Section: Orthopaedics

Original Research Article

STUDY ON FUNCTIONAL OUTCOME OF TREATMENT OF PROXIMAL TIBIAL FRACTURES (TYPE V & TYPE VI SCHATZKER) BY DUAL PLATING

Jomin George[1], Saju S[2]

[1]Consultant Spine Surgeon, Caritas Hospital Thellakom, Kottayam, India.
[2]Associate Professor (CAP), Department of Orthopaedics, Govt. Medical College, Parippally, Kollam, India

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Corresponding Author:
Dr. Saju S,
Email: drsajus79@gmail.com

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ABSTRACT

Background: Knee is a major weight bearing structure in body. It is involved in other mechanical activities like walking, running etc. Without the flexibility of the knee joint, movements of human body in its bipedal stature will be awkward and will be very much inefficient. Bony members of knee joint are distal femur, patella and proximal tibia. Consequently injuries involving these bony structures would definitely be compromising the flexibility of knee joint. **Objectives:** To analyze the functional outcome of managing proximal tibial fractures (Type V & Type VI Schatzker) by dual plating. **Materials and Methods**: In this observational study, a total of 30 patients of proximal tibial fractures (Type 5 & Type 6) treated with dual plates, who met the inclusion criteria, done in a tertiary care centre in Central Kerala were followed up for a period of 6 months. The age group involved in our study ranged between 23 years and 82 years. All the patients had routine antero-posterior and lateral x-rays of Knee. CT Scans were taken to know the extent of intra articular involvement. After surgery, patients were followed up at 4 weeks, 12 weeks, and 24 weeks. During follow up period functional outcome was measured by using Rasmussen's functional score. The collected data was entered in Microsoft excel and analyzed using SPSS software for evaluating the statistical significance. **Results:** Out of 30 patients 90 % were males 10% were females. Adults were affected, more in 36-50 years (40%) followed by 20-35 years (36.6%). Most common type of fracture was type 6 (70%), followed by type 5(30%). In this study, when patients were followed 6 months after surgery, there was considerable improvements in the functional outcome, which was assessed by Rasmussen's functional score. Excellent outcome was obtained in 4 (13.3%), Good outcome in 22(73.3%), Fair outcome in 3(10%), and poor outcome in 1(3.3%). **Conclusion:** Dual plate fixation of proximal tibial fractures is an effective surgical technique in maintaining stability of fracture and there is significant improvement in functional outcome.

INTRODUCTION

Knee is a major weight bearing structure in body. It is involved in other mechanical activities like walking, running etc. Without the flexibility of the knee joint, movements of human body in its bipedal stature will be awkward and will be very much inefficient. Bony members of knee joint are distal femur, patella and proximal tibia. Consequently injuries involving these bony structures would definitely be compromising the flexibility of knee joint.

Proximal tibial plateau involvement is one of the most common intra-articular fractures. They occur as a result of either indirect trauma causing coronal fracture pattern or direct trauma causing axial compressive patterns. Proximal tibial fractures account for only for 1% of all fractures and 8% of fractures in the elderly.[1] These are usually caused by high energy trauma especially the comminuted types (TYPE V, TYPE VI). 1-3% of proximal tibial fractures are open fractures (2). Isolated involvement of lateral condyle occurs in 70%, medial condyle in 15% and rest 15% are bicondylar.[2]

Schatzker classified proximal tibial fractures with articular involvement into 6 types. These fractures are also classified by AO, HOHL, Moore and Luo.

The most common mechanism of injury is road traffic accidents followed by fall from heights. The victims of injuries are usually the productive age

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group as they are the ones who are commonly involved in RTAs.

