E-ISSN:2455-5436
P-ISSN:2456-9518
RNI:MPENG/2017/70870

Research Article

Proximal tibial fractures

Surgical Review - International Journal of Surgery Trauma and Orthopedics

2024 Volume 10 Number 1 Jan-Dec

Publisher
MEDRESEARCH
www.medresearch.in

Treatment in proximal tibial fractures is to obtain the early union of the Minimally invasive percutaneous plate osteosynthesis technique

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DOI:https://doi.org/10.17511/ijoso.2024.i01.02

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Introduction: Fractures of the proximal tibia are serious injuries and present a treatment challenge as the damage in such fractures is usually extensive. Open fractures, compartment syndrome, and neurovascular injuries are commonly associated with such injuries. Treatment options in proximal tibia fractures vary from closed reduction, cast immobilization, nailing to open reduction and internal fixation with plating. We conducted a study on the management of these fractures by using the minimally invasive plate osteosynthesis (MIPO) technique.

Methods: This study was conducted in the Department of Orthopaedic Surgery, BSMMU from January 2023 to February 2024. This was a prospective study where 60 patients with proximal tibia fractures were enrolled. The mean age of patients was 47.23 years (range 20-70 years). There were 32 male patients and 28 female patients. The enrolled patients were evaluated by the emergency department.

Results: In our study, 60 patients with proximal tibia fractures were treated with closed reduction and internal fixation by using the minimally invasive plate osteosynthesis (MIPO) technique. The mean age of patients was 47.23 years (range 20-70 years). There were 32 (53.33%) male patients and 28 (46.67%) female patients. Left-side proximal tibia fracture was in 22 (36.67%) patients and right-side in 38 (63.33%) patients. Out of 60 patients 34 (56.67%) fractures were caused by road accidents, 20 (33.33%) by fall, 4 (6.67%) were sports injuries and 2 (3.33%) caused by other reasons. The mean operative time was 49.57 minutes. The mean time for the radiological union was 15.6 weeks. Superficial wound infection was found in 10 (16.67%) patients, which resolved with daily dressings and antibiotics. Delayed union occurred in 6 (10%) of patients and nonunion in 2 (3.33%) patients. Wound necrosis was found in 4 (4%) patients.

Conclusion: Minimally invasive plate osteosynthesis (MIPO) technique in the treatment of proximal tibia fractures gives stable as well as optimal internal fixation and complete recovery of limb function at an early stage with minimal risk of complications.

Keywords: Proximal tibia fractures, minimally invasive surgical procedure, osteosynthesis

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How to Cite this Article

Forhad S, Ara A, Siddiqui EH, Musa SM, Miraj AKA, Hossain MS, Treatment in proximal tibial fractures is to obtain the early union of the Minimally invasive percutaneous plate osteosynthesis technique. Surgical Rev Int J Surg Trauma Orthoped. 2024;10(1):8-14.
Available From https://surgical.medresearch.in/index.php/ijoso/article/view/280

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Manuscript Received	Review Round 1	Review Round 2	Review Round 3	Accepted
2024-11-11	2024-11-18	2024-11-25	2024-12-03	2024-12-11

Conflict of Interest	Funding	Ethical Approval	Plagiarism X-checker	Note
None	Nil	Yes	13.36	

Introduction

Fractures of the proximal tibia are serious injuries and present a treatment challenge as the damage in such fractures is usually extensive. Open fractures, compartment syndrome, and neurovascular injuries are commonly associated with such injuries [1,2]. Proximal tibia fractures are the common fractures of the lower extremity resulting from high-energy trauma, such as motor vehicle accidents, falls from height, direct blows, and sports injuries [3].

A proximal tibia fracture can be treated nonsurgically or surgically. There are benefits and risks associated with both forms of treatment. Whether to have surgery is a combined decision made by the patient, the family, and the doctor. The standard approach of tibial plateau fracture fixation is the use of a direct technique of open reduction and internal fixation (ORIF), with a variety of implants to reduce and stabilise the fracture [4].

This involves creating a surgical fracture on the proximal aspect of the tibia, usually on the inside part, which involves cracking bone of the tibia, leaving a 10-15 mm size hinge of bone intact on the lateral aspect of the tibia, and opening it up to allow the leg alignment to swing over. Treatment in proximal tibial fractures aims to obtain an early union of fractures in the most acceptable anatomical position with early and maximum functional return of activity [4,5,6].

