Minimally Invasive Plate Osteosynthesis
For Proximal And Distal Tibial Fractures

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ABSTRACT

The concept of biological osteosynthesis refers basically to the conservation of vascularity of the bone during surgical intervention to ensure the continued vitality of the individual fragments and to achieve improved fracture healing. Intramedullary nailing has become the standard of care for most displaced tibial shaft fractures. However, proximal and distal shaft fractures can be difficult to control with an intramedullary device, increasing the frequency of malalignment. The present study was carried out for evaluation & analysis of the role of minimally invasive plate osteosynthesis in cases of proximal and distal tibial fractures. Total of 30 patients were taken up & after proper pre-operative assessment plating was done and the results were evaluated. On the basis of the finding of this study it was concluded that: MIPO technique preserves most of the osseous vascularity thus providing for a more biological repair.

Keywords: proximal and distal tibial fractures- minimally invasive plate osteosynthesis

INTRODUCTION

Fracture is the result of mechanical overload with important biological consequences. Proper understanding of mechanical and biological aspects of fracture repair is the key to selection of particular type of treatment modality for a given fracture.

With the damage to soft tissues following the high energy of proximal and distal tibial fractures, conventional open reduction and internal fixation often result in substantial soft tissue complications such as wound breakdown and deep infection1-3. To avoid these complications, the hybrid or circular wire external fixator is a good option, but problems of nonunion, mal-union, and pin track infections are common4. The Minimal Invasive Plate Osteosynthesis (MIPO) technique was developed-not only to improve the rate of fracture healing, but also to limit soft tissue elevation at the fracture site5-7. 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 intervention5,8. Thus the emphasis should be laid on maintaining a precarious balance between devascularization and mechanical perfection.

Minimally invasive plating techniques reduce surgical trauma and maintain a more biologically favorable environment for fracture healing, reducing risks of infection and nonunion9. Fractures fixed by MIPO do not show primary bone healing as seen in rigidly fixed fractures with DCP (Dynamic Compression Plate). The bone healing in case of MIPO depends upon the formation of bridging callus.

MATERIAL AND METHODS

30 patients (15 each of proximal and distal tibial fractures) were operated by minimally invasive plate osteosynthesis and the results were observed.

The patients were placed supine on a fracture table to allow access to the image intensifier. Closed reduction of the fracture was done. The whole of operative limb was cleaned. For proximal tibial fractures the anteromedial/anterolateral approach was used. A 2 cm incision was made proximal to the fracture site and a subcutaneous tunnel was created with the help of a periosteal elevator. The appropriate length of the plate (T- buttress or a locking compression plate) was

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determined by placing a plate along the anterior aspect of the leg and adjusting it so that under fluoroscopy the proximal end of the plate is just below the joint line and the distal end extends at least three screw holes beyond the distal limit of the tibial fracture. The plate was then slid subcutaneously across the fracture site to reach distal fragment. Another 2 cm incision was given distally where the plate ended. This plate was then contoured precisely to conform to the condyle and proximal metaphyses and secured to the condyle with appropriate locking / cortical / cancellous screws of sufficient length (Figure 1 and 2).

For minimally invasive plate osteosynthesis of distal tibial fractures, Open reduction and internal fixation of fibular fracture, if present, was initially performed with the help of a 1/3rd semitubular plate through the lateral approach. The attention was then directed to the tibia and the articular fragments were anatomically reduced by percutaneous method, utilizing fluoroscopy and pointed reduction forceps. Once articular reduction was achieved, if possible, the articular fragments were stabilized with lag screws. The appropriate length of the plate was determined by placing a plate along the anterior aspect of the leg and adjusting it so that under fluoroscopy the distal end of the plate is at level of the tibial plafond and the proximal end extends at least three screw holes beyond the proximal limit of the tibial fracture. The plate was then flattened along its entire length and the distal end bent to match the contour of the distal tibia. A 2-3 cm incision was made along the antero-medial aspect of the tibia, proximal to the fracture and distally at the level of the medial malleolus. Typically, a subcutaneous tunnel was created between the two incisions and along the medial aspect of the tibia by blunt dissection using a periosteal elevator or any other similar blunt instrument. Cortical/cancellous screws were then placed at each end of the plate through the two incisions and in the mid position via small percutaneous stab incisions. (Figure 3).

Post operative check X-ray was taken to assess the reduction. Parenteral antibiotics (Inj ceftriaxone + Inj amikacin) were given for two days followed by oral antibiotics depending upon the condition of the wound. On 3rd post-operative day wound was examined and antiseptic dressing done. The splint was removed and physical therapy with quadriceps exercises and gentle active assisted exercises started depending on toleration of patient. Sutures were removed between 10th to 14th days (Figure 4).