There were multiple modalities of treatment for these fractures, ranging from conservative treatment to new contoured LCP plates. The comminuted fracture types which were once treated on a conservative basis are now being increasingly treated with open reduction and internal fixation, as the imaging technology is getting better and we are able to plan better preoperatively. By treatment of these fractures, we aim to attain a stable knee joint with normal mechanical axis and congruous articular surface, which gives a painless, near normal ROM.[3]

The increasing load of high energy tibial plateau fracture is an indicator of future increased osteoarthritis and morbidity later in life unless these fractures are managed properly now. In this prospects, a study on management of high energy tibial fractures by dual LCP plates are of great significance.[4]

MATERIALS AND METHODS

It was a Prospective Longitudinal Observational Study for a period of 18 months between 01/03/2019 - 31/08/2020 In Government Medical College Hospital, Kottayam

Sample Size

In a study conducted by, Shyam S Khatri,[4] et al "Evaluation of functional and radiological outcome of tibial plateau fractures Schatzker type V and VI treated with dual plating" published in International Journal of Orthopaedics Sciences 2017; 3(2): 150-156 93.33% of the patients had an satisfactory score(excellent + good) according to Rasmussen's functional grading system. Using this data the sample size required for this study was calculated using the following formula.

N = Z*Z*P*Q/d*d = 1.96 at 95% CI

P = 93.33%

Q = 1-P

d = relative precision = 10% of p = 9.3

N = (1.96 * 1.96 * 93.33 * 6.67) / 9.3 * 9.3 = 28.61

Minimum sample size required for the study is 29 which was rounded off to 30. The cases meeting the inclusion criteria were taken consequently to meet the sample size.

Study Tools

1. Case Record Form
2. Rasmussen's Anatomical Grading
3. Rasmussen's Functional Grading

Study Procedure

After obtaining ethical clearance from the Institutional review board, written informed consent was taken from all eligible patients undergoing the study. Postoperative assessment of cases included clinical details, X-ray & CT findings. Post-operative patients were immobilized in knee immobilizer for first two weeks. The patients were advised static quadriceps exercises for the first 2 weeks from the third post operative day. Follow up visits were conducted at 4, 12 and 24 weeks during which they were evaluated for progress of treatment.

Inclusion Criteria

1. Patient with Type V and Type VI Schatzker Fracture treated with dual plates

Exclusion Criteria

1. Patient with other fractures of the same lower limb
2. Open fractures
3. Fractures with associated compartment syndrome
4. Fractures with neurovascular injuries
5. Pathological fractures
6. Osteoarthritis knee of same limb
7. Patients with ligament injuries of the knee of same limb

Statistical Analysis

Data was entered in Microsoft Excel Software, and analysis was done using SPSS Version 20.0. The level of statistical significance was fixed at < 0.05. The data was collected using a structured questionnaire. The results were analyzed and summarized as percentages and proportions. Clearance was obtained from Ethical Review Board from the Institution.

RESULTS

Out of 30 patients ,90 % (27) were males 10%(3) were females. Patients affected were more in 36-50 years (40%) followed by 20-35 years (36.6%). Most common type of fracture was type 6 (70%), followed by type 5(30%) .

Table 1: Distribution of fracture types among study subjects

Type	Frequency	Percentage
Type 5	9	30%
Type 6	21	70%
Total	30	100%

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Table 2: Distribution of study subjects based on type of fracture and Rasmussen's functional score outcome

Type of fracture		Excellent	Good	Fair	Poor	Total
Type 5	No	2	5	1	1	9
	%	6.7%	16.7%	3.3%	3.3%	30%
Type 6	No	2	17	2	0	21
	%	6.7%	56.7%	6.7%	0%	70%

Out of 9 Type 5 fractures, 2(22.2%) showed excellent outcome, whereas 5(55.5%) had good outcome. One person had fair (11.1%) and one(11.1%) had poor outcome. Out of 21 Type 6 fractures, 2(9.5%) showed excellent outcome, whereas 17(80.9%) had good outcome and 2(9.5%) had fair outcome. There was no significant difference in Rasmussens score outcome among people with various type of fracture treated by dual plates (p value > 0.05).