There are several treatment modalities available for proximal tibia fractures as closed reduction and cast application, closed reduction and external fixation, closed reduction and internal fixation, and open reduction and internal fixation. The anteromedial approach to the tibial shaft is through an incision placed just lateral to the anterior tibial crest. Its most common use is for fractures of the distal third tibial shaft. However, it can be used to expose the entire anteromedial surface.

Each method has its advantages and disadvantages. Minimally invasive percutaneous plate fixation has gained wide acceptance for treating such fractures [4-11]. The theoretical advantages of the MIPPO technique include minimal additional damage to the soft tissues in the fracture area, and preservation of blood supply to fracture fragments, thereby providing suitable conditions for indirect fracture healing with callus formation.

Material and Methods

This prospective study was conducted in the Department of Orthopaedics This study was conducted in the Department of Orthopaedic Surgery, BSMMU from January 2023 to February 2024. In this study, we enrolled 60 patients with proximal tibia fractures. The mean age of patients was 47.23 years (range 20-70 years). There were 32 male patients and 28 female patients. The enrolled patients were evaluated by the emergency department. Patients selected for the study underwent pre-anaesthetic checkups and radiographs of affected limb in AP and lateral views.

All enrolled patients fulfilled inclusion criteria that involved

- Patients with proximal tibia fractures and give written consent for the procedure.
- Minimum age 18 years and maximum age 70 years.
- Acute proximal tibia fractures with intra or extra particular type.
- Patients with proximal tibia fractures with no neuro deficit.
- Closed A0 type B or C proximal tibia fractures.
- The exclusion criteria were patients who didn’t give consent, fractures with Gustilo Anderson grade 2 or more, established compartment syndrome, with neuro deficit, and comorbidities like Diabetes, immunosuppression, RA and need of ligament reconstruction, closed AO A type.

Procedure

The patients were operated under spinal or regional anaesthesia. Antibiotic prophylaxis in the perioperative period was given in all cases 30 minutes before the application of the tourniquet. In all cases, surgery was performed in the supine position, but the position of the lower leg differed according to the fracture location. All surgeries were performed with the use of an image intensifier. A triangle support or bolster was used to provide knee flexion at 30 to 60 degrees. This facilitated radiographic control in the lateral view and also prevented posterior sagging of fracture fragments, thus helping in fracture reduction. Fracture reduction was achieved manually on a fracture table.

An incision 3 to 4 cm long was performed at the level of proximal metaphysis according to the location of the fracture. In the case of an Intra-articular fracture, the reduction and fixation of joint fragments were performed as a first stage. Then the subcutaneous or sub-muscular tunnel was prepared with the use of an elevator for subsequent plate insertion. The plate was bent with pliers according to the contour of the bone. After insertion of the implant, the position of bone fragments and the plate was checked with an image intensifier. After proper reduction plate was fixed proximally and distally with provisional k wires. After the reduction of fracture and position of the plate was found satisfactory under image intensifier in both AP and lateral views. The proximal fragment was fixed with locking cancellous screws through the main incision. The distal fragment was fixed with cortical and locking screws percutaneously.

The choice of side of plate insertion, medial or lateral, was based on fracture type and location as well as on soft tissue condition. After fracture fixation was completed and final radiological evaluation of all components of fixation performed, the wounds were closed. Intravenous antibiotics were given in all cases for 3 days followed by orals after surgery.

Figure 1: Active surgical drain

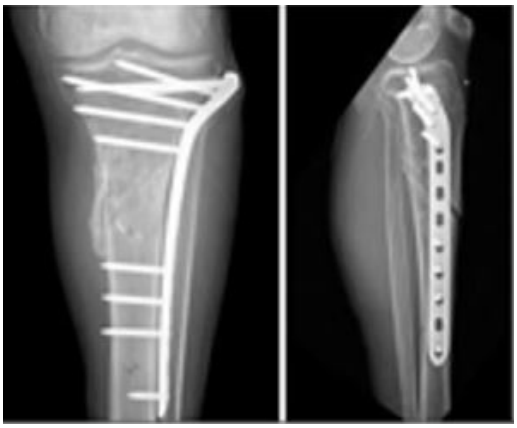

Figure 2: Some pre and post-operative radiographs

Post-operative Care

Rehabilitation was started on the second postoperative day with quadriceps setting and continuous passive motion of the knee joints. Postoperative radiographs were done on day one. The wound was inspected on the second postoperative day and sutures were removed on the 14th postoperative day. At the time of the patients, the patients were encouraged to perform the straight leg-raising exercise and active flexion of their knees and ankles, from a tolerable range of motion followed by a gradual increase of range similar to unaffected limb.

