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Dr. Mani Ramesh
Associate Professor, Department
of Orthopaedics, Sri
Muthukumaran Medical College
Hospital and Research Institute,
Chennai, Tamil Nadu, India

Tibial shaft fractures treated by minimally invasive percutaneous plate osteosynthesis

Dr. Mani Ramesh

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Abstract

Objective: To analyse the clinical, functional and radiological outcomes along with the duration of union and complications in treating tibial shaft fractures with Minimally Invasive Percutaneous Plate Osteosynthesis.

Methods: A prospective study was performed on thirty adult patients who underwent locking compression plate using MIPPO technique for closed fracture tibial shaft in the Department of Orthopaedics from May 2017 to April 2018 and were followed for one year. The functional outcome was measured using AOFAS (American Orthopaedic Foot and Ankle Society score) and Olerud and Molander scores and was then graded as excellent/good/fair and poor. Radiological outcomes assessed by taking anteroposterior and lateral view x-ray of affected and normal limb and compared. Duration of union and complications were assessed.

Results: Majority of the patient were male (60%) belonging to the age group of 36 to 40 years (26%). AOFAS score depicts excellent result in the majority of the patients (70%). Olerud and Molander Score depicts good results in 57% and excellent results in 43% of patients. Duration of union is less than 16 weeks in almost 50% of patients. Complication resulted in 22% of patients.

Conclusion: Minimally Invasive Percutaneous Plate Osteosynthesis technique for the treatment of tibial shaft fracture provides good healing and excellent functional results in most of the patients with few complications.

Keywords: MIPPO, percutaneous plate osteosynthesis, LCP, tibial shaft fracture

Introduction

The process of unplanned and rapid urbanization in developing country like India lead to increase in number motor vehicle. There is a massive increase in morbidity and mortality due to road traffic accidents in the past few years. Recently road traffic accident takes ninth place in disease burden and will occupy the third place by 2020(1). All over the world, around 1 million death and around 50 million injuries occur due to a road traffic accident [1]. In India, around eighty thousand death and around 1 million injuries occur due to a road traffic accident. Among these RTA, half of the population belong to the wage-earning group [2]. Tibia is the most common long bone fracture involved in RTA. Tibial shaft fracture is more common among all tibial fracture [3]. Delayed bone union, Non-Union, wound complications such as dehiscence and infection are the complication following post-traumatic tibia fracture due to the peculiar blood supply, superficial location of bone and use of certain treatment methods [4]. Surgical treatment available for the shaft of tibia fracture includes ORIF with plating [5, 6], external fixator [6-10] and intramedullary nailing [11-13]. Recently Minimally Invasive Percutaneous Plate Osteosynthesis is used in the treatment of complex bone fracture of the lower extremity [14-16]. The main aim of this procedure is to provide stable plate fixation and maintain fracture biology without extensive soft tissue damage. Vascular studies following MIPPO technique demonstrated preservation of blood supply when compared to open plating [17]. Open reduction and plating cause extensive soft tissue damage and periosteal injury associated with complications like infection, malunion and non-union [18-23]. Intramedullary nailing remains gold standard for the shaft of tibia fracture, but reaming of marrow leads to the destruction of bone marrow and make the bone brittle after implant removal [24]. External fixator also associated with complications like pin site infection, loosening of pin and non-

Corresponding Author:
Dr. Mani Ramesh
Associate Professor, Department
of Orthopaedics, Sri
Muthukumaran Medical College
Hospital and Research Institute,
Chennai, Tamil Nadu, India

union. In MIPPO technique, soft tissue attachment and hematoma surround fracture fragment are not disturbed. Hence it preserves the vascularity and osteogenic capacity of the fragment. The fracture site is stabilized by fixing plate proximal and distal to the fragment by minimal soft tissue damage. Displaced and angular alignment are corrected by closed reduction technique. The advantage of MIPPO technique is

- It preserves extraosseous blood supply.
- Fracture hematoma is not disturbed.
- Biologically friendly and stable fixation.
- Sub-cutaneous tunnelling of the plate avoids large incision.
- Iatrogenic injury to vessels and nerves are prevented.
- Provides both angular and axial stability.

Aim and Objective

To analyse the clinical, functional and radiological outcomes along with the duration of union and complications in treating tibial shaft fractures with Minimally Invasive Percutaneous Plate Osteosynthesis.

Materials & Methods

This prospective study was conducted at our Medical College Hospital, during the period from May 2017 to April 2018 in the Department of Orthopaedics. Thirty-two patients have been operated with MIPPO technique for the shaft of the tibia. Out of which one patient lost to follow up, and one died because of an unrelated cause, and they were excluded from the study. Thirty cases were followed for twelve months. Written consent from all the patients was taken to publish their clinical and radiological data. Necessary clearance was also sought from the institution's research and ethical committee for the conduct of this study.

