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### Radiological Analysis to Study Efficacy of Lockinng Plate Fixation in Treating Schatzer Type II Tibial Plateu Fractures in Government Tertiary Care Institute

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### ABSTRACT

**Background:** Treatment of Split and depressed fracture of proximal tibial plateu has undergone substantial evaluation in recent years from conventional butreessing plates to angled fixed locking plates. This study was performed in adults to determine the efficacy of open reduction, elevation, lateral knee arthrotomy, Iliac Tricortical Strut bone grafting and raft locking fixation in comparision to Conventional buttressing T or L plates for intraarticular lateral condyle fractures of tibia ie Schatzer type II or AO Ota 4.1 B3 on union, implant failure and incidence of malalignment, collapse and loss of reduction in patients who sustained an intra-articular fracture of the proximal tibia

**Methods:** We reviewed the records of 36 proximal tibia that involving split and depression type of lateral tibial condyle fracture Between april 2008 and December 2016. Schatzer type II or AO Ota 4.1B3 fractures in adults having step more than 5 mm and increase in valgus more than 10 degrees were included for study. Group A has undergone low profile raft locked fixation using standard technique whereas Group B by conventional T or L Butrss Plates or Hockey plates. The Radilogical anlalysis was done till follow-up of two year

**Results:** primary union was still evident in 97.32%. no incidence of broken plate, infection or collapse no revision surgery. delayed union especially in osteoporotic bones and non locking groupLate Collapses are seen in Group B. 4 Pts had excellent results, 2 had good results and 4 had fair results.

**Conclusions:** The raft locked fixation with tricortical bone grafts is matching the gold standard method of treatment in our institute for treatment of proximal metaphyseal lateral tibial tibial plateu fractures especially in osteoporotic bones.

Key Words- Schatzer II fractures, Locking plates, Non locking plates, Tricorticl strut grafts.

#### Introduction

Injuries around the knee joint is one of the commonest injuries sustained due to outdoor

activities of individuals for day to day living in urban population. Individuals are expected to sustain ligament injuries or proximal tibial

injuries. The proximal tibia fractures are one of the commonest intra-articular fractures. The cause foe suc injuries are either high energy trauma or low energy trauma. Higher energy trauma is commonly associated with either intrarticular or metaphyseal communition in adults usually following vehicular accidents. although elderly population can have similar pattens in trivial falls like fall in bathrooms or fall from staircases. The majority of the intraocular fractures in proximal intrarticular tibia are split, split and depression injuries to the lateral condyle of tibia following valgus force sustained in trauma following vehicular accidents or fall from heights. Adults sustain these injuries due to adventurous activities during festiivals in India.

The valgus force being more common followed by varus forces then indirect shaering forces 12.. Elderly osteopenic bones are more likely to sustain depression type fracture due to weaker and less dense sub-chondral bone incapable of resisting axial directed loads. The various clinical studies established that bone beneath a rigid conventional plate are thin and atrophic which are prone for secondary displacement due to insufficient buttressing and secondary fractures after removal of plate, fracture site take longer period to osteosynthesis due to interruption of vascular supply to bone due to soft tissue and periosteal stripping.

So there was the birth of a new concept of biological fixation using the plates, otherwise called minimally invasive plate osteosynthesis (MIPO). But this was difficult as conventional plates needed to be accurately contoured to achieve good fixation; steoporosis also posed the same problem of poor fixation with conventional plates.<sup>5</sup>

Most of the studies in todays times are around proximal tibia especially catering on functional outcome on surgical treatment of proximal tibial fracture based on early clinical outcome following restoration of congruent articular surfaces of the tibial condyles. there are very few repotred Radiological studies. The aim of our study is to study the progress of radiological changes till union and any associated complications affecting radiological outcome in Surgically treated Schatzer Type II fracture of lateral Condyle Tibia when treated with low profile locking plate or Butress Plate. secondly we wish to focus on efficacy of raft design in locking plates in buttressing the thin reconstructed subchondral bone till union and preventing collapse after removal of fixation. Also to study the relationship of various radiological measurements in treatment of depressed lateral condyle fracture of tibia.

