

## Original Research

# Assessment of functional outcome of locking plate osteosynthesis in proximal tibia fracture

<sup>1</sup>Dr. Nishant Narayan Gholap, <sup>2</sup>Dr. Sunkara Mangala Bhargav, <sup>3</sup>Dr. Amar Vishal

<sup>1</sup>Assistant Professor, Department of Orthopedics, Konaseema institute of Medical Sciences and Research Foundation & KIMS General Hospital Amalapuram

<sup>2</sup>3rd Year PG Student, Department of Orthopedics, Konaseema institute of Medical Sciences and Research Foundation & KIMS General Hospital Amalapuram.

<sup>3</sup> Professor and HOD Department of Orthopedics, Konaseema institute of Medical Sciences and Research Foundation & KIMS General Hospital Amalapuram.

### Corresponding Author

Dr. Nishant Narayan Gholap

Assistant Professor, Department of Orthopedics, Flat no 309, Godavari block, Dr's quarter, Konaseema Institute of Medical Sciences and Research Foundation, & KIMS General Hospital Amalapuram Andhra Pradesh

[Email-nishantngholap@yahoo.co.in](mailto:Email-nishantngholap@yahoo.co.in)

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### ABSTRACT

**Background:** Fractures in the upper portion of the tibia, the largest bone in the lower leg, are referred to as proximal tibial fractures. Due to complex anatomy of the proximal tibia and the nature of soft tissue covering present around it, there is still a dilemma regarding surgical treatment of proximal tibia fractures. Conservative management of displaced proximal tibia fractures, there is high rate of knee stiffness, non-union, malunion, mechanical failure and late varus collapse, and functional disability reported by many studies. Treatment by conventional available plates (T plate L plate) the results are not promising. Elizarov technique/hybrid external fixator, Less Invasive Stabilisation System (LISS) is ideal but it is expensive and cumbersome for the patient and rate of pin tract infection and mechanical malalignment is high as reported by some studies. Hence, we have decided to study the anatomically pre contoured locking compressive plates (LCP) and here we are giving our results of 70 patients operated with LCP This study provides findings regarding duration of fracture healing, the union rate, and to study various complications and to compare with other studies reported earlier. The present study was conducted to assess the functional outcome of locking compressive plate osteosynthesis (ORIF & MIPPO) in proximal tibia fractures.

**Materials & Methods:** 70 proximal tibial fractures of both genders admitted on day-to-day basis in the casualty at our hospital during February 2020 to October 2023 and were treated with MIPPO and ORIF with LCP. Parameters such as gender, age, side, nature of injury, type of fracture, type of reduction, principal, approach to fix it and whether monocolumnar, bicondylar or Tri columnar fixation done, duration of fracture union, and functional outcome according to Knee Society Score (KSS) and complications etc. were recorded.

**Results:** Out of 70 patients, males were 38 and females 32. The type of fracture was vertical split 29, split with depression 16, only depression 4, medial condyle fracture in 9, bicondylar fracture in 8, and bicondylar with metaphysis diaphyseal extension in 4 patients. Side was left in 28 and right in 42 cases. The method of reduction was ORIF in 26 and MIPPO in 44 cases. The principle of reduction was compression in 40, bridging in 22, and combined in 8 cases. The difference was significant ( $P < 0.05$ ). Common complications were knee instability in 1, knee joint stiffness in 3, superficial infection in 2, and varus deformity in 1 case. The difference was significant ( $P < 0.05$ ). We have got 27.14 % ( 19cases) excellent, 62.85 % ( 44cases) good, 7.14 % ( 5cases) satisfactory, 2.85% ( 2 cases) poor result which is comparable with other methods of treatment

**Conclusion:** For the treatment of proximal tibia fractures, the use of locking compression plates in combination with open reduction and internal fixation (ORIF) and MIPPO is preferable for optimum functional result and less complications.

