MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS (MIPO) : A NEW ARMAMENTARIUM IN THE TREATMENT OF MULTIFRAGMENTARY FRACTURES OF THE TIBIA AND FEMUR

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Summary

Minimally invasive plate osteosynthesis (MIPO) in multifragmentary fracture of tibia and femur are technically feasible and advantageous as there is less soft tissue injury and less devascularization of the fracture fragments. This is a study to assess the role of MIPO in the treatment of 30 adult patients multifragmentary tibial and femoral fracture. According to AO classification 20 patients had 43A type, 4 patients were 42B and 4 patients were 33A and 2 patients was 33B type fracture. All were treated with biological plating techniques using indirect reduction method, with limited operative exposure, with out exposing the fracture site. All cases showed radiological union between 16 to 24 weeks and went to full progressive weight bearing in 20 weeks with full range of ankle and knee movement. No case require any bone grafting. Incidence of complications were very low, with only two of superficial infections that were treated with oral antibiotic therapy and in another case a locking screw broke.

Key words

Multifragmentary; tibial and femoral fractures; locking plates; MIPO.

Introduction

Current thinking in fracture fixation is a symbiotic link between biology and mechanics in the healing process of fractured bones. Minimally invasive plate osteosynthesis (MIPO) is a modern concept of fracture fixation. The first attempt at which it was called as biological plating date back some 20 years [1]. It has gained popularity in 1980's.The development of indirect reduction techniques [2], the development of web plate and bridging plate , plate with angular stability brought about a basic change to fracture treatment using plate [3].

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Conventional plating technique if applied to multifragmentary fractures leads to a variety of complications like delayed union, non-union and implant failure[4]. This is because in order to achieve anatomic reduction this technique require wide surgical exposure and fragments are stripped off the soft tissue attachment.

Classic intramedullary osteosynthesis do not provide a stable fixation while open reduction and rigid internal fixation by classic plates recommended in the 60–70's requires a large incision with important deperiostation[5,6]. Potential complications as infection, consolidation delays and construct damage due to nonunion undergo frequently [7]. There obtained superior biomechanical result (absolute stability) but poor long term biological effects [8]. The main disadvantage of anatomical reduction and rigid internal fixation by plate led to the development of 'Biological plate osteosynthesis' concept [6].

Biological plate osteosynthesis is important to preserve bone vascularity to improve consolidation, decrease infection rate, avoid fractures or bone grafting. MIPO technique limits extensive dissections in complex extra-articular fractures of the proximal and distal femur [9,10]. MIPO technique avoids direct exposure of the fracture site and transforms the implant in an internal extramedullary splint. Furthermore MIPO was successfully extended to complex tibial fractures being actually indicated in all long bone complex fractures that are not suitable for intramedullary osteosynthesis [11,12].

Many reports claim success in using MIPO technique in treating long bone fractures in both upper and lower limbs have led us to treat such fractures in last 4 years using locking plates with the MIPO technique [4,6,8,11,13].

The aim of this study were to assess the outcome of the patients treated with MIPO techniques for multifragmentary fractures of tibia and femur with specific references to fracture union, weight bearing, implant failure or other surgical complications.

Materials and methods

This prospective study includes 30 adult patients with multifragmentary fractures of tibia and femur. The study were conducted in private clinics in Chittagong. All patients underwent operative treatment with

MIPO technique from August 2008 to December 2012. There were 24 males and 6 females of mean age 40 years (ranges 15 to 65 years). According to AO classification: 20 patients - 43A, 4 patients- 42B, 4 patients-33A, 2 patient-33B. Long bone complex fractures not suitable for intramedullary fixation are included. Clinical and radiographic follow up minimum 12 months. Radiographs are taken at 4-6 week interval to monitor fracture union , implant loosening or breakage. Records of all patients were reviewed for age, sex, mechanism of injury, date of injury and date of surgery, operation time, hospital stay, healing time ,time of recovery to work, delayed union, or nonunion and infections. (Table I & II)

Table I: Demographics of the study group

N=30	AO*	Sex	Age
Multifragmentary	42B	F	15
fracture of tibia (n=24)	42B	M	18
	43A	M	46
	43A	M	35
	43A	M	50
	43A	M	48
	43A	M	41
	43A	M	35
	42B	M	20
	43A	M	38
	43A	M	36
	43A	M	41
	43A	M	47
	42B	M	45
	43A	M	56
	43A	M	44
	43A	M	41
	43A	M	46
	43A	M	52
	43A	M	43
	43A	M	40
	43A	M	42
	43A	M	62
	43A	M	50
Multifragmentary	33A	F	47
fracture of femur (n=6)	33B	F	45
	33A	M	40
	33B	F	60
	33A	F	62
	33A	F	65

* *AO= Arbeitsgemeinschaft Für Osteosynthesefragen*

Surgical technique

Basic steps of MIPO:

- Indirect reduction by manual traction without fracture table.
- Skin incisions remote from the fracture site one on each site of the fracture.(fig 1)
- Sub muscular, extraperiosteal tunnel for plate done by plate end itself .
- Introduction of the plate and fixation of the two ends of the plate through original incision .
- The quality of reduction, axial alignment, length and rotation has been checked by portable X-ray.
- Completion of the fixation with screws introduced through stab incisions. The position of the screw holes can be located by placing a plate of similar length over the skin matching the position of the inserted plate. The underlying muscles of step incision are split with a hemostat until the plate hole is addressed.(Fig1)
- Final check on fracture reduction and implant position.
- Wound closure.(Fig 2)

Fig 1 : Operative steps of MIPO for fracture tibia

Fig 2 : Minimal footprint after MIPO

Post operative management

Partial (toe touch) weight bearing allowed after 3 weeks, followed by progressive and protected weight bearing until fracture united. All patients were followed up and radiographs obtained every month until fracture healing occurred. Thereafter Patients were generally seen every 3 months.

