MANAGEMENT OF BICONDYLAR TIBIAL PLATEAU FRACTURES TREATED WITH LATERAL LOCKING PLATEG. S. Mukharjee¹, K. Vindhya², Dakshina Murthy. T. S. S³**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: BACKGROUND AND OBJECTIVES: Incidence of fracture of proximal tibial fractures is increasing regularly due to Road Traffic Accidents. Being one of the major weights bearing joint around it will be paramount importance. Bicondylar tibial plateau fractures usually include damage to the soft tissue, and efforts to fix both the lateral and medial columns with plates can result in tissue loss and infection. In an effort to reduce further damage to the soft tissues, a number of techniques and new implants have been developed. One promising technique involves the use of a single lateral locking plate. **MATERIALS AND METHODS:** We prospectively followed a case series of 21 patients with bicondylar tibial plateau fractures treated with single lateral locking plate. All the cases were closed. We assessed malreduction, secondary loss of reduction and infection rates in patients treated with single lateral locking plate. **RESULTS:** We followed all cases until union of fractures. Average time for healing was 12-14 weeks. Healing occurred earlier in cases where MIPO technique was used. We had total of 5 complicated cases which included 1 case of knee joint stiffness with infection, 2 cases of malreduction and 2 cases of post-operative loss of reduction. We had no case of any purely implant related complication like screw loosening, screw breakage plate failure. **CONCLUSION:** We concluded that single lateral locking plate is a good alternative in the treatment of Bicondylar tibial plateau fractures. Even though it is biomechanically inferior to dual plate fixation it can be considered as good treatment option in case of severe soft tissue involvement. The reduction technique for exact alignment is demanding and we used ligamentotaxis through distractor to achieve near anatomical reduction. The infection rate is low for single lateral locking plate.

KEYWORDS: Bicondylar tibial plateau fractures, single lateral locking plate.

INTRODUCTION: The knee joint is one of three major weight bearing joints in the lower extremity. The proximal tibial fractures are one of the commonest intra articular fractures generally these injuries fall into two broad categories, high energy fractures and low energy fractures. The majority of tibial plateau fractures are secondary to high speed velocity accidents and fall from height where fractures results from direct axial compression, usually with a valgus (more common) or varus moment and indirect shear 2 forces.

Extra-articular fractures of the proximal tibia usually secondary to direct bending forces applied to the metaphysis and diaphyseal region of the upper leg, older patients with osteopenic bone are more likely to sustain depression type fracture because their subchondral bone is less likely to resist axial directed loads.¹

The aim of surgical treatment of proximal tibia fracture is to restore congruent articular surfaces of the tibial condyles maintaining the mechanical axis and restoring ligamentous stability eventually can achieve functional painless and good range of motion in the knee joint.²

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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 occur after removal of plate, fracture site takes 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, osteoporosis also posed the similar problem of poor fixation with conventional plates.³

This leads to the development of the internal fixators. PC-fix I later PC fix II. As more and more concepts about biological fixation become clearer the innovation of plates progressed lead to development of less invasive stabilizing system (LISS). Research to combine these two methods has lead to the development of the AO locking compression plate (LCP).⁴ This new system has been regarded as technically mature. It offers numerous fixation possibilities and has proven to worth in complex fracture situations and in osteoporosis.

In Bicondylar tibial plateau fractures, there is a lot of soft tissue damage and by placing two plates on either side to fix it leads to more soft tissue injury and infection. It may also lead to implant exposure on medial side. In an effort to reduce further damage to the soft tissues, a number of techniques and new implants have been developed.

One promising technique to reduce soft tissue injury and thereby reducing infection rate involves the use of single lateral locking plate in fixation of Bicondylar tibial plateau fractures. This study was initiated to evaluate early results of single lateral locking plate for bicondylar tibial plateau fractures.

OBJECTIVES: To study the functional outcome of bicondylar tibial plateau fractures managed with single lateral locking plate. To study the duration of union in bicondylar tibial plateau fractures managed with single lateral locking plate.

MATERIALS AND METHODS: The study was carried out in Government General Hospital, Kakinada from March 2010 to November 2012. The total number of cases being 21 with youngest aged 21 and oldest aged 65.

The intention of the dissertation was to study the treatment of bicondylar tibial plateau fractures with single lateral locking plate to decrease rate of infection and to achieve good range of motion.

Inclusion Criteria Include:

- 1) Schatzker type V and VI fractures.
- 2) Age groups included 16- 80 years.

Exclusion Criteria Include:

- 1) Fractures managed with dual plating.
- 2) Compound fractures.

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On admission demographic data was taken, thorough history and mechanism of injury noted. Clinical examination was done and soft tissue injury assessed. After which, radiological assessment was done.

Procedures carried out Pre-operatively:

- 1) Ruling out other fractures.
- 2) Evaluation of soft tissue condition.
- 3) Stabilization of patient hemodynamically and obtaining physical fitness for surgery.
- 4) Planning for MIPO technique or open reduction and internal fixation.

Follow up of outpatients ranged from 16 weeks to 64 weeks.