**Key words:** Proximal tibial fractures, locking compression plate, knee stiffness, functional out come

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### INTRODUCTION

Fractures in the upper portion of the tibia, the largest bone in the lower leg, are referred to as proximal tibial fractures. It consists of intra articular portion, and proximal 4<sup>th</sup> metaphyseal extra articular portion. In the past it was called as bumper fractures as it is very

common in bike accident Proximal tibia consists of medial condyle, lateral condyle and the metaphysical part of upper tibia. Incidence of proximal tibia fracture is 1% of all fractures and 8% of elderly fractures. Incidence of medial condyle fracture alone is 10-25%, lateral condyle fracture alone is 55-70%,

Bicondylar fracture 10-30% & 1-3% fractures are open fractures. Bicondylar fracture with chance of associated posteromedial component 74%, and posterolateral component is 26%. Incidence of associated medial meniscus injury 21%, lateral meniscus 45%, Medial collateral injury 55%, lateral collateral ligament injury 45%. Incidence of associated ACL injury 23%, associated PCL injury 28%. Incidence of meniscal injury in tibial plateau fracture 67%, vascular injury 3%, peroneal nerve injury 23%. Compartment syndrome present in 25%, DVT 5-10%, pulmonary embolism 1-2%, superficial infection 3-38%, deep infection 2-9.5%, pin tract infection 33% and associated with high energy trauma. In case of tibial plateau fracture, the risk of requirement of early total knee replacement is five times more. To fracture lateral condyle the energy required is less as compared to high energy related medial condyle fracture. The lateral plateau is convex in nature and small and medial plateau is concave in nature and big. Proximal tibia has posterior slope of 8-10 degree. The associated injury is medial collateral ligament, lateral collateral ligament, medial and lateral meniscal injury and vascular injury. At the time of evaluation detail inspection of skin condition, and associated ligamentous injuries to be documented. The associated injuries have a major role in planning of treatment and the functional outcome. Medial condyle is a weight bearing condyle and hence fixation of this kind of fracture needs proper guidelines. But there is still a dilemma in the treatment plan of proximal tibia fractures. Medial condyle is very important as it has to play important role in weight carrying mechanism but the soft tissue coverage is very less. So, if medial condyle fracture is there then what kind of fixation to be chosen is still uncertain. Treatment of this kind of fractures is a challenge even for the most experienced trauma surgeon. The results of conservative management of displaced tibial fracture are not good as documented by many studies and using conventional plates and screws or using ring fixator, hybrid fixation or Elizarove fixation the results are not promising either because of high rate of non-union, malunion implant failure, infection, varus malalignment and knee stiffness<sup>5</sup>. There is still confusion regarding only lateral plating, medial or lateral plating, bicolumnar plating, or only medial plating, only screws at medial side or a buttress plate on medial side. The rate of soft tissue infection for medial side conventional non locking plates is high as documented by many studies<sup>12</sup>. Hence our aim is to study the results of anatomically precontoured proximal tibia locking compressive plates (LCP) for proximal tibia fracture fixation, its union rate, duration of union and functional outcome of the affected knee and to study the type and rate of complications after fixation. Being a major weight-bearing bone, fractures to the proximal tibia can seriously impair a person's ability to walk and carry out daily tasks.<sup>2</sup> For more communitied proximal tibial fractures, open

reduction and internal fixation (ORIF) may be required.<sup>3</sup> This treatment realigns the fracture, helps in elevation of plateau and fixes them with plates, screws. In certain cases, a bone graft may also be necessary to promote the healing of the fracture.<sup>4</sup> Recovery durations for proximal tibial fractures might vary depending on the therapeutic approach taken and the severity of the fracture. Therapy may be necessary to restore strength, flexibility, and mobility in the affected leg following a proximal tibial fracture, which frequently takes many months to heal completely.<sup>5</sup> In recent years, the approach known as minimally invasive plate osteosynthesis, or MIPPO, has become more common.<sup>9</sup> The vascularity of the soft tissue envelope is preserved while stabilizing proximal tibia fractures with the use of indirect reduction techniques in percutaneous plating.<sup>6</sup> The present study was conducted at KIMS General Hospital Amalapuram Andhra Pradesh to assess the functional outcome (knee society score-KSS)<sup>13</sup> of anatomically precontoured locking plate osteosynthesis in proximal tibia fracture by using ORIF, MIPPO or combine technique.

