11% medial condyle and 19% bicondylar lesions.[12]

Based on our study surgical methods give excellent to good results. Similar reports have been published by Chaix et al reported 86% good to excellent results by surgical means of treatment.[2] Tscherne reported 190 (77%) of the 244 cases of tibial plateau fractures treated by surgical methods showed good results.[13] Keogh reported, out of 13 patients treated for displaced tibial plateau fractures with percutaneous screw fixation 11 had satisfactory results, one had fair and one had poor results.[14] Stokel reported 65% had good to excellent results after being treated by surgical means with operative treatment.[15] Roberts in 1968 got 76% good to excellent results but they were mainly split compression fractures.[16] Burri et al reported 89% acceptable results of fractures treated by experienced surgeons with accurate reconstruction of articular surface, rigid external fixation and early mobilization.[17]

All fractures in this studies treated surgically were treated with various modalities. On reviewing numerous series where they have studied various methods of treatment of different fracture types, but it is not mentioned anywhere where they advocate one particular type of implant or method for a particular fracture type. In our study implant selection was based on the type of fracture, the skin condition and the financial considerations of the patient and according to the surgeons preference.

In an article that has been published by Shrestha et al in the Kathmandu University Medical Journal where they had reviewed 81 patients in whom Type 1, 2, 3 were treated with

CC screws whereas 5 and 6 were treated with dual buttress plate or external fixator.[18] In a study of 33 patients by Ariffin et al, he used Modified hybrid fixator for high-energy Schatzker V and VI tibial plateau fractures and he achieved (48%) excellent Rasmussen knee functional scores (42%) had a good functional.[19]

Most of the patients were operated by indirect open reduction percentage being 55%, followed by percutaneous CC screw 25% (closed reduction), followed by MIPPO 20%. Being intra articular fractures of major weight bearing joint articular restoration is an essential feature of management and hence to achieve this indirect open reduction was done in majority of the cases.

Keogh reported, out of 13 patients treated for displaced tibial plateau fractures with percutaneous screw fixation 11 had satisfactory results, one had fair and one had poor results.[14] Stokel reported 65% had good to excellent results after being treated by surgical means.[15]

Our average follow up period is 10 months minimum being 6 months and maximum being 19 months. We have evaluated results as per Rasmussen's clinical and radiological criteria Rasmussen's clinical score 67.5% have excellent results, 22.5 % have good results and 10 % have fair results. Similar results were reported by Roerdink et al reported.[20]

In 65% of the patient's union was between 10-14 weeks and in 35% percent of the patients union was between 15- 18 weeks. In a similar study done by Biyani et al where they studied 32 patients with proximal tibial fractures they found the average time to fracture union was 12 weeks (range 10 to 20 weeks).[21]

Rasmussen's score radiologically is defined by parameters like articular depression, condylar widening, varus valgus deformity and osteoarthrosis on final follow up. In our series of patients treated surgically according to Rasmussens radiological score 72.5% have excellent results, 25 % have good result and 2.5 % fair result. Jensen et al reported 54% excellent and good results with surgical management.[13] They advocated that meniscec- tomy at the time of surgery and postoperative im- mobilization was responsible for poorer functional results

Funding: No funding sources Conflict of interest: None declared Ethical approval: The study was approved by the institutional ethics committee I.

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