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Original Article

Study of surgical management of proximal tibial fractures using anatomical proximal tibia locking compression plate

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Abstract:

Background: Treatment of these proximal tibia fractures using minimally invasive percutaneous plate osteosynthesis (MIPPO) techniques may minimize soft tissue injuries and damage to vascular integrity of fracture fragments.
Methods: This study was a hospital based prospective study centred in department of orthopaedics at GSL Medical College Rajahmundry, from December 2017 to May 2019 in which 20 patients with proximal tibia fractures. These patients were treated with locking compression plate (LCP).
Results: The assessment of clinical outcome was made according to Rasmussen's functional grading system. End results showed excellent outcome and out of 20 patients, 19 Patients (85%) showed radiological UNION
Conclusion: Surgical management of proximal tibial fractures will give excellent anatomical reduction and rigid fixation to restore articular congruity, help to facilitate early mobilization and reducing post-traumatic osteoarthritis and hence to achieve optimal knee function. LCP remains a good choice in comminuted or more severe patterns of fractures.
Keywords: Proximal tibia fractures, locking compression plate, minimally invasive percutaneous plate osteosynthesis, Intra-articular fractures.

Introduction:

Ever since the advents of high velocity transport system, there is an alarming increase in road traffic accident (RTA) with increased orthopaedic related morbidity and mortality. Proximal tibia being involved in body weight transmission through knee joint and leg, it plays a vital role in knee function and stability. Fractures of proximal tibia have historically been difficult to treat because of its subcutaneous location of the anteromedial surface of the tibia. Severe bone and soft tissue injuries are not infrequent and there is high incidence of open fracture compared with other long bones. [1]

The aim of surgical treatment of proximal tibial fractures is to restore and preserve normal knee function, which can be accomplished by anatomical restoration of articular surfaces, maintaining mechanical axis, restoring ligamentous stability and preserving a functional pain free range of motion of knee. [1]

The incidence of malunion, non-union and infections are relatively high in many reported series, causing significant long-term disability. Recently more attention has been paid to the condition of soft tissue envelope. Soft tissue friendly approaches and minimally invasive techniques have improved the outcome. Treatment of these injuries using minimally invasive percutaneous plate osteosynthesis (MIPPO) techniques minimize soft tissue injury and damage to vascular integrity of fracture fragments. [2, 3]

Over the last decade plate fixation has become popular for the treatment of proximal tibial fractures. This coupled with biological advantage of percutaneous insertion has resulted in high union rates. Locking compression plate device offers potential biomechanical advantage over other methods by

- Better distribution of forces along the axis of bone
- Can be inserted with minimal soft tissue stripping using minimally invasive percutaneous plate osteosynthesis (MIPPO),
- Substantially reduces failure of fixation in osteoporotic bones,
- Reduces the risk of a secondary loss of intraoperative reduction by locking with screws to the plate,
- Unicortical fixation option,
- Better preservation of blood supply to the bone as a locked plating does not rely on plate bone compression,
- Provides stable fixation by creating a fixed angle construct and angular stability and allows early mobilization. Locking compression plate has added advantage of the ability to manipulate and reduce the small and often osteoporotic fracture fragments directly. [4]

METHODS:

This is a study of proximal tibial fractures treated with locking compression plate (LCP) which was conducted in the Department of Orthopaedics at GSL Medical College Rajahmundry, from December 2017 to May 2019. Clearance

was obtained from hospital ethical committee. During this period 20 patients were treated for proximal tibial fractures by LCP fixation and all the required data was collected from the patients during their stay in the hospital and during follow up at regular intervals.

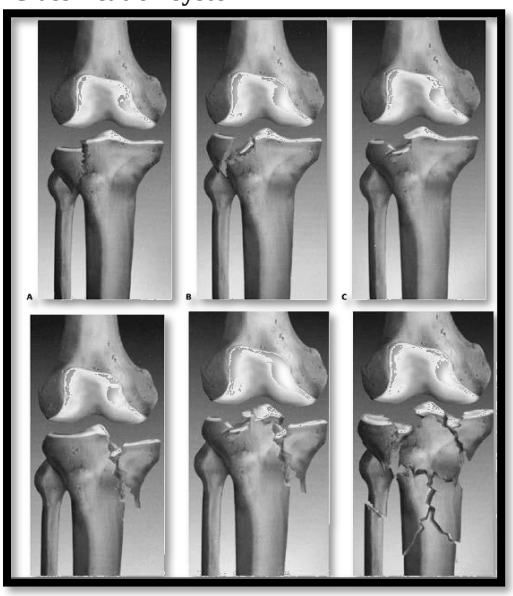
Inclusion Criteria:

1. Age above 18 years
2. Closed / Open Gustilo-Anderson Type I, II and IIIA
3. Intraarticular / Extraarticular proximal tibial fractures (AO 41A and 41C).