#### Methods

The study was carried out in State Government run Grant Medical College and Sir J J Group of Hospital, Mumbai from 2011 to 2016. We reviewed the records of the Patients Operated for proximal tibial fracture presenting to the department of Orthopaedics. Base on the intensions of our Study, We included Schaters Type II or AO /OTA type 4.1.B3 treated with low profile designs of proximal lateral locked tibial having raft screws for supporting plates reconstructed articular surface were included for study designs. Schaatzer type I fracture is excludes from study. Communitted fractures Like Schatzer III to VI are also excluded because of combination of various principles and avoid biases in the Study. Even Patients with open fractures, previous knee joint surgeries, polytrauma, intraarticular step less than 5 mm, pelvis and ipsilateral extremity injuries were also ecluded to avoid biases in radiological outcome. The details of patients and course of treatment, enents were recordred through the data available through the computerised data storge / Digital data storage system installed in the hospital as wellas manual data storage from medical records department of our Hospital.



Figure 1. Schematic Diagram showing methods of Retrieval of Data/ resources of data for analysis

On Evaluation of records, all the folders are prepared for analysis. Firstly they are clubbed together as per individual identieg. The History, examination record, ward notes, preoperative xrays, intraoperative records, subsequent follow up xrays were clubbed together for separate analysis. As per details of operative records, they are maintainly categorised into two main groups. Group A compriseds of those patients operated with low profile locking plates. Group B those patients comprises of operated bv conventional T? L buttress plates.

In our study, patients were haemodynamically stabilised in the . Demographic data, deatails of injuries, softissue status. thorough history. thorough and clinical examinations details recorded. Closed fractures were subjected to radiological assessment of the fracture using Schatzker's classification. And AO classification for proximal tibia. Associated injuries and fracture type wer recorded. The recorded procedures were found that the fractures with soft tissue swelling around knee or effusion were terate with limb elevation. the surgical procedures were

intensionally delayed to avoid complication of flap necrosis and wound dehiscences and exposure of plates. Perioperative antibiotic prophylaxis was given as routine protocols. The xrays have been preoperative analysis for selection of plates. The CT Scan evaluation was done to locate the exact level of depression in the lateral condyle. And to plan the window to approach the depressed site for elevation either medially or laterally. The 3 D reconstructuion images in articular view have been really helpful in assessing the exact site of depression whereas coronal and sagittal cut images have been used to assess the exact measurement in depression and articular steps were also assessed using. the # D images were studied for planning approaches . MRI evaluation was sought in suspected cases of ligamentous injuries excessive knee effusions.

All patients were operated by anterolateral incision by curving J shaped incision laterally along the joint line. After soft tissue dissection the depressed tibial plateu was located using changing positions of c arm image intensifier. the site foer cortical window is planned . once cortical window

is done. Osteotome is used to create subchondral osteotomy with apex directed towards medial articular surface. Intrarticular joint restoration is done using the gradyuallly elevating subchhondral bone, intrarticular reduction was confoirmed using lateral submeminscal arthrotomy ass well as plapation by probe. Trapeozoidal shaped graft was used to support elevated articular a surface., through tricortical graft to avoid displacement. The smallest sixe od plate was selected. The cortical drill hole is used for drilled. The exact of cortical screw was used for clength compressing and buttressing the plates. The position of plate was adjusted using the carm image iintensiifier. The K wires are inserted through plates and confirmed for collateral location in relation to joint line. All raft screws ate inserted and confirmed radiologivally. The finallty the distal locking screws are inserted. In the immediate postoperative period, care was given to the general condition, fluid balance, IV antibiotic and analgesics as per the protocol. Early range of motion started on pain relief usinally around 3 to 5 datys. and from the 5th day the range of motion was gradually allowed to increase as per patient tolerance and after suture removal full range of movement was allowed.

Whenever there was doubt about the stable fixation, external splinting in the form of plaster of Paris slab was given for support and advised to do static quadriceps exercises. Continue passive motion exercise (CPM) was done daily with temporary removal of slab under careful supervision. Partial weight bearing was started after suture removal from toe touch bearing until 3 weeks and 50percent weightt allowed from 6 week to 12 weeks with the aid of walker. full weight bearing was allowed after 12-16 weeks. The first follow up was between 4-6 weeks and later on patients were followed up at regular interval of 4-6 weeks till complete fracture union. During follow up the course of fracture healing was documented radiologically at 6 weeks intervals Once complete healing was achieved .defined radiologically as complete cancellous

matrix formation at fracture site, patients were evaluated for loss of reduction and complications. The radiological outcome were evaluated periodically till graft resorption.