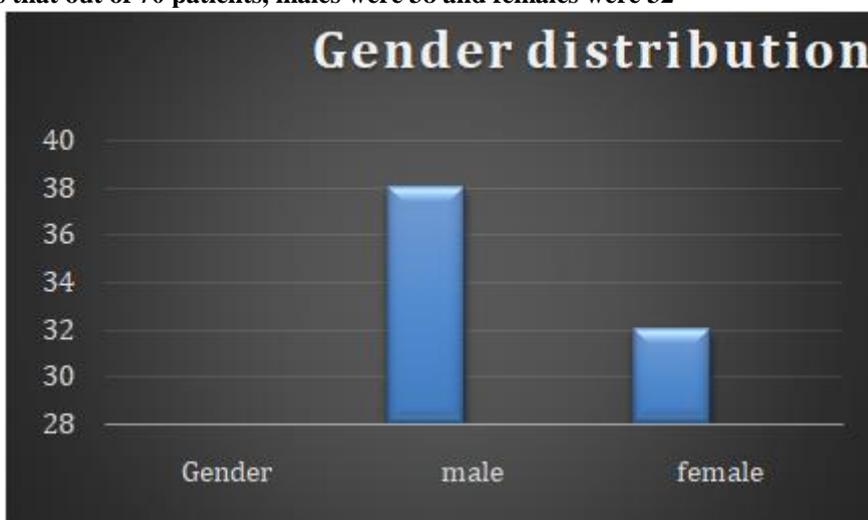
#### MATERIAL AND METHODS

The present study consisted of 70 proximal tibial fractures of both genders admitted during year 2020-2023 at KIMS General Hospital, Amalapuram, and Andhra Pradesh. All enrolled patients gave their written consent to participate in the study. Ethical approval obtained before starting the study. Our inclusion criteria were adult fractures with age group 20-80, simple or complex, displaced significantly intra or extra articular fractures of proximal tibia with meta-diaphyseal extension. Our exclusion criteria were paediatric age group fractures, undisplaced fractures, compound fractures, fractures with vascular compromise, and dislocations and fractures above 80 years of age, and patient not fit for surgery and patient with neuromuscular disease. Demographic data such as ID, name, age, gender, site etc. was recorded. The nature of injury documented. For simplicity, we have used Schatzker (1) classification which is the commonly accepted classification of proximal tibia fractures. We have used simple AP and Lateral X-ray for evaluation of fractures. All intraarticular fractures further evaluated by CT scan 3d reconstruction study and fracture management planned accordingly. As our study is of LCP plating by MIPPO or ORIF technique, we preferred to wait for minimum 6-7 days for oedematous condition to settle and appearing of wrinkle sign. After review of the skin condition, patient taken for surgery. Fracture fixation done appropriately by using anatomically precontoured LCP on lateral, medial or bilateral and posteromedial and posterolateral depending upon fracture pattern. All patients were managed with MIPPO and ORIF technique. Single midline incision or lateral or medial or posteromedial approach decided on the basis of fracture pattern and need of fixation.

Additional bone graft used whenever required. Parameters such as side, type of fracture, type of reduction, principal, operative time, blood loss, hospital stay, healing time etc. were recorded. Wound closure done in a standard manner. All patients evaluated on day 2, 2 weeks, 4 weeks, 6 weeks, 8 weeks, 12 weeks and 20 weeks for grades of pain, instability and range of movement as advised by Knee society score system (KSS). Serial x ray for bony union documentation done on immediate post op, 6 weeks and 12 weeks post op. In case of delayed union x ray repeated 16, 20, and 24 weeks. Suture removed on day 14 post op and all patient given meticulous physiotherapy 1:1. With range of movements, quadriceps and hamstring strengthening exercises and mobilisation on CPM machine done day 2 post op onwards. Weight bearing allowed after fracture healing or after 3 months as per comfort and after assessing the x ray for callus formation and on gradual

