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MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS WITH DISTAL TIBIAL ANATOMICAL PLATE FOR DISTAL TIBIAFRACTURE

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Abstract

Background: Management of distal Tibial fractures is therapeutically challenging, because of its unique anatomic subcutaneous location with precarious blood supply and proximity to the ankle joint, leading to the potential for postoperative complications and poor outcome.

Methods: Twenty five patients with closed distal Tibia fracture without intra articular extension (AO classification: 43A1, 43A2, 43A3) treated with MIPO with Distal Tibial Anatomical Plate were prospectively followed for duration of 6 months

Results: Mean pre-operative delay was 8.56 days and mean duration of surgery was 66.36 minutes. Mean total hospital stay was 14 days composed of mean admission to surgery & post-operative stay of 8 and 10 days respectively. In 68% cases radiological union was achieved within an average duration of 18 weeks while 20% had union at 12 weeks & remaining 12% had union at 24 weeks of follow-up. There were four superficial and two deep post-operative wound infection. All infections healed with extended period of intravenous antibiotics. Three patients suffered from ankle stiffness. 64% of total patients had Excellent result according to Oleur and Mollander functional score while 28% had Good result & 8% had Fair result at the end of 6 months of follow-up.

Conclusion: The present case study shows that MIPO with Distal Tibial Anatomical Plate is an effective treatment method in terms of union time and complications rate for distal Tibiafracture. Malleolar skin irritation is common problem because of prominent hardware.

Introduction

The distal Tibia was defined as the area within two Müller squares of the ankle joint, in which the proximal and the distal segments of long bones are defined by a square whose sides have the same length as the widest part of the epiphysis.[1,2] In the modern era with the increase in number of fast-moving vehicles there is a great increase in number of Road traffic accidents leading to increase in incidence and severity of fractures.[3] The mechanism of injury is axial loading due to talus hitting hard the lower end of the Tibia.[4] The axial loading on the distal Tibia determines the articular surface injury, metaphyseal injury may be complex, and the predominant force is vertical compression. The location of the articular portion the fracture is determined by the position of the foot at the moment of impactof.[5–7] Treatment of distal Tibia fracture without intra-articular extension is challenging because of its unique anatomical characteristics of subcutaneous location with precarious blood supply and proximity to the ankle joint. Most of these fractures are managed with an operative intervention such as closed reduction and intramedullary interlocking (IMIL) nailing or open reduction and internal fixation (ORIF) with plating or closed reduction and per cutaneous plating or external fixators. Each of these techniques has their own merits and demerits. IMIL nailing has been reported with higher rate of malunion because it is difficult to achieve two distally locking screws. Wound infection, skin breakdown and delayed union or non-union requiring secondary procedures like bone grafting are some of the complications associatedwith conventional osteosynthesis with plates. Similarly, pin tract infection, pin loosening, malunion and nonunion leading to osteomyelitis is potential complication of external fixators and hence not preferred as definitive fixation method.[8]

Recently, techniques of closed reduction and minimally invasive plate osteosynthesis (MIPO) with Distal Tibial Anatomical Plate has emerged as an alternative treatment option for distal Tibia fracture. When applied subcutaneously, Plate does not endanger periosteal blood supply, respect fracture hematoma and also provides biomechanically stable construct. Numbers of previous clinical studies have established MIPO with Distal Tibial Anatomical Plate as a biologically friendly and technically sound method of fixation for distal Tibia fracture. We prospectively studied closed distal Tibia fracture without

Intra-articular extension managed with MIPO with Distal Tibial Anatomical Plate.[9]

Methods:

Twenty five patients with closed distal Tibia fracture without intra articular extension treated between December 2018 to June 2020 were prospectively followed. Demographic variables, mode of injury, injury-hospital and injury-surgery interval, time required for union, complications and need of secondary procedures were recorded. Fracture was classified according to AO/OTA classification system. Patients with pathological fractures, ipsilateral multiple fractures were excluded.

