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THE EVALUATION OF LOCKED COMPRESSION PLATING IN METAPHYSEAL FRACTURES OF LONG BONES AND ITS OUTCOME – A RETROSPECTIVE ANALYSIS

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ABSTRACT **BACKGROUND:** Open reduction and internal fixation in metaphyseal fractures of long bones jeopardizes fracture fragment vascularity and often results in soft tissue complications, tibia being the most common fractured long bone of the body. **AIMS AND OBJECTIVE:** To treat the patients with Metaphyseal fractures of long bones between 21-65 years presenting in the department of Orthopaedics and were treated with locking compression plates. **METHODS AND MATERIALS:** This is a prospective study, conducted from November 2019 to January 2021 at department of Orthopaedics, Madhubani Medical College, Madhubani, Bihar. Patients presenting with Metaphyseal fracture of long bones were taken in to study. Trauma was assessed as per ATLS fracture and classified according to AO/OTA classification. X-rays were taken in two planes- A.P, lateral and mortise view including ipsilateral knee and ankle. In open fracture, wound washing with H2O2 and saline was done and prophylactic anti tetanus and I.V antibiotics were given. **RESULT:** In our study we included 80 cases, 66 were males and 14 females. The mean age of patients was 42.2 years (15-70 years). Maximum number of patients was in the age group of 21-30 years. 40 cases of distal femur, 18 cases of proximal tibia, 12 cases of distal tibia, 6 proximal humerus and 4 distal radius were fixed with LCP.58 patients were closed (72.5%) and 22 were open (27.5%). For maximum number of patients mostly stainless steel plate was used (88%) for fixation and for 6 cases titanium plate was used. **CONCLUSION:** Reduction and internal fixation of distal tibial fractures using locking compression plate technique is one of the acceptable forms of treatment for lower third tibia including the articular surface with or without complication.

KEYWORDS : Distal tibial fractures, ORIF, Locking compression plates and comminuted fracture.

INTRODUCTION

Conventional plating techniques have focused on providing absolute rigidity and stability after anatomic reduction to ensure predictable primary bone healing. It serves to resist bending, torsional, axial loading by transferring these loads to the bone-plate interface in the form of shear stresses that friction forces resist between the plate and bone. Tibia being the most common fractured long bone of the body [1], distal Metaphyseal fractures comprise 5-7% the injuries [2], with or without involving the articular surface. Fracture of the humeral shaft (diaphysis) account for approximately 3% of all fractures and represent 20% of all humeral fractures [3, 4]. They have bimodal distribution. One group consists of mostly young males of 21-30 years age group and other of older females of 60-80 years. Various literatures are available showing the advantages of the conservative method of treatment [5, 6]. Fracture with intra-articular extension, neurovascular injury and pathological fracture almost always require operative treatment. Comminuted fracture of the shaft and distal one third can be surgical challenge requiring great surgical skills and optimal implant design to obtain stable fixation to attain early mobilization. Important variables affecting the clinical outcome of these fractures are fracture pattern and type, trauma associated to the surrounding soft tissue, modality and method of fracture treatment and caliber of reduction of fracture and articular surface. Fracture of lower third of tibia is very common in males of 30-50 years age group and mostly due to high energy injuries like road traffic injuries, fall from height or sports injuries [7]. This fracture poses challenges for the Orthopaedics traumatologist as it is prone to complications due to distal part of tibia is weight bearing, inherent instability, bone being subcutaneous in whole extent with minimal soft tissue cover, poor blood supply, frequently being comminuted and compound. For a successful outcome, we need to preserve normal axial biomechanics of knee and ankle joint preserve the joint articulature and also preserve the near normal arc of motion of the joint. Precise reduction and absolute stable fixation have its biological price [8]. There has been evidence to show the superiority of biological fixation over a stable mechanical fixation [9]. This led to the development and improvement in the techniques of biological fixation for fractures and also the development of stabilization systems that help in achieving a biological fixation [10, 11].Many authors have proved the superiority of locking plates over dynamic compression plates in various cadaveric long bone models [12, 13, and 14]. Some biomechanical studies have suggested that locking plate constructs are stiff and suppress inter fragmentary motion to a level that may be insufficient to reliably promote secondary fracture healing [15, 16, and 17].

AIMS AND OBJECTIVE: The aim of the study was to assess the outcome of treatment of Metaphyseal fractures of long bones using locking compression plate by both open and minimal invasive techniques in terms of rate of union, leg length difference and gait, return to daily routine activities and other consequences associated with distal tibia plating and compare the results achieved by other researches and to describe any complications and evaluate the functional outcome.

MATERIALAND METHODS: A retrospective hospital based study at department of Orthopaedics in Madhubani Medical College, Madhubani, Bihar, conducted from November 2019 to January 2021.

