



A STUDY OF MANAGEMENT AND OUTCOME OF PROXIMAL TIBIA PLATEAU FRACTURE BASED ON THREE COLUMN CONCEPT

Orthopaedics

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ABSTRACT

Introduction: proximal tibia fractures are one of the commonest intra-articular fractures. Incidence of proximal tibial fractures is 1% of all and 8% in elderly. Most injuries affect lateral tibial condyle (55 to 70%) and medial condyle fractures in 10 to 23%, both condyle fractures is 10 to 30%. **Objectives:** To prospectively study the functional outcome of proximal tibial fractures treated by ORIF using 3- column concept after a minimum follow up period of 6 months. **Materials & Methods:** study of functional outcome in proximal tibia fractures fixing using three column concept conducted in the dept of orthopedics at AL ameen medical college and hospital in a period on may 2022 to June 2023 with sample size of 30 patients. **Results:** The mean age of the patients was male 39.8years females 32.3years.RTA was the main cause 90% and 10% were due to fall. In our study medial column fractures are 3 and lateral column are 4, Fractures involving two columns were 14 and fractures involving all three columns were 9 with excellent results in 20%, good results in 64% (overall 84% satisfactory results). In addition we have 16% fair and 0% poor results. **Conclusion:** Column based concept classification makes the surgeon better prepared for intra and post operative complications and yields better results than conventional classification. The functional outcome is also similar or superior to the studies based on conventional classification.

KEYWORDS

proximal tibia, column based concept, tibial plateau

INTRODUCTION:

One of the most frequent intra-articular fractures is proximal tibia fractures. A direct axial compressive force or an indirect coronal force is typically the mechanism of damage. One percent of all fractures and eight percent of fractures in the elderly are proximal tibial fractures. The majority of injuries (55–70%) involve the lateral tibial condyle, and solitary medial condyle fractures happen in 10–23% of cases, whereas both condyle fractures are included in 10–30% of reported series¹

THE SCHATZKER and AO/OTA classification has limitation in identifying the integrity of posterior articular surface of tibial plateau which lead to incomplete treatment plan.with updated three column concept based on CT imaging and 3-D reconstruction technique can be evaluated in multi planar fashion helps surgeons realize the importance of posterior fixation in tibial plateau fracture especially for the posteromedial fragments^{25,26}

Yang et al., posterior tibial fractures are frequently caused by high-velocity trauma. A CT-based three-column classification system is essential for comprehending fracture morphology and the mechanism of injury, as it directs surgical care and enhances interobserver reliability.²⁷

High velocity injury happened in automobile accidents and increase in incidence of road traffic accidents as a whole is creating an ever-growing problem. Since man has used to traveling at high speeds in the sitting position with the loading edge composed of flexed hind limbs, when the vehicle in which the subject is traveling stops suddenly, most of the impact is taken at first upon the knee joint the patella, then the tibia and femur in varying proportions of velocity and at various positions which is otherwise called as 'Dash Board Injury'². In other cases the stationary lower limb may be struck by a moving object; this is the most common pedestrian injury, the so called "BUMPER FRACTURE", since the bumper of most vehicles being placed roughly at knee height of the pedestrian.

Various other modalities of treatment for proximal tibia fractures like hybrid fixation and now locking compression plate fixation using MIPPO technique have also been suggested. Each method of treating the proximal tibia fractures has its own advantages and disadvantages.⁴⁻¹¹ The advancement in the treatment of proximal tibial fracture fixation by the locking compression plates has allowed the treating doctors, the use of minimally invasive technique for unilateral fracture with care in handling the soft tissue.¹²⁻²¹

Thus we have advanced from the conservative approach to internal fixation in fractures as an acceptable mode of treatment. In spite of that,

proximal tibia fractures remain challenging because of their number, variety and complexity in management. In spite of many articles, published in the past 50years that have elaborated the problems of classification and results of various treatments the optimal method of management still remains controversial¹

In our study we have studied the functional outcome of proximal tibial fractures treated by open reduction and internal fixation using three column concept^{22,23} after a minimum follow up period of 6 months by modified Rasmussen score.²⁴

MATERIALS AND METHODS:

This current study is a prospective study carried out at Al-Ameen medical college hospital from may2022 to june2023.A total of 30 patients with displaced proximal tibial fracture.