increasing mode. Functional ability of the knee assisted by knee society scoring system (KSS) (13). KSS consists of total 100 points (part1) Pain in the knee joint 50 points, stability 25 points, Range of movements 25 points. The results then further graded as excellent, good, and satisfactory and poor, Pain none, mild, moderate, severe Instability checked for every patient after 3 months as antero-posterior and medio-lateral and above 10-degree instability in both planes considered significant. Range of movement arc measured for every patient. 125-degree arc considered excellent Functional assessment of KSS (part2 KSS) is done with walking normally, climbing staircase normal and whether uses walking aids for walking. It also graded as 100 points. Total points 90-100 excellent, 80-89 good, 70-79 satisfactory and below 69 poor. Data thus obtained were subjected to statistical analysis. P value <0.05 was considered significant.

**Table: I shows that out of 70 patients, males were 38 and females were 32**



**Side Distribution**

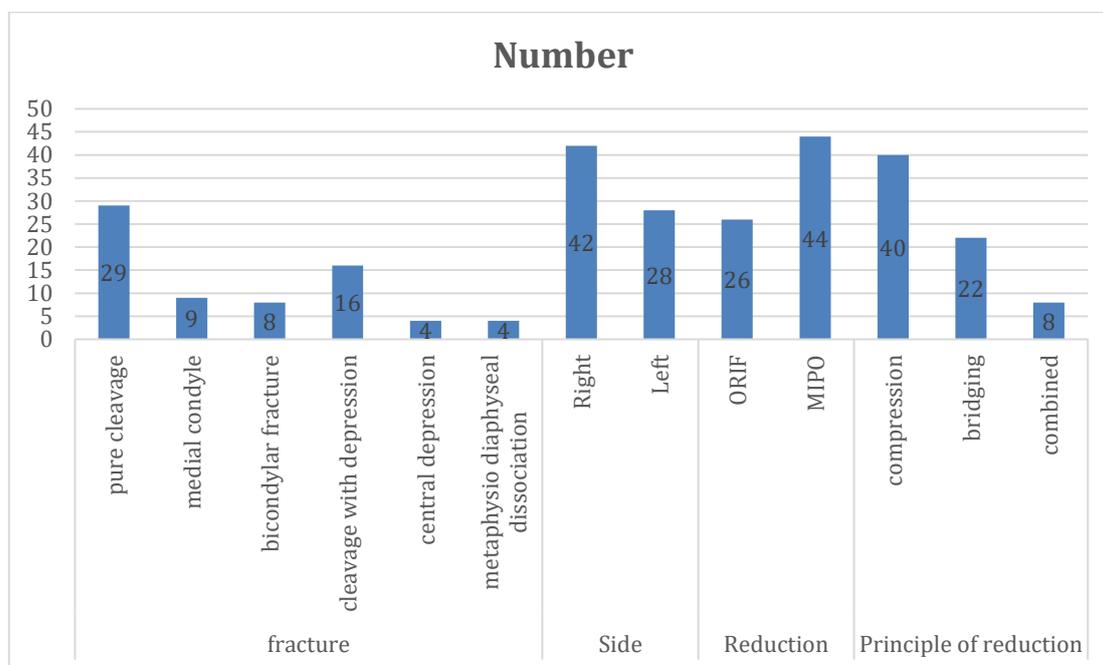
**Table: II Assessment of Parameters**



**Table: II Assessment of Parameters**

Parameters	Variables	Number	P value
Fracture	Pure split	29	0.05
	Split with depression	16	
	Central depression	4	
	Medial condyle	9	
	Bicondylar fracture	8	
	Metaphysio - diaphyseal dissociation	4	
Side	Right	42	0.01
	Left	28	
Reduction	ORIF	26	0.03
	MIPO	44	
Principle of reduction	Compression	40	0.04
	Bridging	22	
	Combined	8	

Table II, graph I show that type of fracture was pure split in 29, medial condyle fracture in 9, bicondylar fracture in 8, split with depression in 16, central depression in 4, and metaphysio diaphyseal dissociation in 4 patients. Side was left in 28 and right in 42 cases. The method of reduction was ORIF in 26 and MIPO in 44 cases. The principle of reduction was compression in 40, bridging in 22 and combined in 8 cases. The difference was significant ( $P < 0.05$ ).



