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Dr. Pathik Vala
MS Ortho, DNB Ortho,
Assistant Professor, C.U. Shah
Medical College, Surendranagar,
Gujarat, India

Dr. Rakesh Goyal
MS Ortho, Senior Resident,
Gangaram Hospital, Delhi, India

Dr. Ajay Devda
MS Ortho, Consultant
Orthopaedic Surgeon, Mavjat
Hospital, Palanpur, Gujarat,
India

Assessment of results of different modalities of treatments in fractures of Tibial plateau

Dr. Pathik Vala, Dr. Rakesh Goyal and Dr. Ajay Devda

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Abstract

Introduction: The knee joint is complex joint and is the commonly injured joint now a day because of increased vehicular trauma and sports related injuries. Being superficial joint and more exposed to external forces, this joint easily gets injured⁵. Intra-articular fractures of proximal tibia are difficult to treat. Age, skin conditions, osteoporosis further increase the obstacles in the healing process.

Material and method: The criterion for selection of the cases was a radiologically demonstrable fracture of the tibial condyle with the fracture line extending into the articular surface of the knee joint. Patients with polytrauma and multiple fractures were excluded from the study. The fractures were classified using the method of Schatzker's classification

Computerized Tomographic evaluation was done in cases which had more comminution and when x-ray was inconclusive. All of the cases in this study were treated operatively as articular surface reconstruction was the main consideration.

Patients were evaluated for one year, with serial x-rays at 1,2,3,6 and 12 months. The results were evaluated using the functional grading of Rasmussen *et al*.

Observations: The RTA is the most common mode of injury present between the age group 22 yrs to 75 yrs with almost equal distribution in males and females.

Type II fracture pattern (44.4%) is most common type of fracture followed by type VI (22.2%) then type V (14.8%). The treatment modality varies from CCS fixation, ORIF with fragment elevation with or without bone grafting and unilateral or dual buttress plating according to varying nature of the fracture pattern.

Results of surgery are acceptable (92.6%) for the varying type of fractures except complication developed due to infection in terms of decreased ROM and stiffness which lead to poor results (7.4%). It is mandatory to delay the surgical procedure till the soft tissue condition improves. This may decrease the chances of complications like wound dehiscence and infection.

Conclusion: In our series type II is the most common type of fracture pattern. CT scan with three dimensional reconstructions gives accurate idea of fracture geometry for preoperative planning for osteosynthesis. Result of various types surgeries are good for various patterns of fracture pattern except when complications developed in elderly patient with type VI fracture pattern in the form infection and stiffness which led to an unacceptable outcome Medial side buttress plating is always desirable in bicondylar fracture pattern with unstable medial condyle as otherwise it collapses into varus.

Keywords: Modalities, treatments, fractures, Tibial plateau

Introduction

The knee joint is complex joint and is the commonly injured joint now a day because of increased vehicular trauma and sports related injuries. Being superficial joint and more exposed to external forces, this joint easily gets injured^[1].

Intra-articular fractures of proximal tibia are difficult to treat. Age, skin conditions, osteoporosis further increase the obstacles in the healing process. Various modalities of treatment are available but no ideal treatment has yet evolved. At the Chicago Orthopedic society in 1956 Manson Hole has rightly mentioned that "these fractures are tough"

Complex kinematics of its weight bearing position and complex ligamentous stability and articular congruency are the main reason why these fractures are of concern to surgeon and cause disability to the patients.

Various studies have been carried out and different treatment modalities have been advised, consensus has not been reached. As these are problem fractures we have undertaken a study on the management of tibial condylar fractures.

Correspondence

Dr. Ajay Devda
MS Ortho, Consultant
Orthopaedic Surgeon, Mavjat
Hospital, Palanpur, Gujarat,
India

The mobility and stability of the lower limbs mostly depends upon the integrity of knee joint. With an aim of achieving a stable, well aligned, mobile joint with minimum articular irregularities, we started our study using different previous and recent methods for treatment of these fractures.