We studied the medical and radiological records of 36 total patients 28 males and 8 female patients and their mean follow up of 2.5 years. Group A and Group B has 18 patients each. The study has taken into account all the radiological xrays of affected Knee taken in two Orthogenal Plane AP And Lateral Projections. and analysied for disappearance of lysis, progress of trabeculli formation, union, incioraption of tricortiical graft and dissolution of graft. collapse reappearance of step degree of restoration of step and complication like infection and its due course during resolution. The serial xrays helped yyus in assessing progress of union. Dror paleys measurement was taken for joint orientation line, mechanical axis deviation, anatomic Axis deviation Centre of axis of rotation, Fujisawa point, Medial proximal tibial angle (mPTA), And Posterior proximal tibial Angle (pPFA). Final Radiological outcome was assessed also by Rasmusson Radiological Scoring system The data was analysed using SPSS Version 19.0; IBM, SPSS Inc., Chicago, IL, USA. Continuous variables are expressed as mean±SD and categorical variables are expressed as number and percentages. Chi square test was used to compare categorical variables. A p value less than 0.05 was considered statistically significant.



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**Figure- 2** showing fracture treated with conventional plates

#### Results

We studied 38 patients each with unilateral lateral tibial condyle fracture who were treated with locking compression plate. Demographic and clinical characteristics of the study population are summarised in Table 1.

Characteristics	Group A	Group B
Age	45.6±10.4	49.06±0.4
Right : left	12:06	13:05
Radiological osteoporosis	2	3

Associated fractures were observed in three patients. One had ipsilateral anterior cruciate ligament injury, whereas another had fracture of both bones of ipsilateral forearm. And one had clavicle and two had radial head fracture.

**Table 2.** showing preoperative assessment ofintrarticular incongruity

Characteristics steps in	Group A	Group B
measurement		
5- 8mm	7	6
8-12 mm	3	4
12-15mm.	5	5
More than 15 mm	3	3

#### Table 3. Intraop correctibility achieved

	Group A	Group B
Undercorrection	3	4
Acceptable	5	11
anatomical	9	2
overcorrection	1	2
total	18	18



Figure 3 – schematic representation of various radiological parameters

### **Table 4.** showing Radiological assessment in Immediate Post Op period

Radiological parameters	Preoperative assessment		Postoperative assessment	
	Group A	Group B	Group A	Group B
Joint congruence Angle (mean)	$4.14 \pm 0.64$	$5.06 \pm 0.04$	$1.0\pm0.64$	2.10±0.4
Mechanical axis deviation from fujisawa point in mm	7.16±0.12	4.06±0.03	$5.06 \pm 0.04$	$5.06 \pm 0.04$
Centre of axis of rotation at medial articular surface	$5.06 \pm 0.04$	4.88±0.24	$1.06 \pm 0.04$	2.06±0.04
medial to tibial eminence				
Medial Proximal tibial Angle (mPTA)	93.06±0.02	95.06±0.04	87.06±0.04	90.06±0.74
Posterior proximal tibial angle (pPTA)	79.46±0.54	5.06±0.04	80.46±0.14	$5.06 \pm 0.04$
Anatomic axis deviation	$5.07 \pm 0.35$	5.06±0.6	$1.06\pm0.04$	$0.06 \pm 0.04$
Collapse/ depression in mm/ articular step	12.06±0.31	14.06±0.04	3.06±0.04	5.06±0.44
Knee valgus / varus	10.06±0.54	12.02±0.04	5.06±0.04	8.06±0.04

#### Table 5 showing Rasmussen Radiological Scoring system

Parameter	Score
Depression	
None	6 excellent
Less thhan 6	4 good
6-10	2 fair
More than 10	0 poor
Condylar widening in mm	
None	6 excellent
Less thhan 6	4 good
6-10	2 fair
More than 10	0 poor
Angulation (valgus/varus)	
None	6 excellent
Less than 10 degrees	4 good
10-20 degrees	2 fair
More than 20 degrees	0 poor