Fourteen patients were treated with MIPO technique and seven patients were treated by open reduction and internal fixation. The approach used was anterolateral approach. The reduction was achieved using ligamentotaxis through distractor. A medial to lateral lag screw was placed in some cases for compression before placing the plate and fixing it.

Post-operative: In the immediate postoperative period. Care was given to the general condition, fluid balance, IV antibiotics and analgesics.

Mobilization: Whenever stable internal fixation was achieved, the patient was mobilized after 48 hrs after removal of the drains, for 2-3 days the range of motion allowed was 0-20°, from the 5th day the range of motion was gradually allowed to be increased to 90° or more, after suture removal full range of movement was allowed.

Partial weight bearing was delayed until 6 weeks and full weight bearing allowed only after 12-16 weeks.

Follow Up: The first follow up was usually between 6-8 weeks and later on patients were followed up at regular interval of 6-8 weeks till complete fracture union.

During Follow Up:

- 1) The course of fracture healing was documented radiologically with minimum 6 weeks interval. The moment of complete healing was defined as radiologically complete bone regeneration at fracture site.
- 2) Evaluation of any possible loss of reduction.
- 3) Assessment and analysis of any complication.

ANALYSIS OF RESULTS- Results were assessed using Modified Rasmussen clinical and radiological assessment. Malreduction was defined as an intraarticular step-off of 2 mm or greater, or a malalignment in the frontal or sagittal plane of greater than 5°.

An increase of 5° malalignment or in particular depression of 2 mm compared with the first postoperative radiograph was defined as secondary loss of reduction.

We studied 21 patients with Bicondylar tibial plateau fractures who were treated with Single lateral locking plate.

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AGE GROUP	NO. OF PATIENTS	PERCENTAGE
21-30	2	9.52%
31-40	6	28.57%
41-50	8	38.09%
51-60	3	14.28%
61-70	2	9.52%
TOTAL	21	100
AGE DISTRIBUTION		

CLASSIFICATION	NUMBER OF FRACTURES	PERCENTAGE
TYPE V	3	14.28%
TYPE VI	18	85.71%
TOTAL	21	100%
TYPE OF FRACTURE-(ACC. TO SCHATZKER'S CLASSIFICATION)

TYPE OF FRACTURE

POSTEROMEDIAL FRAGMENT	NUMBER OF PATIENTS	PERCENTAGE
PRESENT	4	19.04%
ABSENT	17	80.95
TOTAL	21	100%
POSTEROMEDIAL (CORONAL) FRAGMENT		

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POSTEROMEDIAL FRAGMENT

METHOD	NUMBER OF PATIENTS	PERCENTAGE
MIPO TECHNIQUE	14	66.66%
ORIF TECHNIQUE	7	33.33%
TOTAL	21	100 %
METHOD OF FIXATION USED		

Preferred technique was MIPO as it reduced the chances of infection. Open reduction and internal fixation was used only when exposure of fracture fragments was required for reduction and fixation (as in old tibial plateau fractures).

BONE GRAFTING	NUMBER OF CASES	PERCENTAGE
NO	16	76.19%
YES	5	23.80%
TOTAL	21	100%
USE OF BONE GRAFTING		

LAG SCREW USED	NUMBER OF FRACTURES	PERCENTAGE
USED	12	57.14%
NOT USED	9	42.85%
TOTAL	21	
LAG SCREW FIXATION		

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COMPLICATION	NUMBER OF PATINETS	PERCENTAGE
1. KNEE JOINT STIFFNESS	1	4.76%
2. MALREDUCTION	2	9.52%
3. SECONDARY LOSS OF REDUTION	2	9.52%
4. INFECTION		
SUPERFICIAL	1	4.76%
DEEP	1	4.76%
5. SCREW CUT	0	NIL
6. BROKEN PLATE	0	NIL
7. NON UNIONS	0	NIL
COMPLICATIONS		

- Knee joint stiffness was seen in two cases in which there was associated distal femur fracture. (Deep infection was seen in one case of knee stiffness).
- Malreduction was seen in two cases.
- Varus deformity (Secondary loss of reduction) was seen in two cases where deformity occurred due to collapse of medial fracture fragment.
- There were no cases of screw cut out or implant failure or non-union.

DISCUSSION: The treatment of bicondylar tibial plateau fractures remain debated in the literature,

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and there is less consensus on the relative merits of single lateral locking plate over dual plate constructs.

In our study we attempted to fix bicondylar tibial plateau fractures with single lateral locking plate to minimize infection and skin necrosis with minimal invasive and bridging techniques wherever possible. Main interest of our study was to evaluate infection and alignment.

Bicondylar tibial plateau fractures are often associated with a high degree of soft tissue damage. The overall rate of deep infections with tibial plateau fractures is 4%–87%.⁷

The percentage of deep infection in our study was low despite only bicondylar tibial plateau fractures being taken. For bicondylar fractures, wound healing problems associated with ORIF with plating are reported as being as much as 37.5%, with a 15% rate of deep infection.

In our series one patient operative period secondary to antibiotics (ceftriaxone and pop cast application developed deep infection (4.76%) in the post uncontrolled diabetes, he was treated with IV amikacin), implant removal and above knee.