Table 3: Distribution of study subjects based on Injury to Surgery interval and Rasmussen's functional score outcome

Injury to Surgery Interval		Excellent		Good		Fair		Poor		Total
		Type 5	Type 6	Type 5	Type 6	Type 5	Type 6	Type 5	Type 6	
<=7 days	No.	1	0	2	14	0	1	1	0	19
	%	3.3%	0%	6.7%	46.7%	0%	3.3%	3.3%	0%	63.3%
>7 days	No.	1	2	3	3	1	1	0	0	11
	%	3.3%	6.7%	10%	10%	3.3%	3.3%	0%	0%	36.7%

Most of the people were treated in less than a week post injury(63.33%, n=19).Out of the people who were treated in less than a week post injury, 1(5.3%) showed excellent, 16(84%) showed good, one (5.3%) fair and one (5.3%) showed poor outcome. Out of the people who are treated after a week post injury, three (27.3%) showed excellent and 7(54.5%) showed good, 2(18.2%) showed fair outcome. But these differences in Rasmussens score outcome and the Injury to surgery Interval were not statistically significant (p value > 0.05).

Table 4: Distribution of study subjects based on injuries sustained and Rasmussen's functional score outcome

Type of injury		Excellent		Good		Fair		Poor	Total
		Type 5	Type 6	Type 5	Type 6	Type 5	Type 6	Type 5	
Pure orthopaedic	No.	1	1	3	16	1	1	1	24
	%	3.3%	3.3%	10%	53.3%	3.3%	3.3%	3.3%	80%
Orthopaedic And Surgical	No.	1	1	2	1	0	1	0	6
	%	3.3%	3.3%	6.7%	3.3%	0%	3.3%	0%	20%

Most of the people in the study had pure orthopaedic injury (80%).Out of those who had pure orthopaedic injury 2(8.3%) showed excellent outcome, 19(79.2%) had good outcome,2(8.3%) had fair outcome and 1(4.2%) had poor outcome. Out of those with combined surgical and orthopaedic injury ,two (33.3%) had excellent outcome and three (50%) had good outcome and one(16.7%) had fair outcome. These differences between the types of Injuries sustained and the Rasmussens score outcome did not show any statistical significance (p value > 0.05).

Table 5: Distribution of study subjects based on Rasmussen's anatomic score outcome and Rasmussen's functional score outcome

Anatomic score		Excellent		Good		Fair		Poor	Total
		Type 5	Type 6	Type 5	Type 6	Type 5	Type 6	Type 5	
Good	No.	2	2	4	15	0	1	0	24
	%	6.7%	6.7%	13.3%	50%	0%	3.3%	0%	80%
Fair	No.	0	0	1	2	1	1	1	6
	%	0%	0%	3.3%	6.7%	3.3%	3.3%	3.3%	20%

As per the Rasmussen's anatomic score ,most of the X-rays fell into the good category (80%).Out of the 24 people who presented with good X-rays at 6 months, four (16.7%) had excellent, whereas 19(79.2%) had a good and 1(4.1%) had fair outcome. Out of the six people who was had presented with fair x-rays at 6 months, three (50%) had good, two(33.3%) had fair, and one(16.7%) had poor functional outcome. This association between Xray appearance at 6 months and Rasmussens score outcome was seen to be statistically significant(p value < 0.05).

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Table 6: Distribution of study sample based on post surgical infection and Rasmussen's functional score outcome

Postsurgical infection		Excellent		Good		Fair		Poor	Total
		Type 5	Type 6	Type 5	Type 6	Type 5	Type 6	Type 5	
Nil	No.	2	2	3	16	1	0	0	24
	%	6.7%	6.7%	10%	53.3%	3.3%	0%	0%	80%
2 weeks	No.	0	0	0	1	0	0	0	1
	%	0%	0%	0%	3.3%	0%	0%	0%	3.3%
4 weeks	No.	0	0	1	0	0	2	0	3
	%	0%	0%	3.3%	0%	0%	6.7%	0%	10%
24 weeks	No.	0	0	1	0	0	0	1	2
	%	0%	0%	3.3%	0%	0%	0%	3.3%	6.7%

Post surgical infection was not seen in majority of the patients(80%).Out of the 24 people who did not present with any infection at 6 months, four(16.7%) had excellent, 19(79.1%) had a good and one(4.2%) had fair outcome. Out of six people who had experienced post-surgical infection during the 6 month follow up period, three(50%) had good, two (33.3%) had fair and one (16.7%) had poor outcome. This difference between presence of post-surgical infection and Rasmussens score outcome was statistically significant (p value < 0.05).

