A Clinical Study For Management Of Tibial Diaphyseal Fractures In Adults With Locking Compression Plate Using Mippo Technique

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Citation

Abstract
Background: The tibia is the most commonly fractured bone of all the long bones in the body. In-spite of advances in treatment, fractures of tibia still pose a challenge to the orthopaedic surgeon as to their best method of management. Vulnerability of soft tissues and increased incidence of open fractures further complicates these fractures. Minimally invasive percutaneous plate osteosynthesis is one of the modalities of treatment of tibial diaphyseal fractures which causes minimal disturbance of blood supply and preserves the soft tissues around the fracture site. The aim of our study is to show the results of treatment of tibial diaphyseal fractures using MIPPO technique. Patients and methods: Our study included fifty patients with tibial diaphyseal fractures treated with locking compression plate using MIPPO technique. Fourteen patients had associated skeletal injuries. Ten patients had a type one open fracture. Results: All the fractures united at an average of 22.25 weeks. Forty patients (80%) were pain free, six patients (12%) had occasional pain (no limitation of activities) and four patients (8%) had persistent pain with limitation of daily activities. 46 (88%) had excellent or good results and 4 (8%) had poor results. 4 (8%) patients had delayed union and 1(2%) patient developed superficial skin infection, 6 patients (12%) had a palpable hardware and 3 patients (6%) had ankle stiffness. Conclusion: Minimally invasive plate osteosynthesis is a good and safe technique for treatment of tibial diaphyseal fractures providing fracture healing, rapid functional recovery, with minimal soft tissue damage and preservation of blood supply. It is a reliable approach for the management of tibial diaphyseal fractures with proper indications.

INTRODUCTION
The tibia is the most commonly fractured bone of all the long bones of the body. No fracture in the body arouses more controversy regarding treatment than tibial fracture. Due to their frequency, topography, mode of injury and sometimes type of treatment, they have become source of temporary or permanent disability. Fractures of the tibia still pose a challenge to the orthopaedic surgeon due to certain peculiarities like; tibia is a subcutaneous bone so more chances of open type of fracture, greater tendency of displacement of tibial fractures and increased chances of post-op infection. Due to its poor blood supply and less soft tissue coverage there is an increased incidence of delayed union and non union. Biological plating techniques are those in which blood supply to the fractured fragments is maximally preserved. The objective of biologic fixation is to assist physiological process of bone healing wisely and optimally with minimal amount of operative intervention. Stress is laid on maintaining a precarious balance between devascularisation and mechanical perfection.

The first attempts at which is called as biological plating date back some 30 years (Boitzy and Weber), but it has gained popularity in the 1980’s. The development of indirect reduction techniques (Mast et al 1989), the development of wave plate (Brunner and Weber 1981) and the bridging plate (Heitemeyer et al 1985) brought about a basic change to fracture treatment using plates.

Biological fixation principles can be summarized as:

1. Repositioning and realigning by manipulation at a distance to fracture site, preserving soft tissues (Indirect reduction techniques).
2. Leaving comminuted fragments out of the mechanical construct, while preserving their blood supply.
4. Limited operative exposure.

Minimally invasive plate osteosynthesis (MIPPO) is one such method in which percutaneous inserted plate is fixed at a distance proximal and distal to the fracture site through minimal exposure.

Advantages cited for MIPPO:
- Simpler technique, easy to master.
- No need of additional expensive instrumentation.
- Improved rates of union.
- Decreased infection rate.
- Decreased need for bone grafting.
- Ideal technique for dealing with multiply injured patient.
- Early mobilisation of extremity possible.
- Decreased incidence of refracture after plate removal.

AIMS AND OBJECTIVES
- To study the advantage and disadvantages in the management of tibial diaphyseal fractures with MIPPO.
- To access the complications with the use of locking compression plate by MIPPO technique in diaphyseal fractures of tibia.
- To evaluate the Union rate and the average time taken for fracture union with MIPPO.
- To study the advantage and disadvantage of MIPPO over conventional plating by open reduction and internal fixation.
- To access the over all final functional results of patient and return to normal activity.

MATERIALS AND METHODS
The study has been conducted in the post graduate department of orthopaedics of government medical college Jammu during the period from April 2007 to April 2009. Both male and female patients have been included in the study.

Criteria for selection of patients: The following diaphyseal fractures of tibia were taken up for study.
- Transverse fracture.
- Spiral fracture.
- Oblique fracture.
- Comminuted fracture.
- Diaphyseal fracture with extension into metaphysis.
- Compound type fracture.
- Segmental fractures.

Criteria for exclusion of case:
- Tibial diaphyseal fractures in children
- Compound fractures with substantial soft tissue damage.
- Pathological fractures.
- Fractures extending into articular surfaces.
- Old fractures ie more than 3 weeks old.
- Infected fractures and fractures with bad skin condition.
- Fractures with compartment syndrome or impaired circulation.