Follow UP

Patients were advised to follow up regularly in OPD. Toe-touch weight bearing with crutches was started at approximately 4 weeks postoperatively, and limited weight bearing was allowed only after obtaining radiographic evidence of healing. During the first 6 weeks after the surgery, only partial weight bearing was allowed. Then weight bearing increased according to clinical and radiologic union acquired at follow-up visits scheduled at 6 to 8, 12 to 14, and 18 to 20 weeks after surgery and further with 6-week intervals if needed until fracture union.

At each visit, we determined the ROM of the operated limb and assessed axial and rotational malediction. Any wound complications or other consequences were noted. AP and lateral views were obtained at each visit and healing was assessed with these radiographs. The fracture was considered united if three of four cortices showed bony bridging and full weight bearing was pain-free.

If fracture union was not achieved by the sixth month after surgery, the situation was graded as delayed union and by the ninth month as nonunion. We assessed deformities in sagittal and frontal planes and shortening on standard long-leg radiographs. The joint orientation angles were used to access axial deviation in frontal and sagittal planes. The length was accessed both clinically and radiographically.

Knee and ankle ranges of motion, limb rotations and alignment, and any sign of implant-associated complication were checked at all follow-up visits. The final clinical outcome was evaluated.

Results

In our study, 60 patients with proximal tibia fractures were treated with closed reduction and internal fixation by using the minimally invasive plate osteosynthesis (MIPO) technique. The mean age of patients was 47.23 years (range 20-70 years). There were 32 (53.33%) male patients and 28 (46.67%) female patients. Left-side proximal tibia fracture was in 22 (36.67%) patients and right-side in 38 (63.33%) patients. Out of 60 patients 34 (56.67%) fractures were caused by road accidents, 20 (33.33%) by fall, 4 (6.67%) were sports injuries and 2 (3.33%) caused by other reasons.

The mean time from trauma to surgery was 8 days and the majority of patients were operated within the first week of trauma. The mean operative time was 49.57 minutes. The mean time for the radiological union was 15.6 weeks. Superficial wound infection was found in 10 (16.67%) patients, which resolved with daily dressings and specific antibiotics. Delayed union occurred in 6 (10%) of patients nonunion in 2 (3.33%) patients and 4 (6.67%) of patients with wound necrosis occurred (table 1).

Table 1: Demography of patients

		No. of patients	Percentage
Gender	Male	32	53.33%
	Female	28	46.67%
Mode of trauma	Road accidents	34	56.67%
	Fall	20	33.33%
	Sports Injury	4	6.67%
	Others	2	3.33%
Side of trauma	Right	38	63.33%
	Left	22	36.67%
Complications	Superficial infection	10	16.67%
	Delayed union	6	10.00%
	Non-union	2	3.33%
	Wound necrosis	4	6.67%

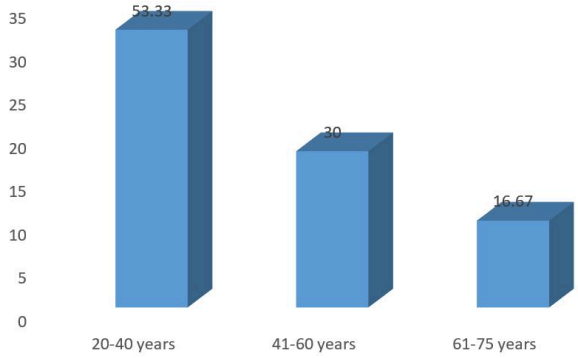

Figure 3: Distribution of patients based on age group

This study shows that a maximum of patients 32 (53.33%) belong to the age group of 20-40 years (fig-1).

The final assessment was done based on bony and functional results classified into four categories ranging from excellent to poor according to SJLAM criteria (1964) [12] in table 2. In our study 42(70%) of patients had excellent results, 12(20%) patients had good results, 4(6.67%) patients had fair results and 2(3.33%) patients had poor results.