Exclusion criteria:

1. Pathological fractures
2. Patients medically unfit for surgery

Classification system



Schatzker's classification: Currently, more widely used. Differentiation between medial & lateral tibial plateau fracture is done.

Management

The patients were first seen in the casualty/ OPD. The history was taken followed by general and local examination of the patient. Concerned specialists undertook appropriate management of any associated injuries. Intensive care was given to those patients who presented with shock following head injuries and immediate resuscitative measures were taken. Once the patient's general condition was fit, relevant x-rays were taken. Higher investigations such as CT scan were done if indicated.

The patients were taken for surgery at the earliest possible time depending on their medical condition, skin condition and the amount of swelling. If definitive surgery was delayed, fracture was immobilized with an above knee posterior splint. All surgeries were done under C-arm image intensifier control. Fractures were fixed either with MIPPO technique or by open reduction and internal fixation with LCP.

Preoperative planning

• Consent of the patient/ patient attenders was taken prior to the surgery. •Appropriate length of the plate to be used was assessed with the help of radiographs.
• A dose of tetanus and antibiotic was given preoperatively.
• Preparation of the part was done before the day of surgery.
• The injured leg was immobilized in a plaster-of-paris slab during preoperative period.
• Instruments to be used were checked and sterilized.

Position

Patient supine on radiolucent operating table.

Operative Procedure

• Type of anaesthesia: Spinal anaesthesia.
• Betadine scrub was given to the limb.
• Pneumatic tourniquet was applied after exsanguinations and time noted.
• Painting and draping of the part done.
• Through anterolateral approach, intraarticular fractures were exposed and reduced anatomically, whereas extraarticular fractures were treated through MIPPO technique.
• After achieving reduction, appropriately sized plate was taken and fracture was stabilized using cortical and locking screws. Cortical screws were put before putting locking screws.
• The major intra-operative problems encountered were in case of comminuted fractures that were tried to reduce by MIPPO technique and later converted to open reduction after unsuccessful attempts.
• Tourniquet was released and haemostasis secured.
• Wound closed leaving suction drain in situ.

Postoperative

Postoperatively after obtaining rigid internal fixation, the patients were mobilized after removal of drains, for 2-5 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 on 12-14th day if no complications, full range of movement was allowed. An immediate postoperative x-ray was also done. Intravenous antibiotics were given for 48 hours in case of closed fractures and more as required in case of open fractures. Analgesics were given till adequate pain relief was obtained. The patients were advised quadriceps exercises, early active knee mobilization and non-weight bearing crutch walking, on discharge. In case of comminuted fractures with unstable fixation, external support was given in the form of slab and mobilization was started after confirming the healing process clinically and radiologically.

Follow up

After suture removal, follow up was done at 6 weeks during which patient were clinically evaluated and an x-ray was taken to look for signs of fracture union and loss of reduction if any. The second follow up was done at 3 months during which one more x-ray was done and a clinical evaluation of union done. Based on the clinical and radiological signs of union patients were allowed partial weight bearing and gradually progressed to full weight bearing. Partial weight bearing was delayed until 6 – 8

weeks and full weight bearing allowed after 12-16 weeks if fracture union seen. The patients were then followed up at 6 months during which time the anatomic and functional evaluation was done using the Rasmussen's functional grading system.

RESULTS:

In our study 20 fractures of upper end of tibia were treated. All cases were fresh, 16 patients were males and 4 patients were females. The median age was 44 years ranging from 22-68 years. 18 of the fractures were caused by road traffic accidents and 2 were due to fall. 11 patients were with fracture on left side and 9 on right side.

Of the 20 'upper end of Tibia' fractures, 1 was of Schatzker type I, 2 were Schatzker type II, 6 were of Schatzker type III; 5 were of Schatzker type IV; 5 were of Schatzker type V and remaining 1 was of Schatzker type VI. All fractures were closed.

4 patients had associated injuries. Of them, 1 patient had comminuted fracture of contralateral tibia. 13 out of 20 fractures were treated by closed reduction and remaining 7 by open reduction. All patients were operated within 7 days 5 of them within 3 days of injury. Average time duration of surgery was 103 minutes with shortest duration being 75 min and longest being 150 min.