Aims and Objective

1. To evaluate the end results of tibial plateau fractures treated by various surgical modalities
2. To evaluate the effectiveness of the different modalities of the treatment and their complications.

Materials and methods

It is a prospective study. 27 cases having tibial plateau fracture, treated in Pramukh swami hospital, karamsad in the period between Feb.2013 till Aug 2014 were included in this study. The criterion for selection of the cases was a radiologically demonstrable fracture of the tibial condyle with the fracture line extending into the articular surface of the knee joint. Patients with polytrauma and multiple fractures were excluded from the study. The fractures were classified using the method of Schatzker's classification [2].

Absolute indications for surgical treatment of tibial plateau fractures are³:

- An open fracture
- Associated compartment syndrome
- Acute vascular injury
- Irreducible fractures

Management in Casualty

On admission the patient was thoroughly assessed clinically. The cause of injury was inquired; vitals parameters were checked; associated head, neck, chest, abdominal injuries were looked for.

On local examination skin condition noted, fracture blisters; haemarthrosis; open or closed; distal neurovascular compromise; any signs of compartment syndrome noted. Any other associated limb injury or bony injury was noted.

According to the general condition and vital parameters intravenous access was sought for and intravenous fluids given accordingly. Other bony injuries were immobilized and appropriately treated.

Surgically Treated Group

In the prospective study of 27 cases depression more than 2-4 mm or split in either sagittal or coronal plane was indication for surgery. Computerized Tomographic evaluation was done in cases which had more comminution and when x-ray was inconclusive and MRI was done in suspected ligamentous and soft tissue injuries. All of the cases in this study were treated operatively as articular surface reconstruction was the main consideration. There was no strict surgical protocol followed in treating these cases. Most of the cases were operated within 2 days of admission. If articular cartilage and meniscal injuries were noted in MRI, then arthrotomy was undertaken.

The patient was suitably anaesthetized-regional or general as the case may be. Surgery was performed in supine position under tourniquet control. Incisions used were medial or lateral parapatellar, midline or two separate for bicondylar fracture. Recommended A-O technique of fracture fixation was used.

Implants Used For Internal Fixation of Tibial Condylar Fracture

Butress Plate

The widening ends of long bone consist of large amount of

cancellous bone. Such bone is comparatively weaker and has tendency of axial deviation or bending under the effect of compressive or shearing force. A lag screw cannot prevent the deformity and in order to supplement the fixation a buttress plate is essential to prevent collapse.

Types : T plate
L plate

Hockey stick plate

T plate has a horizontal and vertical limb. It is thin plate and helps in preventing a thin cortex or defect in cancellous bone from collapsing. L plate is of 2 types left and right offset with a double bend to fit onto the plateau. Hockey stick plate is stout and stronger and majority of times used to buttress lateral plateau.

Locking compression plate

Locking compression plates are indicated for certain high energy bicondylar fractures, those with severe comminution and in osteoporotic fractures. Laterally based locking plate offers an alternative to an additional medial plate or external fixator for support of the medial column in bicondylar fractures [4].

Interfragmentary compression cannot be achieved by locked plates; supplementary use of Interfragmentary screws may be required to prevent loss of reduction and to ensure adequate compression of the fragment [4].

Screws

1. Cortical screws - 4.5 mm diameter of various lengths
2. Cancellous screws:- 16mm, 32mm partially threaded and fully threaded
3. Locking screws

- Cortical screws have a thick core with narrow thread and are used for purchase in cortical bone
- Cancellous screws have a thin core with wide and deep threads and used for purchase in epiphyseal and metaphyseal areas of bone Full threaded screws acts as fastening device for the plate. Partially threaded screws are used as lag screws to achieve compression of fractured articular surface.

Operative Protocols

Central Depression Fracture

A window is made in the metaphyseal area below the depressed fragment, the depressed fragment elevated and autogenous corticocancellous bone graft packed beneath. Autogenous bone graft was harvested from the anterior aspect of the iliac crest. Fragment and graft were stabilised with cancellous screws or plate fixation.