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Posteromedial Incision

Posteromedial Plate in situ

Antero Lateral Incision

Antero Lateral Plate In situ

Wound Closure Anterior View

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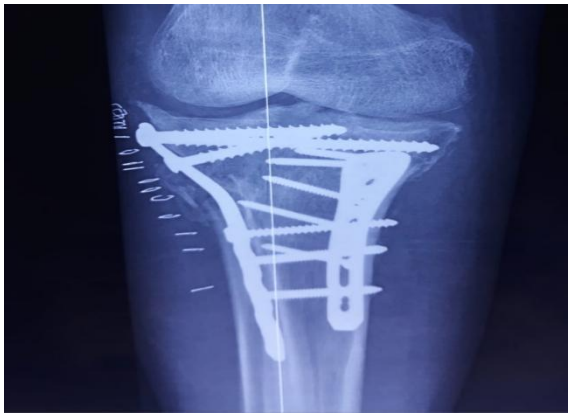
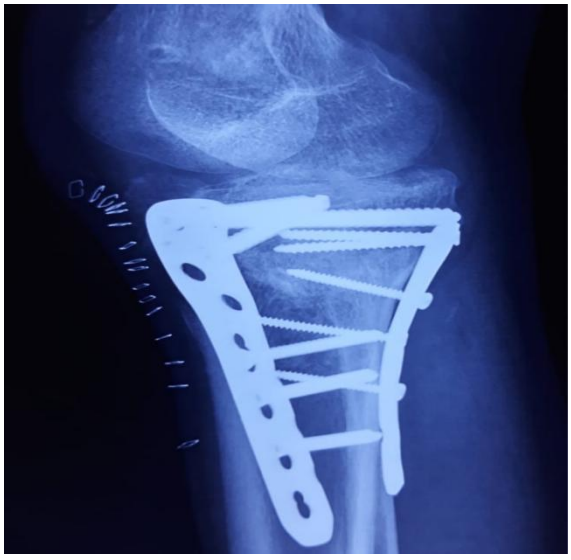
Wound closure Side View



Postoperative Xray AP view



Postoperative Xray lateral view

Clinical Outcome Picture - 1

Clinical Outcome Picture - 2

Clinical Outcome Picture - 3

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Clinical Outcome Picture - 4

DISCUSSION

Fractures of the tibial plateau have the potential to be devastating injuries especially when they have significant bony and soft tissue involvement along with knee instability and incongruity as in type V and VI injuries. Fractures of the proximal tibia are the result of high energy injuries and because of lack of soft tissue coverage in this region, it is vulnerable and open fractures are commonly encountered. In such cases, the treatment of damaged soft tissue is of primary concern.[5] As open fractures can interfere with Open reduction and Internal Fixation(ORIF) the current study excluded open fractures and hence is not a true reflection of outcome of Type 5 and type 6 fractures, but rather a reflection of uncomplicated Schatzker fractures.

In study by Jain RK et. al,[6] majority of the patients were males-46 out of 58 (79.31%). This can be attributed to the Indian setting where males are more involved in outdoor activities and thus more liable for such injuries. The study conducted by Unnikrishnan et al,[7] had a male: female ratio 76:24. In the current study, 27 out of 30 were males and 3 were females with a male to female ratio of 9:1. In study by Shyam S Khatri et.al,[4] total 30 patients were studied, out of them 26 (86.7%) patients were male and rest 4 (13.3%) patients were females.

