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Minimally invasive percutaneous plate osteosynthesis (MIPPO) in treatment of distal meta-physal fractures of tibia: A study on Complications

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Abstract

‘Biological’ internal fixation avoids the need for precise reduction, especially of the intermediate fragments, and takes advantage of indirect reduction. This principle applies equally to locked nailing, bridge plating, and internal fixator-like devices. Indirect reduction aims only to align the fragments. It avoids exposure of the bone thus reducing the surgical trauma. Flexible fixation is advocated to induce formation of callus and is achieved by using wide bridging of the area of the fracture. The patients were followed up at intervals of three weeks for up to 6-10 months to assess the radiological union. After the 1st follow up of 4 weeks patient is allowed to partially bear weight. The fracture was designated as united, when there was periosteal bridging callus at the fracture site at least in three cortices in the antero-posterior and lateral views. Trabeculations extending across the fracture site was also taken into consideration. Partial and full weight bearing were allowed. Two of the patients developed superficial skin infections, which were treated with daily dressings and appropriate antibiotics according to the culture and sensitivity reports. All the infections subsided on the above said treatment. We had 1 patient with ankle stiffness. Probably due to the lack of compliance to the advised physiotherapy at home after discharge of the patient. Ankle stiffness ranged from restriction of ankle movement from 20-40%.

Keywords: Mippo, distal meta-physal fractures of tibia, complications

Introduction

The internal fixation of fractures has evolved in recent decades with a change of emphasis from mechanical to biological priorities. More flexible fixation should encourage the formation of callus while less precise, indirect reduction will reduce operative trauma. This approach is described as ‘biological internal fixation’. It involves the use of locked internal fixators which have minimal implant-to-bone contact, long-span bridging and fewer screws for fixation.

Although the first attempt at ‘biological plating’ dates back at least twenty years, the concept is gaining greater attention^[1].

In 1989, Mast *et al.* published their techniques for ‘indirect reduction’. Particularly useful in those fractures not amenable to internal fixation with an intramedullary nail, i.e. comminuted articular or periarticular fractures, these techniques minimize direct exposure and muscle stripping by reducing the fracture by distraction. The articular fragments, if present, are first reconstructed using interfragmentary screws and the stabilized fragment is internally fixed to the shaft using a plate that extends across the fracture. The reduction manoeuvre can be performed using either a distractor or a tensioning device/laminar spreader and clamp between the plate and an isolated diaphyseal screw. Once correct alignment, rotation, and length are established, the smaller fragments can be manipulated into place using a dental pick^[2].

Formerly, internal fixation with a plate aimed at absolute stability to avoid micro movement which could result in loosening of the implant and a delay in healing. The new technique of internal fixation, however, seems to tolerate and even require some degree of mobility of the interface of the fracture. The contact between implant and bone is kept stable using screws which function like locked threaded bolts.

Conventional stable internal fixation with precise reduction usually requires a fairly extensive surgical approach to the bone. This contributes to increasing the necrosis which has been initially produced by the injury, consequently enhancing the risk of delayed healing, infection and possibly re fracture. A demanding degree of skill and expertise is required at operation to minimise the biological complications following extended traumatic and iatrogenic necrosis. Recent developments aim to produce minimal biological damage with flexible fixation^[3].

'Biological' internal fixation avoids the need for precise reduction, especially of the intermediate fragments, and takes advantage of indirect reduction. This principle applies equally to locked nailing, bridge plating, and internal fixator-like devices. Indirect reduction aims only to align the fragments. It avoids exposure of the bone thus reducing the surgical trauma. Flexible fixation is advocated to induce formation of callus and is achieved by using wide bridging of the area of the fracture. Pure splinting without compression results in flexible fixation. The avoidance of biological damage produced by overly precise reduction, the application of too many implants and too extensive implant-to-bone contact should reduce the risk of biological complications and improve healing. The aim is to produce the best biological conditions for healing rather than absolute stability of fixation and this approach has been shown to give early solid union. Restoration of function is the principal object of both non-operative and operative treatment. Biological internal fixation does not compromise the restoration of early and complete function of the bone, limb and patients, but recognition of the optimum requirements for bone healing now takes precedence, with mechanical stabilization being less rigid while still allowing painless function and reliable healing. The aim is to reduce the infrequent but possibly severe complications such as sequestration and infection which may be produced by bone necrosis, with less emphasis on avoidance of delayed or nonunion, which is more easily managed. Knowledge of the scientific background to this more flexible biological approach will allow selection of the proper balance between mechanical and biological priorities according to the individual situation^[4].