**Clinical Presentation - Proximal Tibia Fracture & Way of Immobilisation**



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**X ray Knee Joint Evaluation AP&Lateral View**



**Ct Scan 3d Images Depression of Lateral Condyle - axial Section**



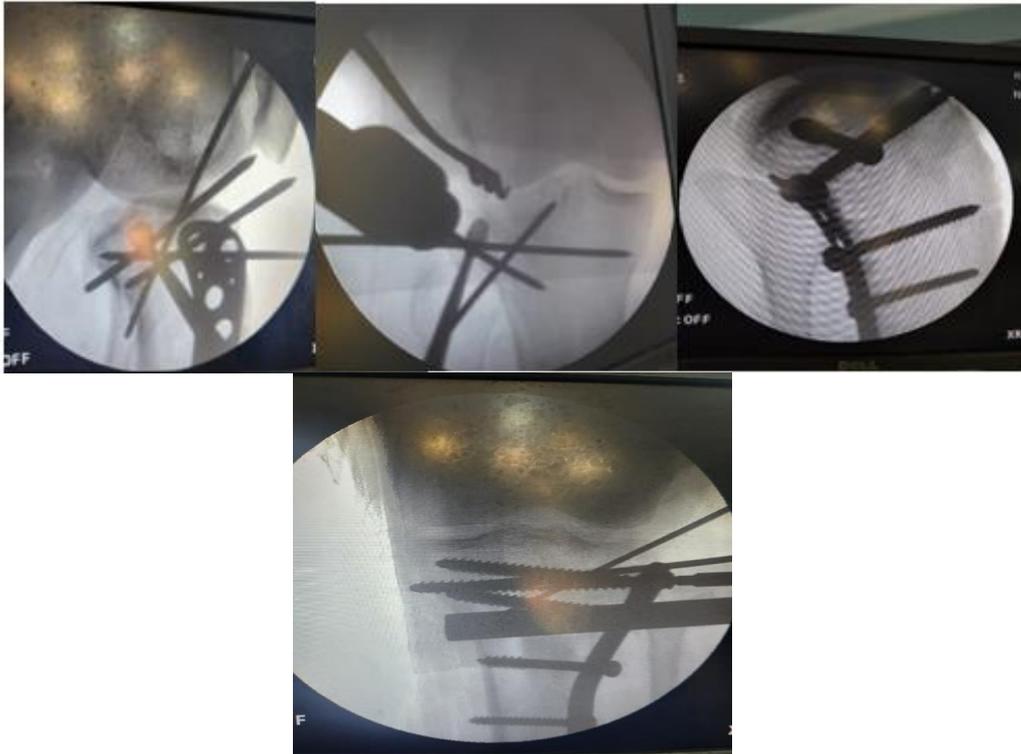
Ct scan cooronal section

**Anatomically Precontoured Locking Compressive Plates (Hockey, RaftAnd T Buttress Plates)**



**Patient Position In Operation Theatre**

**C-Arm Pictures Elevation of Lateral Tibial Plate & Temporary Plate Fixation**



**Reduction Technique & Application of LCP Plate: -Posteromedial and Lateral Aspect**



**RESULT: Post Op Result Of Our Study Is As FollowsPost Op Day 2 Wound Scar**

**Lateral approach**



**Bilateral approach**



**Lateral MIPPO approach**



**Posterior Approach**



**POST OP DAY 14 Healed scar: -**

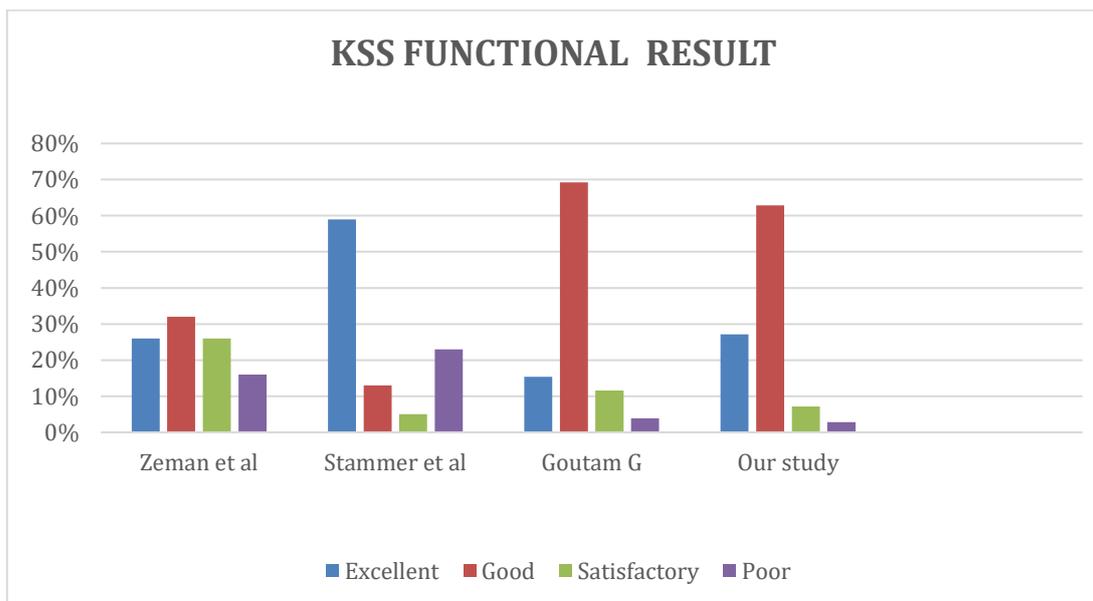