RESULTS
In case of proximal tibial fractures mean age of the patients was 38.2 years. In case of distal tibial fractures mean age of patients...
was 36.35 years. Most of the patients (i.e. 18) were in the age group of 20-40 years.

Of the 15 patients with proximal tibial fractures 12 were males and 3 were females. Of the 15 patients with distal tibial fractures 11 were males and 4 were females.

Road traffic accidents were the commonest mode of trauma in both proximal and distal tibial fractures. Overall out of 30 cases, in 22 cases the injury was due to road traffic accidents.

In 15 cases of proximal tibial fractures, radiological union was seen between 14 to 22 weeks with average time to union being 15.5 weeks. In case of distal tibial fractures the mean time for radiological union was 17 weeks with the range being from 14 to 24 weeks.

In this study of 15 cases of proximal tibial fractures, 10 patients (i.e. 66.67 %) had achieved 0° to 3° 110° of movement at the knee, in 4 patients (i.e. 26.67%) range of movement at the knee achieved was 0°-5° (extension gap) to 90°-110° (flexion) and in only one patient (i.e. 6.67%) the range of motion was >5° (extension gap) to 90° (flexion).

The range of motion at ankle on average was 15.2 degrees of dorsiflexion (range 10-20 degrees) and planter flexion averaged 25 degrees (range 15-35 degrees).

The overall results in case of proximal tibial fractures were tabulated into three groups i.e. excellent, good and poor, according to the criteria laid down by Savoie et al (1987)10. Out of a total of 15 cases 14 had an acceptable result (9 excellent and 5 good) whereas one patient had poor result.

In case of distal tibial fractures the results were evaluated as per Teeny and Wiss11 clinical assessment criteria which are based on 100 points system. The results were excellent in 9, good in 4 and fair in 2 cases. No case of distal tibial fracture had a poor result.

Overall there were three cases who had early infection; 2 in the proximal tibial group and 1 in the distal tibial group; all three were superficial, that healed after appropriate antibiotics and antiseptic dressing.

One patient each in the distal and the proximal tibial group presented with late infection, both were superficial infections in the medial shin area. They were treated by a course of antibiotics. Both delayed infections subsequently progressed to uneventful bony union. The rehabilitation was not affected by late infection.

In this study of 15 cases of upper end tibial fractures, 2 cases (i.e. 20%) had mild persistent pain at the site of implant at 6 months after the tibial plating. Out of total 15 cases of distal tibial fractures there was no pain in 11 cases; two cases had mild pain with walking or running, but no change in activities of daily living and two had slight pain after long walks or sports or mild pain at end of day.

2 patients of proximal tibial fractures had valgus angulation > 5 degrees and one distal tibial fracture had varus angulation of 8 degrees. There was one case of delayed union in the proximal tibial group which was managed conservatively. There was no case of non union.

DISCUSSION

Intramedullary nailing is reported to have the lowest infection rates compared with other techniques12,13 but the technique is associated with other complications such as malunion, fat embolus syndrome, compartment syndrome and anterior knee pain14-16. Angular malalignment and malunion have been reported with intramedullary nailing of these fractures. Studies involving external fixation techniques showed complications such as loosening, malunion, imperfect articular reductions and pin tract infections17, 18. Open reduction and fixation with plate has the advantage of lowest rate of angular malunion compared to external fixation or intramedullary nailing but the downside is the high infection rates19. MIPO however relies primarily on the indirect reduction of the fractures using various techniques and in this way, the fracture environment is better preserved, as well as the blood supply to the bony fragments is not disturbed, which finally leads to decreased infection rate better fracture healing. MIPO offers several theoretical advantages compared to conventional open plating technique. A mechanically stable fracture-bridging osteosynthesis can be obtained without significant dissection and surgical trauma to the bone and surrounding soft tissues. As a consequence, the vascular integrity of the fracture and the osteogenic fracture hematoma are preserved20, 21. However MIPO does not allow direct visualization of the fracture and the surgeon is dependent on intraoperative fluoroscopy to confirm that an adequate reduction has been achieved. Additional radiation exposure during application of the plate to the bone and screw fixation and therefore extended operating time are the disadvantages of this technique.

CONCLUSION

On the basis of the finding of this study it can be concluded that MIPO technique preserves most of the osseous vascularity and fracture hematoma thus providing for a more biological repair. There is rapid fracture consolidation due to preserved vascularity. There are fewer incidences of delayed union.
and non-union. There is a decreased need for bone grafting and incidence of infection is less due to limited exposure.

REFERENCES


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