Inclusion Criteria:

- Patients above 18 years of either sex.
- Closed tibial plateau fractures.
- Diagnosis of fractures with three column concept classification.

Exclusion Criteria

- patients age below 18years.
- Open tibial plateau fractures.
- Pathological fractures other than osteoporosis.
- Neurovascular injuries.

THREE COLUMN CLASSIFICATION^{22,23}

The antero posterior view of a knee radiograph provides the foundation for other classification schemes. Therefore, unlike posteromedial fragments, they are unable to distinguish between the primary fracture line running in the coronal plane. The unique three-column concept of proximal tibia fractures improves interobserver reliability for fracture classification and helps with appropriate preoperative planning. It also directs the selection of the best fixing technique in complicated fractures of the proximal tibia and fractures involving posterior communication.

In bicondylar tibial plateau fractures, Higgins et al. (1988) found 59% posteromedial fragments. Thus, a three column concept categorization based on axial CT and three dimensional CT was developed by Luo et al in 2010²². According to this classification, the tibial plateau is divided into three columns: the posterior, lateral, and medial columns. This system has the advantage of identifying the posteromedial fracture fragment, which requires buttressing and a posteromedial approach. Interobserver reliability is good since this classification is straightforward and easy to use.

Zero column -schatzker type III To be classified as a single column,

there must be a break in one cortex, in accordance with the three column concept. Thus, the only condition with a zero column is depression.

One column - schatzker type I and II A one-column can be characterized as an articular depression in the posterior column with a breach of the posterior wall. Fractures of the posterior column: these are not classified under any category by Schatzker. It is imperative to take into account the posterior column since failing to fixate the posterior column will result in varus collapse during the recovery phase.

Two column - schatzker type IV Typically, the posteromedial fragment is connected to the medial column

Three column -Type V and VI Schetzker There should be one separate articular fragment or more in every column.

MANAGEMENT

Initially, patients were in the trauma emergency ward. The patient underwent a clinical examination once the history was obtained. In the event that there are any related system injuries, relevant doctors managed the situation appropriately. Patients who seemed in shock received intensive monitoring and treatment, and quick resuscitation was carried out.

Once the patient's general condition was stable, relevant X-rays and CT scan for classification were taken. After determining the type of fracture, the displacement, and the amount of tibial plateau depression, the treatment strategy was chosen. Depending on their co morbidities and skin conditions, the patients were taken for surgery as soon as possible. Every surgery was performed with an image intensifier in control. Internal fixation and open reduction were used to treat fractures.

In our study, we employed the floating position, also referred to as the floppy lateral position²², for fractures involving the posteromedial and lateral columns a midway position between lateral and prone; anterolateral approach is allowed by external leg rotation while posteromedial approach is allowed by internal rotation. We used as fractures in other single columns For fractures of other single column we used standard approaches.

For comminuted and depressed fractures, bone grafts were used. Ipsilateral iliac crest or synthetic bone graft substitute was the source of the bone transplant.

Following surgery, patients were wrapped in compression bandages for two weeks or placed on an above-knee POP slab for immobilization. On the thirteenth day following the procedure, the sutures were removed out. Eight days of oral antibiotics and five days of intravenous antibiotics were administered. For the first three weeks, the patients were advised to perform static quadriceps exercises. After that, they were to engage in passive knee range of motion, non-weight bearing crutch walking with the unaffected leg, and weight bearing crutch walking with assistance for a maximum of six weeks. Additionally, a follow-up X-ray was performed immediately following surgery. X-rays were taken again after three, six, and seven weeks.