Split and Depressed Fracture

Surgical intervention is necessary in a fracture more than 2-4 mm split and depressed. The depressed fragment is elevated and autogenous bone grafts from iliac crest are put and split is reduced and reduction is held with Kirschner wires. The fragments are then fixed with suitable plates and cancellous and cortical screws.

Total Condylar Depression

Fracture of medial or lateral condyle needs appropriate reduction as malunion may develop with varus or valgus malalignment. The depressed plateau is elevated, articular surface reconstructed and fixed with buttress plate.

Bicondylar Fracture

A mid line or two incision technique is used for reduction of both the condyles. Arthotomy is done for inspection of ligament injury or meniscal injury. Meniscectomy done if indicated. Depending upon comminution fixation is done by L, T or hockey stick plate or locked plates and cancellous screws. Dual plating can be done if other side is unstable where collapse may occur.

Post-Operative Care

In all the surgeries wounds were closed over suction drains. The drains were removed after 48 hrs. Above knee slab or removable knee brace with leg elevation given to decrease the pain and edema
Injectable antibiotics given for 3 to 5 days Static quadriceps exercises and ankle pump exercise started on second day. The

patients with stable fixation were allowed intermittent knee mobilization once the wound pain subsided, early in type I, II and III in 5 to 10 days and late in type V and VI in 14 days or later depending upon comminution of fracture. Stitches are removed on ten to twelve days and progressive muscle strengthening exercises along with passive exercises instituted. Knee immobilisation with brace or above knee cast was used in cases with ligamentous injuries for 4 to 6 weeks. Weight bearing is deferred until evidence of union is seen on x-rays (usual by 14 -16 weeks). The patient was followed up every 4 weeks for a period of one year. Partial weight bearing was started from 10- 14 weeks depending upon the fracture configuration and correlation with the x-ray. Full range of motion is expected at 8-10 weeks after discharge. The results were evaluated using the functional grading of Rasmussen [5] *et al.*

Table 1

	Points	Acceptable		Unacceptable	
		Excellent	Good	Fair	Poor
A. Subjective complaints					
a. Pain					
No pain	6				
Occasional ache, bad weather pain	5				
Stabbing pain in certain positions	4	5	4	2	0
Afternoon pain, intense, constant pain around the knee after activity	2				
Night pain at rest	0				
b. Walking capacity					
Normal walking capacity (in relation to age)	6				
Walking outdoors at least one hour	4	6	4	2	1
Short walks outdoors > 15 minutes	2				
Walking indoors only	1				
Wheel-chair/bedridden	0				
B. Clinical signs					
a. Extension					
Normal	6				
Lack of extension (0 to 10 degrees)	4	6	4	2	2
Lack of extension > 10 degrees	2				
b. Total range of motion					
At least 140	6				
At least 120	5				
At least 90	4	5	4	2	1
At least 60	2				
At least 30	1				
0	0				
c. Stability					
Normal stability in extension and 20 degrees of flexion	6				
Abnormal instability 20 degrees of flexion	5	5	4	2	2
Instability in extension < 10 degrees	4				
Instability in extension > 10 degrees	2				
Sum (minimum)		27	20	10	6

Results

Age incidence

The age ranged between 20-75 years

Table 1

Males	26-74 years
Females	22-75 years
Average	48.2 years

Sex incidence

Table 2

Males	14	52%
Females	13	48%

Mode of injury

Table 3

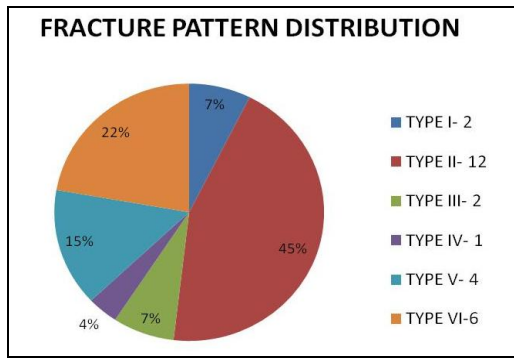
RTA	23	85.2%
DOM	4	14.8

Distribution of fracture pattern

Table 4

Type of fracture	No. of patients	Percentage
I	2	7.4%
II	12	44.4%
III	2	7.4%
IV	1	3.7%
V	4	14.8%
VI	6	22.2%