**Healed Fracture At End Of 3 Months- Post Op X-Rays**

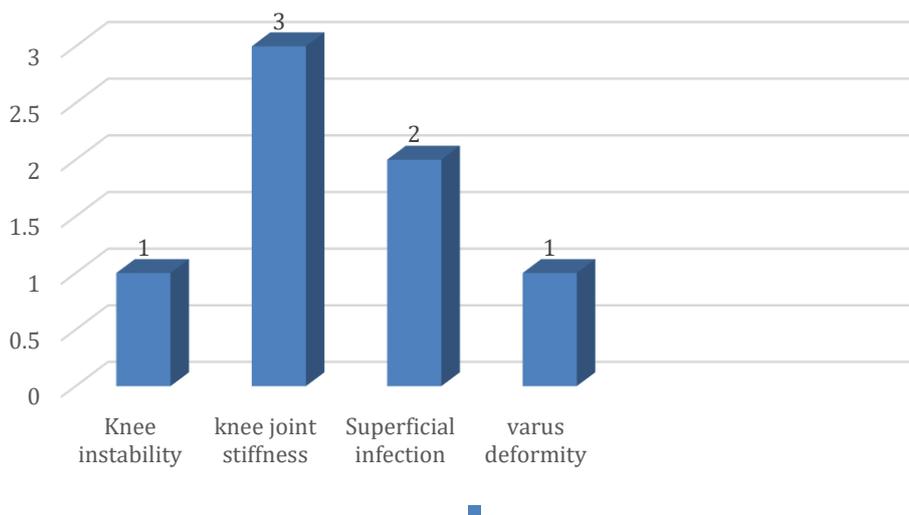


**Clinical Result at End of 3 Months. Excellentresult. & Good Result**



FUNCTIONAL RESULT	%	CASES	KNEE SOCIETY SCORE (KSS)
EXCELLENT	27.14	19	90-100
GOOD	62.85	44	80-89
SATISFACTORY	7.14	5	70-79
POOR	2.85	2	<69





**Table: III Evaluation of complications**

Complications	Number	P value
Knee instability	1	0.05
Knee joint stiffness	3	
Infection	2	
Varus deformity	1	

Table: III shows that in our study complications were knee instability in 1, knee joint stiffness in 3, infection in 2, and varus deformity in 1 case. The difference was significant ( $P < 0.05$ ).