Inclusion criteria

1. Adult's patient aged between 26 to 50 years.
2. Both males and females.
3. Simple closed fractures shaft of the tibia.
4. Complex fractures of the shaft of the tibia.

Exclusion criteria

1. Patients aged below 26 and above 50 years.
2. Associated comorbidity involving renal, cardiopulmonary, hepatic and central nervous system disorders.
3. Pathological fractures
4. Gustilo Anderson Type 3b and type 3c compound fractures of the shaft of the tibia.

Pre-operative planning

- i) Examine for the signs of vascular damage, closed degloving injury, fracture blisters and compartment syndrome.
- ii) Evaluate the soft tissue condition and accordingly plan for the timing of surgery.
- iii) Classify fracture pattern and degree of comminution.
- iv) Evaluate the need for distraction to achieve reduction.
- v) Patient factors like diabetes mellitus, immunocompromised condition, chronic disease, peripheral vascular disease, alcoholism and smoking must be considered.
- vi) Investigations-X-Ray leg Anteroposterior and Lateral views.
- vii) All required preoperative investigation.

Procedure

When trauma patient arrives in casualty, the first thing we stabilize the general condition (airway, breathing and circulation) of the patient. Then we rule out morbid injuries like intracranial haemorrhage, Rib fracture, Pneumothorax and intraabdominal bleeding. After which a head to toe examination is done. Suspected fracture site from the examination is splinted. X-ray of the required portion is taken. In the shaft of tibia fracture, the limb was immobilized temporarily with the above-knee slab. All routine pre-operative investigations done and associated comorbid condition like diabetes, hypertension is treated and brought under control. Anaesthetic fitness obtained and patient posted for LCP plating using MIPPO technique. LCP can be used in different ways:

- Conventional plating (compression and absolute stability)^[25].
- MIPPO technique (relative stability).
- Combination of the above technique.

Stability is mainly due to friction between plate and bone. The main goal of conventional plating is to provide anatomical reduction. Now recently developed bridging plate osteosynthesis is used in multi fragment fracture of the shaft. It has the advantage that it preserves vascularity of the bone, thus allowing the healing process of bone with callus formation. Damage to soft tissue is also less extensive, thus achieving the more rapid union of bone.

Patient in the supine position, with a tourniquet, applied. Regional anaesthesia is given. The indirect reduction was done using manual traction, Steinmann pin, Kirschner wire and reduction forceps. After reducing 3-4 cm incision in the vertical direction is made just proximal and distal to fracture site with care not to injure vessels and nerves. Using a special elevator, a subcutaneous tunnel was made. Locking compression plate was applied based on the fracture pattern. The locking sleeve is used as a handle for inserting the plate through a tunnel across the fracture site. The plate was centred across the fracture site. Initially, the cortical screw is inserted depending on the need for reduction of the proximal or distal fragment. Locking screw was inserted after reduction. There should be a minimum of 6 cortices on either side. Wound site was closed in layers, and a sterile dressing is done. The patient is temporarily immobilized with the above-knee slab.

Post-operative

Prophylactic antibiotic Cefotaxime was given to all patients 30 minutes before incision and was continued till postoperative day 3. In some compound fracture antibiotic is continued till suture removal. Adequate analgesics were given to relieve pain. Alternate suture removal is done on the 12th postop day. Complete suture removal is done on the 14th postop day.

The patient is made to sit and Non-weight bearing mobilized is started on the 1st post-op day. Muscle strengthening exercise and active range of movement exercise were started as tolerated by the patient. Passive range of motion apparatus is used for hip until the patient is discharged from the hospital. Full weight-bearing is advised generally after 18 weeks after confirming union by X-ray. Exercise is continued until the patient regains muscle strength and range of motion. The anteroposterior and lateral view was taken postoperatively to look for an adequate reduction.

Follow-up

The patient is asked to come for a follow-up two week following discharge. Both clinical and radiological evaluation of the patient is done during follow-up. Then after the patient is asked to come for follow up at six weeks, three months, six months, and one year and annually after that. Even though not all patients routinely came for follow-up. Sufficient amount of patients came. Attempts made to call patients those who missed follow-up through a phone call.

Outcome analysis

The functional outcome was measured by using AOFAS & OLERUD and MOLANDER Scores.

The American Orthopaedic Foot and Ankle Society Score (AOFAS) introduced in 1994 consists of nine questions in three components.

Pain (1 Question-40 points),

Function (7 Questions-50 points)

Alignment (1 Question-10 points)

Total score 100 points.

Points to Alignment and range of motion was based on clinical examination and radiograph.