Reduction of contact of a plate to bone can be achieved by appropriate selection of the radius of the plate under surface or by undercutting the latter. The minimum mechanically tolerated contact area depends on the compression exerted by the screws in relation to the compressive strength of the bone. To minimize complications and to optimize outcomes, the surgeon must accurately match treatment techniques with fracture types and soft tissue injury patterns. To do this, the injury in some way must be classified. The group into which, it is classified should give a guide to the risk of complications during treatment, so management strategies can be chosen that will minimize their occurrence and will optimize outcome. Experienced surgeons arrive at these decisions using a variety of data which obtain a feeling about the "personality" of the fracture.

For many years, surgeons have formally classified fracture patterns of the distal tibia. More recently, investigators have attempted to classify the soft tissue injury. Unfortunately, fracture classification in current use have been shown to have relatively poor observer reliability and reproducibility. This problem has seriously hampered the ability to use these systems to accurately predict the risks of complications and to define prognosis, and it has prevented from comparing the results among different treatment methods^[5].

The Ruedi and Allgower classification may have prognostic significance because the incidence of complications and the outcomes have been found to be different for Ruedi type I and II fractures when compared with the most comminuted type III fractures. Other authors have found the clinical outcomes achieved for the three different categories to be less clearly defined.

This surprising finding may be partially caused by poor observer reliability in using the classification^[6].

Methodology

Study site: Department of orthopaedics

Study design: Prospective case series

Sample size

All cases reporting to emergency trauma care and admitting in our hospital were included in this study as per inclusion and exclusion criteria, aiming at minimum of 30 cases

Inclusion criteria

- All distal tibia fractures treated with minimally invasive percutaneous plate osteosynthesis (mippo) technique.
- Adults (>20 years) males and females.
- Simple Distal metaphyseal fractures unfavourable for interlocking nailing
- Complex fractures of the lower end of tibia

Exclusion criteria

- Pathological fractures
- Multiple fractures involving the same limb.
- Peri-prosthetic fracture
- Existing deformity of the same limb.
- Patients not willing to undergo surgery.
- Patients medically unfit for surgery. (Co morbid Medical conditions).
- Open fracture.

Sample Technique

Purposive non-probability sampling method is taken as the sampling technique for the study.

The patients were followed up at intervals of three weeks for up to 6-10 months to assess the radiological union. After the 1st follow up of 4 weeks patient is allowed to partially bear weight. The fracture was designated as united, when there was periosteal bridging callus at the fracture site at least in three cortices in the antero-posterior and lateral views. Trabeculations extending across the fracture site was also taken into consideration. Partial and full weight bearing were allowed.

Results

The age of patients ranged between 22-67 years. Fracture being most common in the third decade with an average age of 44.5 yrs.

Table 1: Age Distribution

Age	No. Of patients	Percentage
21-30	3	10
31-40	10	33
41-50	8	27
51-60	5	17
61-70	4	13
Total	30	100

Out of 30 patients, 21 (70%) are male patients and 9(30%)

were female patients showing increased male preponderance in view of travelling, working in fields and factories.

Table 2: Gender Distribution

Sex	No. of patients	Percentage
male	21	70%
female	9	30%
Total	30	100

There were 16 (53.33%) patients with right distal meta-diaphyseal fractures and 14 (46.66%) patients with left distal meta-diaphyseal fracture.

Table 3: Side affected

Side	No. Of patients	Percentage
right	16	53%
left	14	47%
Total	30	100%

In our study 21(65%) patients sustained RTA, 6(19%) patients had history of slip and fall, 5(16%) patients had history of heavy weight fall on to leg.