Duration for fractures treated by open reduction was more averaging 123 minutes. The size of plate was selected based on the type of fracture. 6 and 7 holed plates were used more commonly for upper end of tibia.

Of 20 patients, 19 Patients (85%) showed radiological UNION within 18 weeks. One patient went for NONUNION with implant failure. Broken plate was removed and treated with Limb Reconstruction system and bone grafting which united over 16 weeks following second procedure.

Average flexion in this study was 105 degree with more than 65% patients having knee range of motion more than 110º. Average knee extensor lag in this study was 5.60 degrees. In this study, very few patients had significant varus/ valgus malalignment. The duration of follow-up ranged from 3 months to 18 months.

Table 1: Clinical and demographic characteristics of the study subjects

Variable		Number	%
Sex	Male	16	80
	Female	4	20
Age (years)	21-30	3	15
	31-40	5	25
	41-50	5	25
	51-60	6	30
	> 60	1	5
Side affected	Right	9	45
	Left	11	55
Mechanism of injury	Road traffic accident	18	90
	Fall from height	02	10
Associated injuries		04	20

Table 2: Distribution of study subjects as per type of fracture

Type of fracture	Number	%
Schatzker type I	1	5
Schatzker type II	2	10
Schatzker type III	6	30
Schatzker type IV	5	25
Schatzker type V	5	25
Schatzker type VI	1	5
Total	20	100

Table 3: Distribution of study subjects as per operative characteristics

Variable		Number	%
Operative time (min)	< 90	5	25
	91-120	12	60
	> 120	3	15
Type of reduction	Closed	13	65
	Open	7	35
Size of plate used	4-6 holded	6	30
	7-9 holded	10	50
	10-12 holded	4	20

Table 4: Duration took place for union (weeks)

Union (weeks)	Number	%
< 16	8	40
16-18	9	45
19-20	2	10
Non union	1	5

Table 5: Time required for union

Achieved time (weeks)	Number	%
8-9	5	25
10-11	9	45
12-14	4	20
> 14	1	5

DISCUSSION:

Proximal tibia fractures present a spectrum of soft tissue and bony injuries that can produce permanent disabilities. Their treatment is challenged by fracture comminution, instability, displacement and extensive soft tissue injures. The goals of treatment are restoration of joint congruity, normal limb alignment, knee stability and a functional range knee motion. The major limitations of non-operative treatment include inadequate reduction of articular surface and ineffective limb alignment control. Furthermore, the extended period of hospitalization and recumbence are not cost-effective in today's health care environment.

The aim of this study is to evaluate the clinical outcome of fracture of proximal tibia treated with locking compression

plate and its complications.19 out of 20 upper tibial fractures showed clinical and radiological union in average period of 16 weeks following surgery. 1 patient went for non-union due to implant breakage.

Rambold [5] in 1960 reported that internal fixation of tibial plateau fractures and early mobilization contributes to good anatomical and functional results. Dennis Jensen [6] in 1990 got good results by surgical treatment of proximal tibia fractures. Chaix et al [7] reported 86% good to excellent results by surgical means of treatment. Lee et al [8] reported good to excellent results by surgical means of less invasive stabilization system treatment. Feng et al [9] reported good results when fixed with LCP in comparison with dynamic compression plate (DCP) with an additional benefit of minimally invasive surgery. Kim et al [10] reported good results with MIPPO technique in treatment of open proximal tibial fractures with adequate soft tissue coverage.

The period of immobilization was again individualized depending on the security of rigid fixation and other circumstances demand. The benefits of early knee motion include - reduce knee stiffness and improved cartilage healing (regeneration). However, these benefits are to be cautiously balanced by risks, including loss of fracture reduction, failure of internal fixation and compromised ligament and soft tissue healing. Several studies stated that the prognosis is given by the degree of displacement, type of fracture, method of treatment and quality of postoperative care.

CONCLUSION:

Road traffic accidents or high velocity injuries are the most common cause of these fractures. These high velocity injuries are associated with more severe or comminuted fracture patterns. Most of these injuries occur in younger and active age groups. The main aim of surgical treatment includes precise reconstruction of the articular surface with elevation of the depressed bone fragment in case of intraarticular fracture, bone grafting in case of bone loss and stable fragment fixation allowing early range of movement. Preoperative soft tissue status and their repair at right time, significantly changes the outcome. All fracture united well in time. Infection plays a vital role in influencing the result of the surgical outcome. Period of joint immobilization plays a major role in the end result. ORIF with LCP seems to be good implant choice in proximal tibia fractures including difficult fracture situations.

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