Individual points are added to get an overall functional score, which is expressed as a percentage.

The Olerud and Molander Score is a patient questionnaire with a score of 0 (Totally impaired) to 100 (Completely impaired) and is based on nine different items:

- Pain
- Stiffness
- Swelling
- Stair Climbing
- Running
- Jumping
- Squatting
- Supports
- Activities of daily living

Radiological outcomes are evaluated by anteroposterior and lateral view X-ray.

Results

Thirty patients with the shaft of tibia fracture who satisfy inclusion criteria are included. They were operated with MIPPO technique.

Majority of the patient were male (60%) belonging to the age group of 36 to 40 years (26%). AOFAS score depicts excellent result in the majority of the patients (70%). Olerud and Molander Score depicts good results in 57% and excellent results in 43% of patients. Duration of union is less than 16 weeks in almost 50% of patients. Complication resulted in 22% of patients.

Table 1: Age and Sex distribution.

Age	Number of patients			Percentage of patients
	Male	Female	Total	
26 to 30 Years	3	2	5	17
31 to 35 Years	3	3	6	20
36 to 40 Years	6	2	8	26
41 to 45 Years	2	3	5	17
46 to 50 Years	4	2	6	20
Total	18	12	30	100%

Table 2: AOFAS Score.

Grading	Points	Number of patients	Percentage
Bad	0-30	0	0
Fair	31-60	0	0
Good	61-90	9	30
Excellent	>90	21	70
Total		30	100%

Table 3: Olerud and molander score.

Grading	Points	Number of patients	Percentage
Bad	0-30	0	0
Fair	31-60	0	0
Good	61-90	17	57
Excellent	>90	13	43
Total		30	100%

Table 4: Duration for the union.

Duration (weeks)	Number of patients	Percentage
<16 weeks	15	50
16-20 weeks	10	33
20-24 weeks	4	13
>24 weeks	1	4
Total	30	100%

Table 5: Complication.

Complications	Number of patients	Percentage
Superficial Infection	3	10
Deep Infection	2	6
Malreduction	1	3
Delayed union	1	3
Total	7	22%

Discussion

Many new innovative surgical techniques have been developed over the years with an improved understanding of biomechanics, which leads to a better functional outcome for patients. Managing a severely comminuted shaft of tibia fracture is challenging. Tibia is a long bone that transmits body weight to the ground. This study is done to access the effectiveness of minimally invasive MIPPO technique in the management of the shaft of a tibia fracture.

Previously more importance of fracture treatment is to achieve anatomical reduction and rigid fixation to achieve stability. This results in an increased incidence of delayed union and non-union due to disturbing soft tissue and hematoma covering fracture. This lead to the development of a minimally invasive technique to avoid damage to fracture hematoma and soft tissue covering fracture. This helps in the early union of the fracture. This type of fixation is a demanding technique and success depends on the technique used

MIPPO has been extensively used in distal tibia fracture. In our study, we have used MIPPO technique in all kind of shaft of a tibia fracture. Tibia is one of second longest bone in our body which bears the entire weight of the body. Treating such bone fracture with minimally invasive technique is a challenging part. Presence of open injury associated with skeletal injury and skin condition all affected outcome.

In our study, we treated thirty patients with the shaft of tibia fracture with MIPPO technique. Males are more commonly involved in the shaft of tibia fracture than female. The reason might be due to males are more involved in our door activities

than female. Most of the cases occur in the age group of 36 to 40 years. AOFAS score revealed excellent result in 70% of patients and good results in 30% of patients. There are no patients with a fair and bad score. Olerud and Molander Score revealed excellent score in 43% of patients and good results in 57% of patients. There are no patients with fair and bad Olerud and Molander score. Almost 50% of patients achieved union within 16 weeks, and most of the patients achieved union within 24 weeks. Only one patient had a union for more than 24 weeks. Complications were seen only in 22% of patients.

Inference from the above study

1. Minimally invasive percutaneous fixation following closed reduction is very effective in the management of shaft of a tibia fracture.
2. It decreases the duration of surgery, intraoperative blood loss and postoperative complication, which allow early rehabilitation.
3. It decreases the duration of the union.
4. AOFAS and Olerud and Molander Score provide excellent results when the shaft of tibia fracture treated by MIPPO technique.
5. It also decreases the postoperative incidence of infection as compared to the open technique.
6. Perfect restoration of limb length, alignment and rotation.

Conclusion

From the above study, we prove that minimally invasive percutaneous plate osteosynthesis has given excellent and good functional outcome in most of the patient. Duration of union is less than 16 weeks in most patients. Complication resulted only in 22% of patients. Hence we conclude that minimally invasive percutaneous plate osteosynthesis can be considered treatment of choice for the shaft of a tibia fracture.

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