Majority of the cases from this study were type II (44.4%), next were type VI (22.2%)



Modalities of treatment

Table 5

Modality of treatment	No. of patients
CCC fixation	3
ORIF+EV+ Buttress P/S	11
ORIF+EV+BG Buttress P/S	10
Dual plating	3
Total	27

**Type of treatment according to fracture pattern
Type I**

Table 6

Modality of treatment	No. of patients
CCS fixation	2

Type II

Table 7

Modality of treatment	No. of patients
CCS fixation	1
ORIF+EV+ Buttress P/S	7
ORIF+EV+BG Buttress P/S	4

Type III

Table 8

Modality of treatment	No. of patients
ORIF+EV+BG Buttress P/S	2

Table 9

Modality of treatment	No. of patients
ORIF+EV+ Buttress P/S	1

Type V

Table 10

Modality of treatment	No. of patients
ORIF+EV+ Buttress P/S	1
ORIF+EV+BG Buttress P/S	3

Type VI

Table 11

Modality of treatment	No. of patients
ORIF+EV+ Buttress P/S	2
ORIF+EV+BG Buttress P/S	1
Dual plating	3

Hospital stay in days

Minimum	3 days	Maximum	32 days
Mobilization in days			
Minimum	3 days	Maximum	20 days
Weight bearing in weeks			
Minimum	12 wks	Maximum	28 wks

Knee movement

Table 12

>120 degree	23
90-120 degree	3
<90 degree	1

Complications

Table 13

Pain	3
Infection	2
ROM < 90 degree	1
Varus	2
Arthritis	2

Table 14

Results	No. of patients	percentage	
Excellent	20	74.1%	Acceptable
Good	5	18.5%	92.6%
Fair	1	3.7%	Unacceptable
Poor	1	3.7%	7.4%



Fig 2

Most of the cases in study were due to RTA and type II fracture pattern was most commonly found pattern in our study. Intra-articular pathology was found in two patients on MRI of type VI fractures where lateral condyle of tibia displaced lateral to lateral femoral condyle and associated with torn lateral meniscus for which lateral partial meniscectomy done through arthrotomy. Patients who had type I and type II fractures were mobilized early and allowed early ROM and early weight bearing. Patients who had type V and type VI fractures were gradually mobilized and weight bearing was delayed.

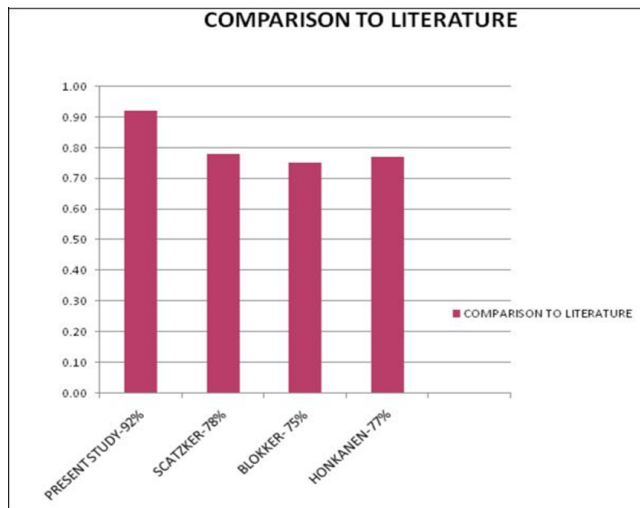


Fig 3

Discussion

The main purpose of the study is to evaluate outcome of the surgery of the study group; hence all the patients that included in the study are of the operative group. We have not included any conservatively managed group. Traction, bracing and external fixator are not done in any of the patient as this is not considered as a preferred modality of the treatment. Our study shows the effectiveness of the operative treatment as the articular surface was restored anatomically and fixed with suitable implant for early mobilization.