**DISCUSSION**

One of the most important places in the human body for load bearing is the tibial plateau. Tibial plateau fractures impact knee mobility, stability, and alignment.<sup>7,8</sup> The frequency of road traffic incidents is rising, which is contributing to the increased incidence of proximal tibia fractures.<sup>9,10</sup> According to new theory, Leo et al (year2010), there are 3 columns of proximal tibia based on the basis of 3D CT scan taken after traction reduction or with temporary external fixation and presence of articular fragment in that particular column considered significant. Thus, in case of bicondylar fracture it is considered as threecolumn fracture whereas central depression fracture is considered as zero column fracture. Each column to be considered at the time of planning of the treatment. The mechanism of injury is such that wedge shaped femoral condyle cause the tibial condyle fracture and bending forces causes the extra articular metaphysio diaphyseal fracture of proximal tibia. Lateral condyle fracture is more common than medial condyle because medial condyle is a stronger structure. Simple AP and Lateral Xray sufficient for evaluation of fracture pattern. Traction x ray to be done in case of intra articular fracture. Application of Ottawa rule before considering for x-ray to avoid unnecessary x ray and expenditure.3D CT scan as advised by Luo et al (2010) necessary for all intra articular fractures. Treatment plan changes 26% after CT scan as stated by SalviPrat et al<sup>12</sup>. The classification most commonly used is Schatzker classification<sup>1</sup> in which type 1 split fracture of lateral

condyle, type II is split depression of lateral condyle, type III is only depression type, type IV medial condyle fracture, type V is bicondylar fracture, type VI is bicondylar plus metaphyseal extension. TypeIV, V, VI are associated with high energy trauma and associated with soft tissue injuries, vascular injuries&dislocations. Careful assessment of 3D CT scanwith axial, sagittal and coronal section to be done to know type of fracture, type of depression, its magnitude and for correct placement of LCP<sup>6</sup>. Central Depression type fracture is more common in elderly person because of osteoporosisfracture Younger group is more associated with medial condyle fracture associated with ligament or meniscal or neuro vascular comprise. In developing countries bike riding is more common and hence bumper fracturesare more common type of injury. Lateral condyle is less strong and hence lateral condyle with vertical split fracture is more common in elderly people. In case of strong suspicion of soft tissue injury MRI scan can be advised<sup>13</sup>. Availability at small centres and cost factors to be considered for MRI.With MRI scan, we can diagnose 77%ACL, 81%lateral meniscal tear, 44% medial meniscal tear. At the time of trauma skin condition need to evaluate properly. Sometime blisters are present. They are like clear fluid type or reddish colour in type. Reddish blister<sup>13</sup> more commonly associated with deeper type of soft tissue damage. Hence for plating purpose 7-8 days waiting is significant for obtaining good result. In our study we almost waited for a week or so before performing surgery If significant depression (range<2mm to 1