Table II : General Data of patients in MIPO

Interval from injury to surgery (days)	Duration of surgery (min)	Hospital stay (days)	Healing time (weeks)	Follow-up time (months)
2-10	100-115	3-5	16 – 24	12

Postoperative asessment

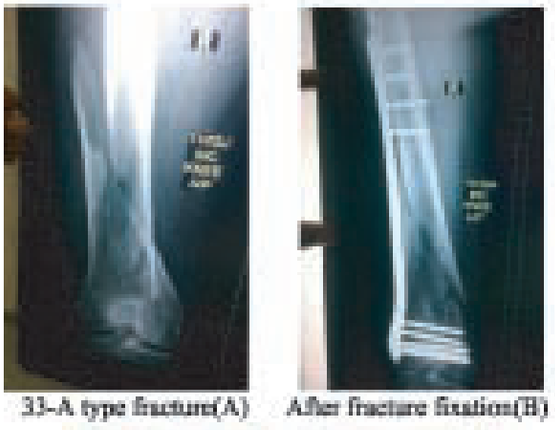
Radiographic union defined the presence of bridging callus in three of the four cortices as seen on AP and lateral radiographs. Delayed union and non union were confirmed when eight and 11 months of time had elapsed without bone union. Malunion was defined more than 5 degrees of angular and rotational deformity. Symptoms of nerve injury occur in the ipsilateral lower limb evident soon after the operation was considered iatrogenic nerve palsy. Long term results were rated using point system for pain, work ability, joint movement and radiological and gross appearances.

The maximum score was 100 points.

Excellent	> 92
Good	82-92
Fair	65-86
Poor	< 65

Results

The average consolidation time was 20 weeks (range was 16 – 24 weeks) (Fig-3). There was no loosening of fixation and rotational malalignment. All patients had complete range of knee and ankle movement (Fig-4). 28 cases in MIPO were evaluated as excellent and two as good. Two cases (AO type B2) had delayed union at 48 weeks, and in another case a locking screw broke. Two patients developed superficial infections managed by antibiotics. There was no deep infection.



16 weeks after fracture fixation with consolidation of fracture site(C,D)

Fig 3 : Postoperative x-rays show fracture fixation with distal femur with LCP

42B-type fracture(A) 18 weeks after fixation with consolidation of fracture site.(B)

Fig 4: 15 years old patient showing faster recovery with [Complete range of movement after MIPO for fracture of tibia with solid union(C,D).]

Discussion

The variety of treatment options have been suggested for these injuries, including nonoperative, extenal fixation, intramedullary nailing and plate fixation. However each of these treatment options has certain defects. Nonoperative treatment may be complicated by loss of reduction and subsequent malunion; external fixation of fractures may result in insufficient reduction, malunion and pin tract infection, there is some concern about the use of intramedullary nailing in distal both tibia and femur fractures, ORIF results in extensive soft tissue dissection and may be associated with wound complications and infections.

In recent years numerous reports have argued MIPO is a safe and worthwhile methods of managing multifragmentary fractures whilst avoiding some of the complications with conventional open plating methods. However, some studies have also revealed defects of the MIPO technique.MIPO more advantageous for soft tissue and bone biology, prolonged healing observed in simple fracture [14]. Reduction should be performed cautiously due to tendency of saggital plane malreduction [15].

For multifragmentary fractures, MIPO is advantageous over ORIF. Because the MIPO requires only realignment of mechanical axis, length, rotation and clear exposure of the fracture is not necessary. The intraoperative image intensifier helps with the closed reduction and avoids excessive disturbance of the fracture fragments.

We found the irritation symptoms in patients with tibia fractures. This could be related to the thin subcutaneous tissue and suboptimal premoulding of plates. However, the symptoms had no effect on their daily life.

Several studies have reported the rate of delayed union or nonunion to be 5-17% especially in simple fractures (i.e. type A3.) A minimal incision can not ensure minimal invasion because surgeons who are unfamiliar with this technique may repeatedly insert and pull out the plate, which would induce a dead space and increase infection risk or delayed union. We have time interval from injury to surgery was 3-10 days. Emergency surgery could provide definitive treatment for those low energy injuries or gustilo type 1 fractures without severe soft tissue damage. Surgeons should be aware that wound infection or skin necrosis is the most common postoperative complication of distal tibia fracture. Delayed elective surgery is relatively more reliable and safe in fractures associated with poor soft tissue status.one drawback is the lack of a control group for direct comparison of our results with those of other methods such as ORIF.Another drawback is that our group of patients(n=30) is small to allow statistical relevance.

MIPO is gaining acceptance because the underlying principles are sound. Once familiar with this MIPO technique surgery is easier, radiographic exposure is low and results are encouraging. MIPO technique provides fast functional recovery so that patient can return to their normal daily life as early as possible.

Conclusion

With the advance of the MIPO technique and locking plate design, the surgical treatment using internal fixation is now gaining ground in managing these fractures. The cosmetically appealing small incisions were not the striking factors that prompted the rapid progression of these minimal invasive techniques but the biological advantages, such as undisturbed fracture healing, less soft tissue compromise and fewer complications associated with faster recovery. MIPO should not serve as an excuse for a badly performed osteosynthesis. So in MIPO technique, it is proved that if the fracture surgeon does something 'LOGICAL' then'' ''BIO'' will do the next.

Disclosure

All the authors declared no competing interest.

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