Follow up: At the three-week , the surgical scar was checked for discharge, inflammation, and changes in range of motion. This was the initial follow-up. A repeat X-ray was performed at the 6-week period as part of the second follow-up to check for fracture union or loss of reduction.

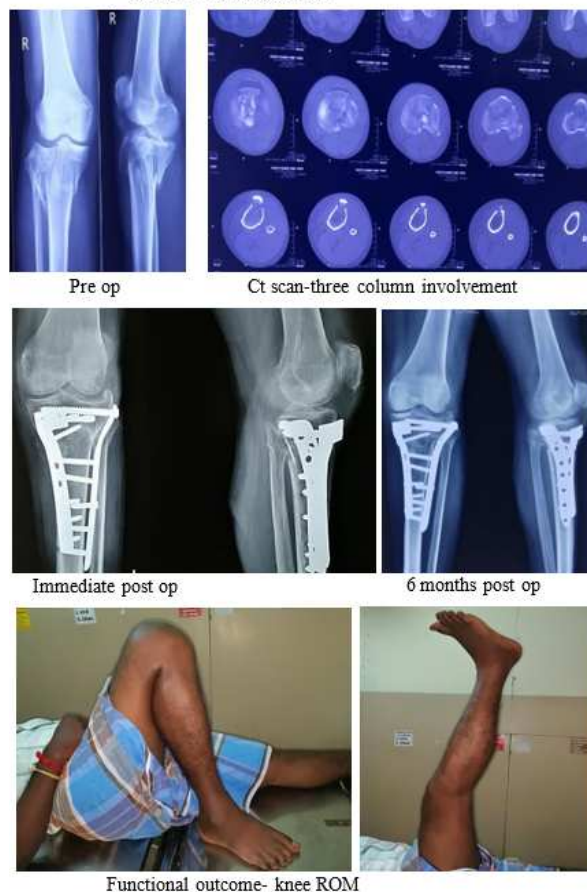
Three months after surgery, a third follow-up appointment took place which included a clinical examination of the union and one additional repeat X-ray. Based on the clinical and radiographic indications of union, patients were initially permitted to bear partial weight before progressively advancing to full weight bearing. The patients were subsequently invited to return for a follow-up at six months, when the modified Rasmussen clinical criteria were used to conduct a functional evaluation.

Fixation done by using

- L' buttress plate
- T' buttress plate

- Proximal tibial locking compression plate
- Posteromedial buttress plate
- 6.5 mm cancellous screws
- 4.5 mm cortical screws
- 3.5 mm cortical screws
- 4 mm cancellous screws

CASE ILLUSTRATION



Functional outcome- knee ROM

RESULTS AND ANALYSIS

Frequency Of Sex Incidence:

In our study thirty patients were assessed between may 2022 to June 2023 of which twenty six cases were male and four of them were female. Mean age of male 39.8 years and mean age for females is 32.3 years.

SEX	NO OF CASES	PERCENTAGE
Male	26	87
Female	4	13
total	30	100

Age Incidence:

In our study most patients belongs to 4th and 5th decade which has the higher association of 74 percent.

AGE	NO OF CASES	PERCENTAGE
18-30	6	20%
31-40	14	47%
41-50	8	27%
51-60	2	6%
TOTAL	30	100%

Mode Of Injury:

In our study road traffic injury is the higher associated mode of injury for tibial plateau fractures which is around 90 percentage.

MODE	No Of Cases	Percentage
Road traffic accident	27	90%
Accidental fall from height	3	10%
TOTAL	30	100%

Side Of Injury:

In our study 57% of the patients sustained injury to the right side and 43% to the left side. In our study, there is right sided predominance, when compared to the left side.

SIDE OF INJURY	NO OF CASES	PERCENTAGE
RIGHT	17	57%
LEFT	13	43%
TOTAL	30	100%

TYPES OF FRACTURE:

Three Column Concept Classification:

In our study proximal tibia fractures involving medial column constitute 10% and involving lateral column constitute 13% fractures involving two columns constitute 47% and fractures involving all three columns constitute 30% of total study population.