Table 2: Bony and functional results according to SJLAM criteria

Parameters	No. of patients	Percentage	6 weeks follow-up	12 weeks follow-up	Final Follow-up
Excellent	42	70.00%	No pain Knee rom 80% X-ray- uniting	No pain Knee rom 90% X-ray- uniting Full weight bearing	No pain Knee rom 100% X-ray- united Full weight bearing
Good	12	20%	Pain Knee rom 60% X-ray- uniting	Slight pain Knee rom 70% X-ray- uniting Full weight bearing	No pain Knee rom 80% X-ray- united Full weight bearing
Fair	4	6.67%	Pain Knee rom 40% X-ray- uniting	Pain Knee rom 50% X-ray- uniting	Slight pain Knee rom 60% X-ray- united Full weight bearing
Poor	2	3.33%	Pain Knee rom 20% X-ray-no callus seen	Pain Knee rom 20% X-ray-no callus seen	Pain Knee rom 25% X-ray-no callus seen

Discussion

We aimed to estimate the rate of union, the rate of major and minor wound complications, the occurrence of mal union, and the level of function in proximal tibia fractures treated by minimally invasive plate osteosynthesis (MIPO) technique. Despite wide acceptance and assurance in the possibilities of the procedure, most reports are based on a small number of patients and the investigators report differing rates of wound complications, union time and function. The limitations of this study were proximal tibia fractures with various degrees of soft tissue injuries, a large number of the patients (60) were included and restoration of weight bearing or resumption of working capacity in patients within one year after surgery. Fractures of the proximal tibia are the result of high-energy injuries, and because of the lack of soft tissue coverage in this region, it is vulnerable. In such cases, the treatment of damaged soft tissues is of primary concern and disturbance of blood supply to the fracture site cannot be avoided, and thus, non-union and infection occur with high incidence.

The rate of deep infection has been reported and most authors have reported rates of 18% or more [13,14]. It is not always easy to reduce and adequately maintain fractures, especially fractures with articular involvement or comminuted proximal tibia fractures. Furthermore, mal-union, joint motion limitations, and patient inconvenience are the main concerns. Recently the use of intramedullary treatment for proximal tibia fractures was advocated [15][16][17]. This minimally invasive technique can be performed without further stripping of the already damaged soft tissue envelope and provides a load-sharing device with superior stiffness. These characteristics may make locked plating an attractive option for treating proximal tibia fractures. Along with the development of minimally invasive plate osteosynthesis (MIPO), the popularity of locking plates for the treatment of these complex fractures has significantly increased, presumably because they do not require large incisions or soft tissue stripping, and thus, minimize subsequent failures due to infection and non-union. Furthermore, locking plates do not disturb either endosteal or periosteal blood supplies to fracture sites, and thus, reduce the risks of resultant infection and non-union. The staged management of proximal tibia fractures has been reported to provide a safe and useful strategy [18], [19]. Rates of fracture union vary in the literature from 68.5% [11] to 100% [9]. Most authors report union in terms of 4 to 6 months after the minimally invasive plate osteosynthesis (MIPO) technique in the treatment of proximal tibia fractures. Authors from Asia typically report shorter times to union, 4 to 4.5 months [20], [21], than authors from Europe, 5 to 6 months [5], [7], [9]. In our study fracture union was seen in 42 (70%) of patients up to 6 months after surgery. Most current articles report a lower level of these complications [5-8, 20]. In this study, 8 (13.33%) of patients had delayed union or nonunion, and 3 patients among these 8 patients had severe injuries of soft tissues. When only fractures without major soft tissue injuries are taken into account, complications of delayed or nonunion were likely seen in the patient. Minimization of the skin incision and further soft tissue injury within the fracture site should decrease the rate of wound complications. In our study, such complications were seen in 10 (16.67%) of patients, which is within the range reported in most studies.

All wound infections in our series were late infections, which is consistent with the data of Lau et al [22]. Who revealed late infections in 15% of their cases? Like in the series of Lau et al., infection complications that were seen in our cases did not affect fracture healing and did not lead to chronic osteomyelitis. The most cited results are ROM in the adjacent joint and resumption of work and sports activity at follow-up. Thus, Red Fern et al [9] reported that all 40 patients had resumed their pre-injury level of activity. In our study out of 60 patients, 56 (93.33%) had completely resumed work activities.

Conclusion

The minimally invasive plate osteosynthesis (MIPO) technique in the treatment of proximal tibia fractures gives stable as well as optimal internal fixation and complete recovery of limb function at an early stage. If soft tissue reconstruction can be performed adequately, MIPO may provide an acceptable means of treating open fractures of the proximal tibia.

Permission from Institutional research board: Yes

Funding: Nil

Conflict of interest: None Initiated

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