Type I fractures 2 in number (7.4 %) are operated because the displacement of articular surface was more than 2mm. Most of these cases are of RTA. Postoperatively these patients are immobilized in brace and active ROM started on third postoperative day and weight bearing is allowed as early as possible (avg.11 wks). These patients achieved full ROM without any deformity and excellent result. Type II fractures are 12 in number (44.4%). These fractures are the most common group in our study. All of these patients are operated with elevation of the depressed fragment, bone grafting and reduction of fracture and fixed with buttress plate. Those patients who have minimum displacement and comminution, bone grafting is not done. Two of these patients showed collapse, out of which one is elderly (no. 2, 72 yrs) with osteoporosis and other is young (no.19, 38 yrs) with severe comminution and inappropriate grafting (big size graft) leading to displacement of fracture fragment. Postoperative follow up of these groups showed good to excellent result.

Type III fractures are present in 2 patients (7.4%). One of these patients is operated one week late because x-ray was inconclusive on day one and continued to have pain on active ROM. CT was showing depression more than 2mm, so underwent elevation of plateau, bone grafting and cancellous screw fixation. In another patient lateral plateau was depressed hence lateral plateau is buttressed with plate. Both the patients showed excellent result.

We have only one (3.7%) case of type IV fracture (no.21). This patient is operated with elevation of the medial plateau and fixed with two cancellous screws. This patient is mobilized late so as to prevent collapse of the fracture fragment and varus deformity as the strength of the construct is inadequate. Outcome is excellent. (Rasmussen ^[5] *et al* score-28)

Type V fractures are 4 in number (14.8%). Most of these fractures are displaced and comminuted. All of the patients are treated with buttress plate from one side, either medial or

lateral depending on the comminution. One of the four patients (no.26) is treated with medial buttress plate by MIPPO technique as lateral plateau was undisplaced with intact fibula. One patient showed varus deformity (no.2) because of collapse of medial side as that side was not buttressed. All of the patients have good to excellent function. (Rasmussen *et al*)

In 2004 James H Lubowitz, Wylie S. Elson, Dan Guttman⁶ studied arthroscopic management of tibial plateau fractures and concluded that arthroscopy is a valuable tool for the assessment of tibial plateau fractures and is the treatment of choice for associated intra-articular pathology. In addition, all arthroscopic reduction and internal fixation (ARIF) is recommended for type III fractures and is a consideration for types I, II, and IV.

In 2006, Barei D P, Nork S E, Mills W J ^[7], *et al* studied 83 bicondylar fracture treated with medial and lateral plate fixation through two exposures. Out of 83, 23 male and 18 females with mean follow-up of 59 months were included in the study. Two patients had deep infection. Seventeen (55%) of those patients had satisfactory articular reduction, 28 patients (90%) had satisfactory coronal plane alignment and 31 patients had satisfactory tibial plateau width. They concluded that satisfactory articular reduction was significantly associated with a better musculoskeletal functional assessment score. Medial and lateral plate stabilization of comminuted bicondylar tibial plateau fracture through medial and lateral surgical approach was a useful treatment method.

Conclusion

In our series type II is the most common type of fracture pattern. Road traffic accidents are the main cause of injury with males and females almost equally affected. CT scan with three dimensional reconstruction gives accurate fracture geometry for preoperative planning for osteosynthesis. Result of various types surgeries are good for various types of fracture pattern except when complications developed in elderly patients of type VI fracture pattern in the form infection and stiffness which led to an unacceptable outcome. It appears that all these problematic cases in the entire series belong to type VI group. So, alternative modality such as external fixator should be strongly considered for such a fracture pattern. Though locking compression plates are used in two of the patients, the results are same as the conventional plating but the numbers of cases in the series are insufficient to draw meaningful conclusion. Medial side buttress plating is always desirable in bicondylar fracture pattern with unstable medial condyle, to prevent delayed medial collapse and undesirable varus deformity.

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