Selection criteria:

Patients presenting with Metaphyseal fracture of long bones were taken in to study. Patients were selected from those who had attended the emergency or outpatient department with Metaphyseal fractures of long bones not more than 2 weeks old in skeletally mature individual. Fractures were managed accordingly by POP slabs or splints.

Inclusion Criteria:(1) All closed and open Gustilo type -1 Metaphyseal fractures of long bones(Intra and extra articular, comminuted / Non comminuted) (2)Age > 21 years (3) Duration < 2weeks.

Exclusion Criteria: (1)Any pathological fractures(2) Local infection (3) Any associated trauma involving vital organs of body and associated comorbid condition that hampers mobilization of the affected limb (4) Fractures >2 weeks . (5) Open Gustilo type II and type III fractures

A clearance from Ethical Committee of institute was obtained. Written

informed consent was obtained from all the patients or their family for participation in the study. On admission demographic data were recorded and thorough clinical radiological evaluation was performed. The following patient data was recorded:

Mode of injury, date of injury, associated injuries of bones and other tissue, skin condition, distal neurovascular status, closed or open fracture, AO fracture classification. The patients were operated as early as possible.

Treatment protocol:
Major trauma was assessed with10 survey and 20surveys as per ATLS. Fracture was assessed and classified according to AO/OTA classification [5]. X-rays were taken in two planes- A.P, lateral and mortise view including ipsilateral knee and ankle. In open fracture, wound washing with H2O 2 and saline was done and prophylactic anti tetanus and I.V antibiotics were given.

Surgical Technique:
Standard surgical incision specifically given for various fractures as needed. For bridge plating single or double incision method were used. Plate selection, Reduction and temporary plate placement, screw application were used for fixation. Universal drill guide were used for insertion of cortical screws.

Threaded drill guide and appropriate size drill – bit used to drill near cortex and position verified under image intensification to determine the final screw placement whether acceptable or not. Threaded drill guide removed and appropriate size locking screw inserted.

Procedure: Preoperatively, the exact modality of surgery and fixation was decided. Postoperatively, patients underwent thorough clinical evaluation including assessment of functional status using UCLA shoulder score and Mayo Elbow Performance Score (MEPS) along with radiological examination. We used AO synthes locking plates in all the participants (Metaphyseal locking plates). For distal tibia metaphyseal fractures, with the patient positioned supine on radiolucent table under image intensifier guidance and under tourniquet control using anteromedial approach to tibia and MIPO technique using smooth gentle curved 5cm incision over tip of medial malleoli taking care not to cut saphenous vein. The articular fragments were reduced anatomically, by indirect reduction using image intensifier and pointed reduction forceps and help in position at times using 'k' wires temporarily. After creating a subcutaneous tunnel along the medial aspect of tibia by blunt dissection, preselected distal tibia contoured plate was advanced through the tunnel, bridging the fracture site, plate was placed parallel to the posterior borders of distal tibia and checked under image intensifier in both A.P and Lateral Planes. Using a threaded drill sleeve in most proximal hole of plate with a small incision at proximal end of plate was a good handle for correct plate positioning. The plate was then temporarily fixed with 'K' wires. After confirming the axial and rotational alignment of fracture under image intensifier, distal and proximal locking screws were inserted. For safety reasons a minimum of three screws are recommended on the either side of fracture.

Post-Operative Care: In the immediate postoperative period, care was given to the general condition and fluid balance, and immobilization of the limb in POP slab. Active assistant mobilization of joints was started on 3rdpost-operative day. Operated limb was elevated to prevent edema. Repeat hemoglobin was done to assess the blood loss so that if required additional blood could be transfused. The patients were encouraged to do quadriceps exercise and mobilization of adjacent joints and other active and passive assisted exercises to prevent joint stiffness. Patients were advised not to bear weight if lower limb was operated and not to carry load if the upper limb is operated. All the plated fractures were kept in a very light removable splint till clinical union and regular active assisted exercises were promoted. The patients were called for regular follow up. Patients were followed at 6 weeks, 3 months, 6 months and 9 months intervals. Partial weight bearing was started when there was clinical and radiological union as evidenced by no tenderness at the fracture site and sufficient callus on the radiograph across the fractured region. During follow-up patients were examined for range of movement involved joints, callus formation in x-rays as an evidence of union and complication, if any.

Complications: There were no cases of intraoperative complications.
Case 1: 65 years old female with distal femur metaphyseal fracture treated with distal femur metaphyseal plate fixation

Fig: 1- pre-op

Fig: 2- post-op

Fig -3: six weeks post-operative

Fig -4: Ten weeks post-operative


Fig -5: Six months post-operative

Case – 2: 55 years old female with metaphyseal fracture of distal tibia and fracture of lateral malleolus treatment with distal tibia and distal fibula metaphyseal plates.