No early soft tissue problems were reported using unilateral fixation with only one surgical incision. Two of nine patients had skin necrosis when a bilateral approach was used. The greatest complication rate was with the S-shaped approach. Ten of 11 patients had skin necrosis and five of 11 patients had infection. According to our study, unilateral locking fixation is associated with a low rate of infection that is comparable to the rate for external fixation.

Eight recent studies report outcomes after locked plating of complex proximal tibial fractures. Malreduction rates ranged from 0% to 23% and loss-of-reduction rates from 0% to 14%.

In our series two cases presented with malreduction. (9.52%) Malreduction is an obvious problem in our study. Minimally invasive fracture reduction is a highly demanding technique. In our study we reduced 14 out of 21 fractures using minimal invasive technique. It is important to reduce the fracture before placement of the implant. The surgeon needs to use specific techniques to manipulate the fragments without additional soft tissue disruption

In our series two cases presented with secondary loss of reduction (9.52%). Misunderstanding of the technique is a main factor for secondary loss of reduction. The principle of an internal fixator necessitates building a proximal bone block by additional lag screws or neutral screws.

The Locking plate does not stabilize the intra articular fragments together well. The self-drilling and self-tapping tip does not add significant stability. Therefore, small medial fragments are not secured with the locking plate and might tend to secondary loss of reduction. A small number of screw threads in the fragment compromises stability. Because of the head's locking effect, the surgeon has no tactile feedback regarding the screw's holding strength. The screw can be completely outside the bone and lock.

Although using a lateral approach for the plate, it might be prudent to insert the lag screws from a medial direction in fractures with small medial fragments. A correct initial reduction seems mandatory.

Medial fragment fixation may require additional screws to stabilize the fracture line located chiefly in coronal plane. This is the limit of the monoaxial configuration of locking screws. Several factors could explain why lateral locked plating is less effective for fractures with coronal medial fracture lines. The direction of locked screws is fixed and is, for the most part, parallel rather than perpendicular to a coronal fracture line.

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This may explain why the fixation failure was not seen with medial articular fracture lines in the sagittal plane.

Further, although the postero-medial fracture fragments may be small, it may serve a critical role in preventing posterior subluxation of the medial femoral condyle. Even when locking screws engage the fragment, the quality of the fixation may be inadequate to resist the forces of displacement. Finally, with small medial fragments, the best fixation is achieved when screws engage the far cortex. This means that screws must pass all the way through the bone.

Surgeons generally avoid prominent medial screws, particularly with the self-drilling tips of the locking screws, thereby leaving the screws shorter than would be best for ideal fixation. The inclusion of a medial plate in the fixation construct avoids these problems and provides a medial buttress to prevent subsidence.

Limitations of the study being small sample size and it is a non- randomized control study.

CONCLUSION: In spite of all the above said complications, the bicondylar tibial plateau fractures fixed with single lateral locking plate have produced excellent and good results in most of the patients. So single lateral locking is a very good alternative for fixation of bicondylar tibial plateau fractures. The imaging study results were stable over time and the short-term clinical outcomes were satisfactory. Importantly, the monoaxial configuration of locking screws requires the insertion of additional screws to provide strong fixation in patients with coronal medial fracture lines.

Unilateral plating with locking head screws seems a reasonable option for treatment of bicondylar tibial plateau fractures. It might not replace conventional ORIF dual plating techniques as the standard treatment, but because of the minor infection rates and high union rates without bone grafting, it is an excellent alternative for treatment of problematic fractures associated with soft tissue damage or extensive metaphyseal/diaphyseal fracture comminution.

REFERENCES:

1. Gosling T, Schandelmaier P, Marti A, Hufner T, Partenheimer A, Krettek C. Less invasive stabilization of complex tibial plateau fractures: a biomechanical evaluation of a unilateral locked screw plate and double plating. *J Orthop Trauma* 2004; 18: 546-51.
2. Messmer P, Regazzoni P, Gross T. New stabilization techniques for fixation of proximal tibial fractures (LISS/LCP). *Ther Umsch* 2007; 60: 762-67.
3. Honkonen SE. Indications for surgical treatment of tibial condyle fractures. *Clin Orthop* 1994; 302: 199-2005.
4. Gonzaleiz HY, Mortan, Sainchez JF, Erasun RC. Early results with the new internal fixator system LCP and LISS: Prospective study. *Acta Orthop Belg* 2007; 73 (1): 64.
5. Ring D, Kloen P, Kadzielski J, Halfet D, Jupiter JB. Locking compression plates for the osteoporotic nonunions of the diaphyseal humerus. *Clin Orthop Relat Res* 2004 Aug; 425: 50-4.
6. Thomas F et al. Shimming a locking plates with washers to correct axial alignment. *J Orthop Trauma* 2007; 21: 400-403.
7. Cole PA, Zlowodzki M, Kregor PJ. Treatment of proximal tibia fractures using the less invasive stabilization system. Surgical experience and early clinical results in 77 fractures. *J Orthop Trauma* 2004; 18: 528—35.

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