Type Of Fracture	Frequency	Percentage
ONE COLUMN-MEDIAL	3	10%
ONE COLUMN- LATERAL	14	13%
TWO COLUMN	4	47%
THREE COLUMN	9	30%

Complications:

Majority of the fractures treated in our study are united without much complications except we encountered screw pull out of the buttressing screws fixed in posterior column in two patients once we started mobilizing the knee by 6th week post operatively which necessitated screw removal of the pulled out screws. We also had knee stiffness in three patients who had knee movements in the range of 30° to 85° flexion with associated pain with no extension and we had wound site infection in three cases which were managed accordingly of which two patients had deep infection which necessitated implant exit.

Complication	No Of Cases	Percentage
SCREW PULL OUT	2	7%
KNEE STIFFNESS	3	10%
WOUND SITE INFECTION	3	10%
NO COMPLICATION	22	73%

Mean Follow Up:

Mean follow up period of our study is 12.5 months. In that mean follow up period of respective column fractures given in the table below.

S.No	Type Of Fracture	AVG. Follow Up (In Months)
1)	ONE COLUMN- MEDIAL	14(15-17)
2)	ONE COLUMN- LATERAL	11.3(9-12)
3)	TWO COLUMN	10.9(6-22)
4)	THREE COLUMN	13.8(6-20)

Columns Fixed:

In our study we fixed only medial column for 3 patients, lateral column only for 8 patients, posterior column only for 3 patients, two column fixation done for 14 patients and three column fixation for 2 patients. The number of columns to be fixed was decided pre operatively after assessing the axial CT scan and radiograph then intra operative reduction assessed through C arm image intensifier to confirm our decision.

Columns Fixed	No Of Cases	Percentage
MEDIAL COLUMN FIXATION	3	10%
LATERAL COLUMN FIXATION	8	27%
POSTERIOR COLUMN FIXATION	3	10%
BI COLUMN FIXATION	14	46%
TRI COLUMN FIXATION	2	7%

Clinical Results:

In our study we found that 20% had excellent score according to Rasmussen's clinical score, 64% had good score and 16% had fair score. No patient had a poor score even after surgical site infection in 3 cases. In other cases also the score is good which shows importance of three column concept on management of periarticular proximal tibial fractures.

Score	No Of Cases	Percentage
EXCELLENT	6	20%
GOOD	19	64%
FAIR	5	16%
POOR	0	0%

Outcome Of Individual Fracture Patterns:

In our study we had excellent and near excellent outcome in single column fractures but as fracture becomes complex, the outcome also reduced to become good in two and three column fractures.

Column Involved	Mean Rasmussen Score	Category
One Column- Medial	28	EXCELLENT
One Column- Lateral	27	EXCELLENT
Two Column	24	GOOD
Three Column	25	GOOD

DISCUSSION:

Tibial plateau fractures are more commonly seen in the active, earning younger age group due to their exposure to high velocity motor vehicle accidents. Closed treatment of these injuries has had very little success in reducing depressed or displaced fracture fragments; this initiated the need for open reduction and internal reduction in most displaced and unstable fractures. It is also extremely important to do a stable fragment fixation and ligament repair to regain the complete range of movements.

Open reduction and internal fixation has the advantage of direct visualization of fracture, complete reduction, and fixation, but there is higher risk of soft tissue complications, joint stiffness and deep compartment infection. The hybrid fixator system avoids these soft tissue complications, but risks are malunion, pin site infections and reduced patient compliance in maintaining the hybrid fixator.

Aim of our study assessing the functional outcome of proximal tibia fractures treated using three column concept classification instead of conventional classifications like Schatzker classification. The advantage of three column classification is it increases the inter observer reliability due to its simplicity and also it considers posterior fracture fragment which is often not considered in Schatzker classification. The posterior column fragment usually addressed by buttressing the fragment using posteromedial approach. If the posterior column is not considered for fixation it may lead to varus collapse in the post operative period and reduced range of movements of the knee.