cm) of the fracture occurs then ORIF with bone graft option to be considered. Instability of >10-degree surgical indication to be considered. For optimum result reconstruction of articular surface, reestablishment of tibial alignment in valgus position, buttressing the elevated fragment with bone graft, reconstruction of ligaments, repair of meniscus and adequate soft tissue repair to be considered<sup>12, 13</sup>. In our case we did the same thing. MIPPO technique to be considered for fracture extending into the shaft, or required medial long plate. Anatomical reduction of posterior medial and posterior lateral fragment is very much essential to avoid secondary malreductions. Gala and Lobenhoffer described posteromedial approach in prone position and Luo et al described inverted L shaped approach for lateral decubitus position. Low energy lateral condyle fracture has excellent prognosis compare to high energy medial condyle fractures.<sup>9</sup>Kuntwad et al evaluated clinical and radiological outcomes associated with surgical treatment of fracture around the knee treated by locking plates. 40 patients who had fractures around knee (Distal femoral or proximal tibial fractures) and were treated by locking plates. There was an overall male preponderance with M:F ratio being 1:0.11. Road traffic accidents were responsible for 90% fractures. The average range of knee flexion was 88.5° in patients with a distal femur fracture, and 106.5° in patients with a proximal tibia fracture. The average Knee society score was 82.35 points (Good) in patients with distal femur fracture and 88.55 points (excellent) in patients with a proximal tibia fracture. There were three cases with non-union, all of them united after secondary bone grafting. Time of healing reported in various studies is 13- 25 weeks our study reported 12-15 weeks. The proximal tibia fractures managed with hybrid external fixation has high incidence of pin tract infection and varus malalignment (Guadinez et al 22% pin tract infection and 17% varus malalignment)<sup>5</sup>Kumar et al in his series reported 5% malunion and 7% infection. In the study of Rademakers et al of tibial plateau fractures 202 cases treated with ORIF, here reported 5.4 % of deep infection,4% malunion. Because of complex anatomy and less soft tissue coverage on medial side of the condyle there is high rate of pin tract infection. The other complications like varus malalignment, malunion, non-union delayed union and implant failure are also high with hybrid ex fixation and with conventional non locking plates. The meniscal injury, and the type of fracture at the time of injury have the association with developing osteoarthritis of knee joint (Jensen et al 22% of OA knee joint in proximal tibia fractures with 6 year follow up, Rasmussen et al reported 17% early osteoarthritis in bicondylar type of fracture)Stannard<sup>7</sup> et al reported 6% superficial infection and 6% malunion in his series of 34cases of tibial plateau fracture operated with LISS (less invasive stabilisation system) and loss of reduction in 16% cases.12% infection rate of external fixation of

proximal tibia fractures (12).Placement of wires ,pins within 14 mm of joint, high chances of infection evaluated by one of the anatomical study. In our study, we found that application of anatomically precontoured LCP applied with ORIF/MIPPO technique gives 27.14 excellent result, 62.85% good result, 7.14% satisfactory result and 2.85% poor result. According to <sup>13</sup>Lorcan McGonagall positioning of modern LCP deals effectively with 72% of all lateral condyle fracture and 91% of medial plateau fracture. According to him locking plates provide angular stability and provides early range of movement and weight bearing compare to non-locking plates. Locking screw to be placed within 22-degree limit of perpendicular plane. Locking screw has best interference strength when inserted perpendicular to plate <sup>(13)</sup> In case of bicondylar and only medial condyle fracture medial column buttressing LCP is essential to avoid late varus collapse of the fracture at the time of weight bearing and varus malalignment. Placement of only screw at the medial condyle failure rate are very high as medial condyle is weight bearing area and hence strong support is needed for the same. This is quoted by many earlier studies and published text books like Trips and Tricks in orthopaedic trauma. Studies regarding external fixation, <sup>4, 5,7,10</sup> hybrid fixation, LISS all noted late varus collapse, and varus malalignment in significant amount of patient at the time of weight bearing in OPD follow ups in subsequent months or year. In our study we noted complications like knee instability in 1, knee joint stiffness in 3, infection in 2, and varus deformity in 1 case. The infection was superficial and cure after antibiotic treatment. Knee instability and stiffness was due to severely comminuted bicondylar type of fracture and was difficult to mobilise because of pain in initial phase of follow up

## CONCLUSION

Proximal tibia fracture treated with hybrid external fixator has high rate of pin tract infection and varus malalignment. Considering the complex anatomy of proximal tibia and the status of soft tissue envelope available, ORIF or MIPPO with an anatomically precontoured LCP we can get the optimum functional outcome Our study of seventy cases, we have got excellent /good result with the same. This is because the anatomically pre contoured LCP gives anatomical reduction & stable fixation at the fracture and hence enhanced the union rate and improve the functional output, increased range of movement reduced the infection rate and avoid malalignment with very minimal rate of complications. In our study there was no comparative group, soto study the long-term effect like varus collapse, implant failure, osteoarthritis of knee joint of the anatomically precontouredLCP still larger comparative trails with longer duration of follow up necessary Authors found that for the treatment of proximal tibia fractures, the use of anatomically precontoured locking compression plates

in combination with open reduction and internal fixation (ORIF) or MIPPO is preferable.

it A systematic review PubMed central published online 3April 2020

#### AREA OF CONFLICT

NONE

#### FUNDING

NONE

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