METHOD
Fifty adult patients of either sex with diaphyseal fracture of tibia (closed and compound type 1) of less than 3 weeks old were included in study.

All cases were assessed initially in emergency section of Government medical college Jammu and they were provided with first aid in the form of analgesia and splintage in order to make the patient comfortable and reduce the chances of further displacement of fracture fragments and thereby avoiding further complications. Following baseline investigations were done so as to access the fitness of patient
for anaesthesia.

Blood grouping, Hb, BT, CT, Blood sugar, Serum urea, Serum creatinine, Serum electrolytes, Urine (R/e), ECG and Radiograph of local part including knee and ankle joint (AP and Lateral view), chest X-ray PA view were also taken.

**TECHNIQUE**

After the selection of the cases for surgery, patients were prepared for elective surgery to be conducted in main operation theatre. All patients received pre-op antibiotics. Limb was anaesthetised with the help of spinal, epidural or general anaesthesia. Tourniquet was applied around the thigh over adequate cotton padding to achieve clear/bloodless field during surgery. Maximum time for tourniquet application was no more than 45 min. to 1 hour.

Fractures were approached by the MIPPO technique, reduction done under fluoroscopy and the fracture fragments were fixed with the locking compression plate. Tourniquet was then released haemostasis achieved and wound closed followed by application of above knee plaster of Paris slab.

**Figure 1**

Fig 1: Operative photograph showing positioning of the plate. (The fracture site not opened)

**Figure 2**

Fig 2: LCP and locking screws with sleeve

**Figure 3**

Fig 3: Pre op radiograph (Left) and immediate post op radiograph (Right) showing fracture at metaphysiodiaphyseal junction of tibia.
Post-operatively limb was kept elevated, antibiotics and analgesics were administered and regular assessment of the distal neurovascular status was done.

Check X-rays in AP and Lateral view were taken to note the position of fragments. Gentle active exercise of the knee and ankle were encouraged as soon as the intensity of pain decreased. Stitches were removed at 2 weeks post-operatively followed by application of patellar tendon bearing cast. Partial weight bearing was allowed at 4 weeks and full weight bearing at 8 weeks onward post-operatively only when some signs of radiological union are noted on X-rays.

**FOLLOW-UP**

Follow-up was taken at 2 weeks, 6 weeks, 12 weeks and 6 months post-operatively. At every visit check radiographs were taken to assess the radiological union.

Follow-up was done taking care of the following parameters:

1. Clinical parameters which included:
   - Condition of scar, Fracture site tenderness, any obvious deformity, range of movements at knee, Ankle and Foot joints.

2. Radiological parameters which included:
   - Position of fragment, amount of bridging callus, Status of LCP and any other complication.

Results were graded as per modified Anderson et al (1978)
criteria into three groups:

1. Excellent:

Excellent results are those in which there is normal return of the function of the limb with no post-operative complication. Time taken for fracture union is 3 months.

2. Good:

Good results are those in which there is sound union in normal position and alignment without shortening with minor post-operative complication in the form of superficial skin infections and ankle or knee stiffness.

3. Poor:

Poor results are those in which there is post-operative complication in the form of deep seated infection, shortening more than 2 cms and delayed union/non union.

**OBSERVATION AND RESULTS**

Fifty cases of fracture of diaphysis of tibia were managed by locking compression plate using MIPPO technique in this series over a period of twenty four months.

This study revealed that most of tibial diaphyseal fractures (68%) occurred in young adults ie less than 35 years of age and were more common in males 84% with road traffic accident being the most common mode of injury (56%). There was predominance of right tibia (64%) as compared to left. Sixty percent of the fractures (30 cases) occurred in middle third of tibia with 24% (12 cases) in distal third and 16% (8 cases) in proximal third. Eighty percent of the fractures in our study ie 40 cases were closed fractures and twenty percent ie 10 patients had a compound type 1 fracture as per Gustilo Anderson classification. This study revealed that 70% (35 cases) of fractures of tibia were type A, 20% type B (10 cases) and 10% type C (5 cases) according to AO classification.

About 28% of the patients in his study have been found to be associated with other injuries signifying that fracture tibia is usually involved in Polytrauma patients. 52% (26 patients) of the cases have been operated within a period of 6-10 day’s from injury in our study. Most of the patients were discharged on removal of the stitches on 14th post-operative day.

Most common post operative complication in this study is palpable hardware.
Healing of the fracture has been assessed radiologically and fracture was said to be united when there is complete obliteration of fracture in two radiological planes (AP and Lateral). 72% of the fractures in this study united in 3-6 months gap.

In this study functional assessment of cases has been based as per modified Anderson et al (1978) criteria.