Fig- 1- Preop


Fig -2-Postop


Fig-3- 6 week postop


Fig-4- 10 week postop


Fig – 5 - 4 month postop

RESULT:

In our study we included 80 cases, of which only one case had delayed union. There was no malunion or non-union. Most of the cases were due to road traffic accidents. Out of 80 cases 66 were males and 14 females. The mean age of patients was 42.2 years (15-70 years). Maximum number of patients was in the age group of 21-30 years. 40 cases of distal femur, 18 cases of proximal tibia, 12 cases of distal tibia, 6 proximal humerus and 4 distal radius were fixed with LCP. 48 Cases were fixed with 4.5mm distal femur LCP, 8 proximal humerus LCP, 6 distal tibial Metaphyseal LCP, 7 Clover leaf LCP, 8 Lateral head plate LCP, 2 locked T-plate and 1 narrow LCP. 58 patients were closed (72.5%) and 22 were open (27.5%). For maximum number of patients mostly stainless steel plate was used (88%) for fixation and for 6 cases titanium plate was used. Bridge plating was used in 31 cases (57%) achieved union with only two implants failures. In 1 case screw was broken in distal femur plating and in 1 plate was broken at the fracture site in distal tibial Metaphyseal plating. Six patients lost in follow up (11%). Union occurred in 79 cases (98.75%), delayed union in 1 case. No malunion or non-union occurred. 1 patient had osteomyelitis. 88% of patients achieved full range of movements and 12 % had limited range of movements. There was no neurovascular complication and wound healing was uneventful.

Table-1: Sex Ratio

SEX	NO. OF CASES	PERCENTAGE
Males	66	82.5
Females	14	17.5

Table 1 shows that out of 80 cases operated for LCP 66 (82.5%) were Males and 14 were Females (17.5%)

Table-2: Mode of trauma

MODE OF INJURY	NO. OF CASES	PERCENTAGE
Road Traffic Accidents	57	71.25
Fall from Height	5	6.25
Slipped on ground	8	10
Assault	4	5
Others	6	7.5

Table -2: shows that out of various modes of injuries. A Road traffic accident was most common and was responsible for 71.25% of cases.

Table-3: Open / Closed Fractures

BONE	CLOSED	OPEN
Distal femur	26	8
Proximal Tibia	18	6
Distal Tibia	8	4
Humerus	6	0
Radius	4	0
Total	62	18

Table-4: Types of implant used

BONE	IMPLANT	MATERIAL	PLATE LENGTH
Distal femur	4.5mm LCP	SS-16/ Titanium-4	7-11 Holes
Proximal tibia	LTHP-15/3.5MM Narrow/ LCP-1	SS	5-120Holes
Distal tibia	Distal tibial-metaphyseal plate-3/ cloverleaf LCP-7	SS-9/ Titanium-1	6-11 Holes
Radius	Oblique locked T plate-2	SS	5 Holes
Proximal humerus	3.5 mm Proximal Humerus LCP	SS-3/ Titanium-1	5 Holes

Table-5: Range of movements

BONE	FULL R.O.M	LIMITED R.O.M
Distal femur	24	6
Distal tibia	18	0
Proximal tibia	22	1
Humerus	5	1
Radius	3	0
Total	72	8

Table-6: Comparative Study

STUDY	MINIMUM AGE	MAXIMUM AGE	AVERAGE AGE	MALES %	FEMALES %	HIGH ENERGY	LOW ENERGY
CoryCollinge et al	17	62	43	77	23	100%	0%
Heather A Vallier et al	16	77	39.1	69	31	51%	49%
Shrestha D et al	20	65	38.75	60	40	50%	50%
Present Study	18	70	42.22	80.7	19.3	71.15 %	28.85 %

DISCUSSION: The overall incidence of Metaphyseal fractures of long bones is increasing worldwide in both developed and developing countries. Our experience with the locking plate has given favorable results. Early mobilization and rehabilitation played a significant role in achieving optimal functional outcome especially when dominant upper limb was involved. Tibia is the most common fractured long bone. Most articular fractures of distal tibial weight bearing surface are the result of high energy mechanisms. In this study, we have prospectively studied the outcomes of surgical treatment of these fractures using LCP. Bone union was defined as presence of bridging callus and full weight bearing without pain.

We evaluated our results and compared there with those obtained by various other studies utilizing different modalities of treatment. Our study revealed the average age of patients with such injuries to be 42.2 years.

CONCLUSION: Reduction and internal fixation of distal tibial fractures using locking compression plate medially by open and MIPO technique is one of the acceptable forms of treatment for lower third tibia including the articular surface with or without complication. The following conclusion was inferred:-

1. The most common mode of injury was road traffic accidents.
2. The most common age group who underwent locked plating was 21-30 years with male predominance.
3. Different types of LCP were used according to bone and site of fracture.
4. Bridge plating technique was used in 31 cases (Tibia-24, Femur-7).
5. Mostly stainless steel and few titanium plates were used,
6. Rate of union with LCP was high and so with bridge plating.

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