Minimally Invasive Plate Osteosynthesis (MIPO) for Multifragmentary Fractures of the Proximal Tibia in 20 Patients in Rangpur Medical College Hospital

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Biological plating techniques are those in which blood supply to the fractured fragments is maximally preserved. 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. The present study was carried out for evaluation and analysis of the role of minimally invasive plate osteosynthesis in cases of Proximal tibial fractures. The objective of biologic fixation is to assist physiological process of bone healing wisely and optimally with minimal amount of operative intervention. A prospective study was carried out at Rangpur Medical College Hospital Rangpur, Bangladesh between November 2012 to December 2015 about the treatment of multifragmentary fracture with or without intra-articular extension of proximal tibia by minimally invasive locking plate osteosynthesis (MIPO). Total 20 patients were included in this study. Among them 18 cases were male and 2 were female. The mean age of the patients was 37 year. After proper pre-operative assessment, plating was done and the results were evaluated. The average follow-up was 23 months. In 18 (90%) out of 20 patients, the fracture healed after the index procedure and had satisfactory results. One patient had a fair result because of valgus malalignment and re-plating was performed. One patient had a poor result because of deep infection. On the basis of the finding of this study it may be concluded that: MIPO technique preserves most of the osseous vascularity thus providing for a more biological repair.

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Key words: Proximal tibial fractures, Minimally invasive plate osteosynthesis

Introduction

Comminuted and segmental fractures, those associated with bone loss are inherently unstable, require early surgical stabilization.[1] Proximal tibia fractures with or without soft-tissue damage and intra-articular extension always represent a treatment challenge.

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In complex periarticular fracture, intramedullary osteosynthesis do not provide a stable fixation, while open reduction and rigid fixation by classic plates require large incisions with deperiostation causes some potential complications as infections, delayed or non-unon.[2] 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.[3] The first attempts of biological plating was done some 20 years back (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.[4]

Conventional plating techniques if applied to multifragmentary fractures lead to a variety of complications like delayed union or non-union, infection and implant failure.[5,6] This is because of open reduction, wide surgical exposure and stripped of the soft tissue attachments.

Biological fixation principles can be summarized[7] 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.
3. Using low elastic modulus, biocompatible materials.
4. Limited operative exposure.

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

Methods

Twenty cases of comminuted fractures of the upper tibia were treated in Rangpur Medical College and Hospital, Rangpur between November/2012 and December/2015. The duration of the follow-up ranged from 12 to 48 months. Only closed fractures were included. All routine pre-anaesthetic investigations and additional investigations (when indicated) were done for all patients. Standard antero-posterior and lateral radiographs were taken. The leg was immobilized in a posterior plaster splint. Many of the patients with other bony or soft-tissue injuries were treated appropriately. The antero-posterior and lateral radiographs were evaluated for the extent of comminution and the length of the plate was calculated.

Surgery was done under regional anesthesia (SAB) and with a tourniquet in the supine position. A small incision was made on the upper end of the fractured comminuted area without disturbing the soft-tissue envelope of the fractured fragments. The incision was extended right up to the bone. A sub muscular tract was made along the surface where the plate was be placed and extended across the fracture to the other side. Once the tract was made, an appropriate length plate was selected ensuring that a hold of at least 6 to 8 cortices was obtained on either side of the fracture. With the plate in situ and some traction provided manually, the alignment was checked using the standard anterior superior iliac spine – centre of the patella – second toe guide line and also by C arm image. The plate was fixed at the upper end with 6.5mm cancellous screws. Initially, only one screw was passed, maintaining plate bone

contact and the alignment, and then the remaining screws were passed. With the fracture reduced by indirect means without dissecting the fractured area by gentle external manipulations, the distal end of the plate was identified. The plate was fixed distally with percutaneously inserted 4.5mm cortical screws or through a small incision. The alignment was checked throughout the procedure. The use of bone holding forceps was avoided with careful handling of the soft tissues and judicious use of the retractors were done. No primary bone grafting was carried out irrespective of the comminution. After operation, when pain subsided, the limb was elevated with ankle and knee range of motion was started. Toe-touch weight bearing was allowed initially, with full weight bearing only with good clinical and radiological evidence of progressive fracture healing.

Fig I. Pre-operative x-ray

Fig 2. Showing incision and plate insertion

Fig 3. Post-operative x-ray

Results

The mean age of the patients was 37 years (21yrs-60yrs) (Table I). 75% of the injuries (15 cases) were because of a road traffic accident (Table II). Two patients had a head injury. The average injury–surgery interval was 10.50 days, with 70% cases operated

within 9–14 days of the injury (Table III). All fractures achieved union. 75% of the patients showed union between 14 and 18 weeks, whereas 20% showed union between 19 and 23 weeks (Table IV). The average period of union was 16.55 weeks. 1 showed delayed union. The overall knee range of motion averaged 105^0 (range 0^0–135^0) at the latest follow-up. The average time taken for full weight bearing was 16.25 weeks (Table V). It was more for cases with bilateral limb injuries. Overall, 95% of the patients achieved full weight bearing by 23 weeks. The average length of hospital stay was 20 days. No case required bone grafting. No deep vein thrombosis or compartment syndrome was encountered.