**Figure 4** showing fixation with low profile lateral plate and result after implant removal **Table. 6** Follow of Rasmussen score in both groups

	1	
Rasmusson score at	Group A Mean	Group B
Immediate postop	16.06±0.04	14.06±0.64
At 3 week	16.06±0.5	14.06±0.24
At 6 week	15.06±0.54	14.06±0.34
At 12 week	15.06±0.34	12.06±0.04
At 6 month	15.06±0.24	12.06±0.04
At 12 months	15.06±0.14	12.06±0.04
After plate removal	15.06±0.04	12.06±0.04
At 24 month	15.06±0.04	12.06±0.04
At 36 month	14.06±0.04	12.06±0.04

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#### Discussion

Treatment for proximal tibial plateau fractures is when difficult. especially metaphyseal comminution is associated with osteoporosis1 and soft tissue injury. G for achieving better functional outconme, the intraarticular reduction through minimal soft tissue dissection, achieving union early and maintainance o joint congruity therafter is the crux of treatment of the lateral condyle fracture. Our study has taken all possible aspect s of measurement that hass implicatons on results . to avoid potential complications of non union collapse, plate failutre, screw loosening, loss of achieved reduction either dure to metaphyseakl collapse or failure odf eweakened subchonfdral bone in resisting axial load bearing forces. There by avoding post traumatic arthrosis or secondary arthrosis by avoidibng reduction.

In most of cass we found restoration of normal mechanical axis, joint incongruity, and medial proximal tibial angle around 87 degrees hass been associated with excellent functional outcome. We have limited reported incidence of lysis in locked plate group due to minimal soft tissue dissection required for inserting low profile plate laterally in good soft tissue environment. Even though avascularised tricortcal graft hass been placed, vascularisation is initiated early owing to good soft tissue cover and consolidation of graft was possible.

Maintainance of achieved radiological Rasmussen score without any variation clearly suggest solid bony union in locked plate group. however constant gradual fall is seen in conventional buttress late group hence suggests doubtful complete union. This could even point to lesser efficacy of conventional locking plates to neutralise effects of axial load as compred to angle fixed locking plated. Raft construct in locking plate has definitely advantageous in supporting lateral articular cartilge as evidenced due to maintaince of mPFA to near normal parameter. use of small-fragment screws for fixation of tibial plateau fractures is recommended, as the pullout strength of 6.5-mm, 4.5-mm, and 3.5-mm crews is comparable.29,30 The 3.5-mm small fragment screws and T-plate decrease the bulk of hardware and improve fixation for small fragments.31 The antiglide screw or buttress plate has no additional advantage over lag screw fixation alone.32 The buttress plate has greater stiffness than lag screws alone.33 Fixation with a raft using 3.5-mm subchondral screws is more resistant to local depression loads than a buttress plate with or without a bone graft.34 Fixation with screws through (rather than outside) the plate enables more stability against plateau displacement

Tibia being the load bearing bone normally aligned knee bears 40 % and valgus aligned knee bears more than 50 %. Such load bearing is bound to have late collapses and subsequent long term complications ons and morbidity of treatment if the used implants are loose and couldnot offer required stability. During this decade the lociked plates have been evolved over the periods to match the expectation of load sharing, offering rigidity in primary fixation, raft construction to support tibial articular surface during healing phase of metaphysis. the plate and the biological tricortical bone graft has important role to play in healing of lateral condyle and its functional outcome .Tricortical strut graft offers mechanical support till full consolidation. Complications after bone grafting have been reported.

The use of a proximal lateral tibial raft plate in anatomically reduced split-depression tibial plateau fracturesprovides sufficient ridgity and prevents collapse, irrespective of the underlying bone quality. Maintaining the anatomic reduction, and enables bone healing decreases operating time and morbidity.

#### Conclusion

The use of a proximal lateral tibial raft plate in anatomically reduced split-depression tibial plateau fractures provides sufficient ridgity and prevents collapse, irrespective of the underlying bone quality. maintaining the anatomic reduction, and enables bone healing decreases operating time and morbidity. The radiological measurement of

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mPFA, Mechanical axis devation And intrarticular congruity has vital role in predicting good functional outcome.

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