High energy tibial fractures usually affect the younger age group in productive life years and have significant socioeconomic impact due to late recovery time and subsequent requirement of early total knee replacement in some complicated cases (8).76.67 % subjects of our study were between 20 and 50 years and 36.67% were between 20 – 35 years who belong to the earning and productive age group. Mean age of patients who sustained tibial plateau fractures Schatzker type V and Vl was 38.17 years in a study by Shyam S Khatri et al,[4] with a standard deviation of 8.23 years. Similar mean age of 37.7 years was observed in a study by Yong Zhang et al.[9]

The AO/OTA classification is well-accepted and defines the fracture morphology precisely.[10] However we chose the Schatzker classification, as the study intended to evaluate the outcome of high-energy tibial plateau fracture morphology which is a challenge to orthopaedic surgeons. Among these, the bicondylar type (Schatzker type V) and the comminuted type (Schatzker type VI) fractures being the most difficult to treat, because of the high complication rates.[11]

The main aim was the surgical reconstruction of the articular surface with elevation of depressed bone fragment and stable fragment fixation allowing early range of movement. Bone grafting or G bone (hydroxyapatite crystals) grafting was done in cases where proper articular congruity was not obtained by elevation alone, similar to the study conducted by Kerkhoffs GM et.al, where primary bone grafting was performed to fill bone defects only in case of depressed fractures.[12]

Surgery was done after the patients were stabilized and local soft tissue condition assessed pre-operatively, else the surgery was deferred till the wrinkle sign appeared.[13] This resulted in variability of time period before surgery. The surgeries had an average preoperative waiting period of 1 week. 19 of them were treated within 1 week and 11 of them were treated after 1 week. The results of waiting period on functional outcome were statistically insignificant though. In study by Shyam S Khatri et.al,[4] mean time interval between injury and surgery was 8.8 days with a standard deviation of 4.6 days. In majority of the patients (76.7 %) tissue oedema settles and wrinkle sign appears within 10 days of injury (5 to 7 days in 50% and 8 to 10 days in 26.7%).

Unlike the study done by Duwelius and Connoly who concluded that observations based on roentgenographic examinations did not correlate with the functional end results,[14] our study showed an association between 6 months post-operative roentgenographic results assessed by Rasmussen's anatomic scores and functional results. All the excellent functional results were obtained for those who were having good anatomic scores. Those who were having fair anatomic scores had a functional outcome ranging from good to poor. This association was found to be statistically significant by Chi square test and Fischer exact test with a degree of freedom of 1.

Surgery using single midline incision not only puts the soft tissue on excessive stretch but also the problem of reaching the posteromedial fragment through a single incision causes wide periosteal stripping and extensive muscle dissection and may hamper reduction as well. Treatment by open reduction and internal fixation either with a single or dual plates through a single mid line incision causes extensive soft tissue injury of the proximal tibia, causing de-vascularization of the fracture fragments, thereby decreasing fracture healing and leading to risks of wound complications.[53] Hence in the current study we did dual plate by using double incision

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technique through an anterolateral and a posteromedial incision.

CONCLUSION

Proximal tibial locking plates are implants that combine the principles of angular stable construct and compression plating. Its design and characteristics allow it to be used by a minimally invasive approach by using the principles of biological osteosynthesis. It reduces the need for compressing the plate directly to a bony surface, preserves blood supply and reduces the need for plate contouring.

The use of dual plates in the treatment of complex tibial plateau fractures allows obtaining near normal anatomy of articular surface, acceptable joint congruity and most of all, early mobilization following surgery, especially if one of the plates is an LCP. It prevents the posteromedial fragment sagging seen with conventional treatment and thereby improving the functional outcome.

This is evidenced by the statistically significant association obtained between Rasmussen's anatomic and functional scores. A better x-ray at 6 month would yield a better outcome and Dual LCP fixation aids the same.

Similarly reducing the post-operative infection can also yield a better outcome, as found from the study. This may be achieved by MIPPO technique, where a minimal trauma on already damaged soft tissue will allow earlier soft tissue healing and there by aid fracture healing and help obtaining a good functional outcome.

So the treatment of proximal tibial fractures (Type 5 & Type 6) by dual plates helps in obtaining a better functional outcome.

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