Long-term final results were rated using point system for pain, function, work ability, joint movement and radiological and gross appearance. 90% (18) cases had excellent to good outcome and only 10% (2) had unsatisfactory (fair and poor) outcome (Table VI).

Table I: Age and sex distribution of cases

	Sex		
Age	Male	Female	%
21-30	4	—	20
31-40	5	—	25
41-50	6	2	40
51-60	3	-	15

Table II: Mechanism of injury

Mechanism of injury	No. of cases	%
Road Traffic Accident (RTA)	15	75
Assault	3	15
Fall	2	10

Table III: Injury surgery interval

Injury surgery interval	No. of cases	%
5-8 days	5	25
9-14 days	14	70
> 15 days	1	5

Table IV: Period of radiological union

Period in weeks	No. of cases	%
14-18	15	75
19-23	4	20
24-28	1	5

Table V: Time at which full weight bearing achieved

Period in weeks	No. of cases	%
14-18	16	80
19-23	4	20
24-28	2	10

Table VI: Functional outcome

Rating	No. of cases	%
Excellent	12	60
Good	6	35
Fair	1	5
Poor	1	5

Discussion

The management of comminuted upper tibia fractures remains a problem for orthopaedic surgeons. These fractures have been treated using conservative methods earlier in the form of casts or traction which led to poor results with respect to joint motion and prolonged recumbence. Closed methods also have limitations in the treatment of bilateral extremity fractures and in individuals with multiple injuries.[8,9] Conventional plating in which the fragments of the broken bone are put together like a jigsaw, irrespective of the soft tissue attachments, also lead to several complications[10-12] like wound breakdown, deep infection, deep vein thrombosis, compartment syndrome, nonunion, myositis ossificans, peroneal palsies, hardware failure and arthrofibrosis.[13-15] As no current method satisfactorily circumvents these limitations, alternative approaches have been explored to minimize these complications. Currently, minimally invasive techniques are gaining favor among orthopaedic surgeons and there have been reports of patients with upper tibia

fractures being treated exclusively using this technique[16-18]

We studied the application of proximal tibial locking Plate using indirect reduction and biological fixation principles. The minimally invasive technique allowed the use of a longer plate. A long plate has several advantages like distribution of stress over a longer length of bone, insertion of screws at the most desirable intact bone away from the fracture site and facilitation of better alignment of the distal and the proximal intact fragment. Despite the fact that fracture gaps were often visible after the indirect reduction technique, fracture union was not delayed. Preservation of osteogenic hematomas, avoidance of devitalization of fracture fragments and preservation of endosteal blood flow affected by reaming and nail insertion in intramedullary nailing could all be the reasons for strong callus formation and fracture stability. In general, the wound complication rate with the use of the percutaneous technique was low.[19-21] This was because of minimization of skin trauma by mini incisions instead of large in traditional open technique. In the present study, all fractures achieved union. Among them 90% showed an excellent to good results, with the time to full weight-bearing union averaging 16.55 weeks .Like our study in a study of upper tibial fractures treated with MIPO, Radziejowski et al found no loss of fixation or evidence of hardware failure.[21] Johner and Wruhs also obtained good results, with union occurring in 12–24 weeks in 22 cases.[22] Thus, the results in terms of union and early mobilization of the present study in the treatment of upper tibia fractures are better than those achieved with the use of conventional plating techniques.

The potential disadvantages of a laterally inserted implant that have been described by Krettek et al[23] include the following: (a) devitalization of the fracture because of elevation of muscles from bone (b) potential injury to the superficial peroneal nerve (c) increased risk of developing compartment syndrome and (d) difficulties in the placement of the implant into confined spaces.

However, none of the above-mentioned disadvantages were found in this study. The potential advantages of MIPO are as follows: (a) it is a simple technique and easy to perform (b) there is no need for additional expensive instrumentation (c) improved rates of fracture union can be obtained (d) there is a decrease in the infection rate (e) there is decreased need for bone grafting (f) it is an ideal technique for the treatment of patients with multiple injuries (g) early mobilization of the extremity is possible and (h) there is decreased incidence of refracture after plate removal.

Conclusion

Indirect reduction and minimally invasive percutaneous fixation appear to be valuable in the management of various diaphyseal–metaphyseal fractures even with intraarticular extensions. The key to success includes early surgery, preservation of the biological healing, potential and careful attention to surgical details. With longer follow-up and a larger number of patients, it seems that the minimally invasive technique of plate osteosynthesis for the treatment of multifragmentary fractures of the lower extremity will prove to be a feasible and worthwhile method of stabilization.

Limitations

Sample size was small, so further prospective study with larger sample and longer duration of follow-up is recommended.

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