Table 4: Mode of injury

Mode of injury	No. of patients	Percentage
RTA	21	65%
history of slip and fall	6	19%
heavy weight fall	5	16%
Total	30	100

Two of the patients developed superficial skin infections, which were treated with daily dressings and appropriate antibiotics according to the culture and sensitivity reports. All the infections subsided on the above said treatment.

We had 1 patient with ankle stiffness. Probably due to the lack of compliance to the advised physiotherapy at home after discharge of the patient. Ankle stiffness ranged from restriction of ankle movement from 20-40%.

Table 5: Complications

Complications	No. of patients	Percentage
superficial wound infection	2	6.7
ankle stiffness	1	3.3
delayed union	1	3.3

Discussion

Our study revealed the average age of the patient with such injuries is 44.5 yrs (22-67).

It is comparable with a study on similar fractures conducted by fellow authors as given below.

Table 6: Comparison of age

Study	Min age	Max age	Average
Liu <i>et al.</i> [7]	21 years	76 years	48.5 years
Li <i>et al.</i> [8]	21 years	57 years	39 years
Gupta <i>et al.</i> [9]	20 years	60 years	40 years
Muzzafar <i>et al.</i> [10]	23 years	74 years	46.5 years
Present study	22 years	67 years	44.5 years

In our study, the male preponderance for these kind of fractures was high 70% when compared to the study by Andrew Grose *et al.*, which was 67% most probably due to the reason of male dominance over the female in travelling, occupational injuries etc., in India.

Table 7: Comparison of Gender

Study	Male percentage	Female percentage
Liu <i>et al.</i> [7]	70	30
Li <i>et al.</i> [8]	51.5	48.5
Gupta <i>et al.</i> [9]	60	40
Muzzafar <i>et al.</i> [10]	72	28
Present study	70	30

Most common mechanism of injury in our study was high energy trauma that is due to road traffic accident, which is comparable to the other studies as co-related below, the proportion of injuries due to high energy trauma(RTA) was higher was comparable to the other studies as given below.

Table 8: Comparison of mechanism of injury

Study	High energy trauma	Low energy trauma
Liu <i>et al.</i> [7]	80%	20%
Li <i>et al.</i> [8]	70%	30%
Gupta <i>et al.</i> [9]	72%	28%
Present study	70%	30%

Our study correlates with the study conducted by Li *et al.*, and Gupta *et al.* who attributed 70% and 72% of injuries due high energy trauma. Liu *et al.* attributes 80% of injuries due to the high energy trauma.

In a study that established open reduction with plate and screw fixation as the standard. Ruedi and Allgower achieved 74% acceptable results in 84 patients. These results did not deteriorate for 9 years. Mast *et al.* satisfactory results in 37 patients with a minimum follow up interval of 6 months. Less dramatic results were reported by a variety of authors when the plafond fractures studied included larger numbers of high energy injuries. Bourne and colleague reported 78% studied 42 patients with tibial plafond fractures, 62% of whom were victims of high-energy trauma. Of the 16 Ruedi type III fractures treated by open reduction and internal fixation, only 44% had a satisfactory result. The majority of these fractures were complicated by nonunion (25%), infection (13%), and Arthrodesis (32%). Ovadia and Beals reviewed 34 fractures equivalent to Ruedi Type III treated with traditional open reduction and plate fixation.

Good to excellent results were achieved in only 47%. Complications were numerous and, although not sub classified according to fracture type, superficial infections or skinloss developed in 9 patients (11%), osteomyelitis developed in 5 patients (6%), 17 patients (12%) required either ankle Arthrodesis or Arthroplasty. Teeny and Wiss studied 60 tibial plafond fractures. 60% of those were secondary to high-energy trauma. They reported 50% poor results when open reduction and plate fixation was used. When the subset of 30 Ruedi Type III fractures was analyzed there were 12(40%) acceptable outcomes with 37% of these fractures complicated by a skin slough or deep infection.

Conclusion

It is effective in extra articular fractures where Intramedullary nails often do not provide enough stability and external fixators which are usually applied for primary stabilization until soft tissue Oedema get subsided and delays the return to work.

It is a simple, has a rapid and straight forward application and has a reduced surgical time in extra articular fractures due to newer anatomically contoured locking compression plates for the distal end tibia fractures.

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