There is no reliable universal scoring system to assess the functional outcome of these fractures. Past researchers used multiple scoring systems like Rasmussen, oxford knee score and knee society score. In our study, we have assessed the functional outcome of the patients using modified Rasmussen score which is a subjective score based on patient's experience.

Mechanism of injury was road traffic accident for majority of these patients. The fractures were classified using three column concept classification. In our study we assessed thirty patients from may 2022 to June 2023 of which twenty six cases were male and four of them were female. Mean age of male 39.8 years and mean age for females is 32.3 years.

In our study patients with medial column fractures were 3 and involving lateral column were 4. Fractures involving two columns which is most common were 14 and fractures involving all three columns were 9.

In our series majority of the patients were males (87%). The significance of tibial plateau fracture-related sex distribution was not available in literature to comment on them.

In our study, there was right sided predominance, compared to the left side with right side 53% and left side 47%. In this study we studied 30 cases of tibial plateau fractures all of them were treated by open reduction and internal fixation. The indications for open reduction and internal fixation were the same standard indications used by the earlier authors as for the tibial plateau fractures.

We have not formulated any criteria as to particular method of fixation for particular column of fracture. So each case was individualized and treated accordingly as needed with good preoperative workup. Apart from the one column fractures which were treated with unilateral plating, some two column (4 cases) and three column(3 cases) fractures also treated with unilateral plating after assessing the radiograph of the knee, axial CT scan and intra operative reduction with image intensifier. Likewise choice of the implant was decided on the fracture pattern, bone quality and intra operative reduction. The period of immobilization was standardized to 3 weeks for all column of fractures.

The major problems faced by us during the course of this study were knee stiffness and infection and screw pull out. The infection may be attributed to nosocomial infection.

In spite of all the complex fracture patterns and soft tissue injuries injuries and Treatment of intra articular tibial plateau fractures is still unsolved. We cannot statistically differentiate the functional outcome

between single column, two column and three column fixation in our study and of other studies at midterm follow up. Choice of the approach/implant should be strictly based on the good clinical judgment of fracture pattern, appropriate classification(three column concept) for the column involved, bone quality and intra operative fracture reduction complications with proximal tibial fractures, we can able to achieve excellent results in 20% of the study population and good results in 64% of the study population (overall 84% satisfactory results) with described standard fixation methods. In addition we have 16% fair and 0% poor results.

The above said results are comparable to the literature and on par with other documented standard studies. The results show the superiority of the three column concept classification over other conventional classifications especially Schatzker classification in pre operative planning and intra operative execution. It is very simplistic to understand which reduces inter observer variability in assessment is another icing on the cake.

Dual plating for two columns or three column fixation gives better biomechanical strength and rigid construct than unilateral plating thereby better control of columns thus avoiding late collapse and loss of reduction. There were no major wound problems in any of these studies. Weight bearing was started only at 2-3 months which is similar to our study.

In our study, there were no late complications like loss of reduction of fragments and malalignment with unilateral plating for two column and three column fractures. We have employed conventional surgical techniques through which we had satisfactory results with the standard conventional methods.

CONCLUSION

Treatment of intra articular tibial plateau fractures is still unsolved. We cannot statistically differentiate the functional outcome between single column, two column and three column fixation in our study and of other studies at midterm follow up. Choice of the approach/implant should be strictly based on the good clinical judgment of fracture pattern, appropriate classification(three column concept) for the column involved, bone quality and intra operative fracture reduction.

The main aim of open reduction and internal fixation include accurate reconstruction of the articular surface with elevation of the depressed bone fragment, bone grafting or bone graft substitute, stable fragment fixation allowing early range of motion and repair of all concomitant ligamentous structures and other soft tissue injuries.

Complication noted in our series are knee stiffness, infection and screw pull out. These complications are mainly noted in high energy injuries (two/three column fractures).

Column based concept classification makes the surgeon better prepared for intra operative and post operative complications and yields better results. The functional outcome is also similar or superior to the studies based on conventional classifications.

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