**DISCUSSION**

Biological fixation is based on other minimally invasive methods of fixation such as intramedullary nailing. These techniques are newer and technically demanding. Indirect reduction techniques are developed to reduce soft tissue elevation at the fracture site and to improve the rate of fracture healing. These techniques in addition reduce the overall incidence of infection, refracture and the need for autogenous bone grafting. The perforators as well as nutrient arteries are well preserved by this method if plate is carefully inserted. The bone healing is excellent with this type of fixation because the stresses are distributed over a longer segment of bone and the force per unit area on the plate is lower if the segment without screws is longer.

Thus the good results in this method can be explained by a combination of rapid fracture consolidation due to preserved vascularity and a greatest resistance of the plate to fatigue, since the stress is distributed over a longer length of plate.

Our study has focussed on the above treatment modality with use of locking compression plate.

Comparison of MIPPO technique with locking compression plate against conventional plating techniques.

Our study has been compared with conventional plating technique of Den Outer et al (1990). Comparison of the two studies revealed that union rate in our study was 100% as compared to 46% in Den outer series. Den outer series had a non union rate of 54% compared to our study which had no case of non union. This is attributed to the preservation of soft tissue envelope at the fracture site and non interference with fracture hematoma leading to excellent union rates.

Union rate in our study was better than Vander Larsen series (1979) attributed to principles of biological fixation. No case of non union was reported in our study as compared to 8% cases in Vanden Larsen series and the infection rate was less as compared to Vander Larsen series in which it was 11.6% compared to 2% in our series.

Reudi et al (1976) study had 2% non union compared to our study where no case of non union was found. Increased infection rate in our study compared to Reudi et al series is because type 1 compound fractures were also included in our study.

This study has been compared with documented study of management of tibial diaphyseal fractures with LCP using MIPPO technique, ESENBOEHLER,D.Rikli,R. Babst (oct 2006). Union rate was 93.75% as compared to 100% in our series, there were 6.25% cases of non union compared to our study where no case of non union is reported and there was one case of implant failure (plate bending) in their series. The average time of union in our study in type A fractures
was 18.114 weeks compared to 24 weeks in Essenboehler study.

**START OF PARTIAL AND FULL WEIGHT BEARING AND TIME TAKEN FOR RADIOLOGICAL UNION**

In our study average time of partial weight bearing was 9.625 weeks. Average time of full weight bearing was 22.25 weeks. Average time for radiological union was 22.25 weeks. The above citation suggests that full weight bearing corresponded to the time of radiological union.

Overall good/normal results were achieved in 80% of cases based on patients self assessment of return to normal activity.

**SUMMARY**

Our study included 50 cases of tibial diaphyseal fractures and all have been treated with locking compression plate using MIPPO technique.

- Most of the patients were in the age of 15 – 35 years.
- There was male preponderance (84%).
- In 64% cases right side was involved.
- 56% of fractures have been caused by road traffic accident which is the most common mode of trauma.
- 80% fractures where of closed type and 20% type 1 compound
- Time taken for partial weight bearing ranged from 6-14 weeks (mean 9.625 weeks).
- Time taken for full weight bearing ranged from 12 – 32 weeks. The mean interval for full weight bearing 22.25 weeks.
- The time taken for complete radiological union ranged from 12 – 32 weeks with mean of 22.25 weeks.
- Overall good results were achieved in 84% of cases with excellent results in 8% and poor results in 8% of cases.

**CONCLUSION**

On the basis of the findings in the study it can be concluded that:

- The application of locking compression plate using MIPPO technique does not compromise with the periosteal blood supply thereby causing less interference with the fracture haematoma and the fracture healing. There is rapid fracture consolidation and better union time.
- There are few incidences of delayed and non union.
- There is decreased need for bone grafting.
- Locking of screw into plate ensures angular as well as axial stability eliminating the possibility of screw to toggle, slide or be dislodged and thus reduces the chance of post operative loss of reduction.
- As the study of locking compression plate doesn’t rely on the compression between the plate and the bone so pre contouring of the plate is not required.
- There is better fixation in osteoporotic bone as locking head screws have more resistance against bending and torsion forces with decreased pull out of the screws.
- Plate induced osteoporosis is less frequently seen with locking compression plate so there are less chances of refracture after plate removal
- There is less incidence of infection due to limited exposure.
- There is no chance of vascular complication by carefully inserting the plate sub muscularly through limited incision.
- There is no need of any specialised instrumentation and the method is less time consuming and cost effective.
- Soft tissue complications knee and ankle stiffness are avoided.
- Few cases complained of palpable hardware which can be minimised by using low profile titanium plate.
Few patients complained of pain and swelling at operation site on exertion which usually resolves on implant removal.

The usefulness of MIPPO technique using locking compression plate has been established in present study.

This technique can be used in fractures where locked nailing can’t be done like vertical slit and markedly comminuted fractures, narrow or very wide medullary canals, fractures with metaphyseal extension and osteoporotic fractures and bad skin condition at the entry portal of I/M nail.

Hence the procedure is reliable approach towards the management of tibial diaphyseal fractures with proper indications.

References
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