Discussion:

Distal Tibia fracture without intra articular extension is one of the difficult fractures to manage. None of the treatment options available perfectly fulfill requirements of fracture characteristics of distal TIbia. Distal tibia has got circular cross sectional area with thinner cortex as compare to triangular diaphysis with thicker cortex. So, intramedullary nail which is designed for tight interference fit at diaphysis cannot provide same stability at distal fracture. Other potential complications of IMIL nailing are malunion (0-29%) and implant failure (5-39%). ORIF with conventional plate which needs striping of periosteum is also not an ideal treatment option because tibia is subcutaneous bone and periosteum provides 2/3 rd of blood supply. Non- union, delayed union and infection are reported with the range of 8.3-35% and 8.3-25% respectively with ORIF with plating. Similarly external fixators as a definitive method of treatment for distal Tibia fracture are also reported with higher rate of infection, implant failure and malunion or non-union and hence recommended only for temporary method of stabilization in open fracture with severe soft tissue injury.[10]

With the development of technique of MIPO with Distal Tibial Anatomical Plate which preserve extraosseous blood supply, respect osteogenic fracture haematoma, biologically friendly and stable fixation method is available for distal Tibia fracture. Indirect reduction method and sub-cutaneous tunneling of the plate and application of locking screws with small skin incisions in MIPO technique prevents iatrogenic injury to vascular supply of the bone. Unlike conventional plates, Distal Tibial Anatomical Plate is a friction independent self-stable construct which provides both angular and axial stability and minimizes risk of secondary loss of reduction through a threaded interface between the screw heads and the plate body.

MIPO with Distal Tibial Anatomical Plate for distal Tibia fracture has been found to be an effective treatment option.[11]

In spite of use of MIPO with Distal Tibial Anatomical Plate as internal external fixators, anatomical reduction of the fracture by using indirect reduction maneuvers before applying the plate is very important surgical step. Malreduction and suboptimal pre contouring of the plate can result delayed union, non-union, prominent hardware, malleolar skin irritation and pain. In the present study, pain and malleolar skin irritation in four patients (16%) was common indication of implant removal.

Indirect reduction of fracture under C arm control can be difficult at time. Various reduction maneuvers such as calcaneal pin traction, external fixators or mechanical distractors have been described to achieve reduction. We used Kirschner wires (3 mm) as a joystick or a reduction clamp after making small opening at fracture site whenever reduction could not be achieved by mechanical traction. Concomitant fibula fracture also play the role in success of reduction especially when fracture is at same level of tibia. We did not routinely fix fibula unless it has involved syndesmosis.

MIPO technique can restore alignment in high velocity distal Tibia fracture and patients can expect predictable return of function. Because of sub cutaneous location, distal Tibia are prone to have gross swelling, skin injury and fracture blisters if the leg is left unsplinted for long time and injury-hospital arrival interval is prolonged. Our protocol for timing of surgery was to fix the fracture as early as possible unless associated with gross swelling or hindered by fracture blisters.

Though skin and soft tissue injury at the time of conventional osteosynthesis has been found to be significantly associated with higher rate of wound infection as compare to IMIL nailing, effect of same on MIPO was superficial wound infection improved with antibiotics but two patient with wound breakdown exposed implant had protracted post-operative rehabili- tation period requiring repeated wound debridemet& implant removal.[12] Other potential complications like injury to sephaneous nerve and great sephaneous vein has been reported in cadaver studies and can be avoided by careful attention towards selection of skin incision site, dissection of vein, dissection of stab incision up to the plate and atraumatic placement of drill sleeve. No case of sephaneous nerve and great sephaneous vein was found in the current study.

Conclusion

Distal Tibia fracture without intra articular extension is one of the difficult fractures to manage with all currently available treatment options. Fracture pattern, concomitant articular extension, condition of soft tissue are important factors to be considered before selection of fixation method. The present case study though small in number shows that MIPO with Distal Tibial Anatomical Plate is an effective treatment method in terms of union time and complications rate. Implant prominence and its related complications because of mismatching of the implant

contouring and supra malleolar anatomy especially in thin built patients or malreduction of fracture still remains a challenge. Prospective randomized controlled trial specially comparing newly available intramedullary nails which has various distal locking options is necessary to establish superiority of the technique.

Results:

There were 23 male (mean age 41 yrs, range 19-65 yrs) and 2 female patients (mean age 51 yrs, range 40-62 yrs). 21 (84 %) patients sustained injury in road traffic accident. Other modes of injury were fall injury in 3 (12 %) patients and physical assault in 1 case (4%). 4 patients (16%) were chronic smokers. 1 patient (4%) had history of alcohol consumption. Most of the patients (60 %) had AO Type 43A1 fracture, 28 % had Type 43A2 fracture and 12 % had Type 43A3 fracture. Mean pre-operative delay was 8.56 days. Mean duration of surgery was 66.36 minutes. Mean total stay was 14 days composed of mean admission to surgery stay and post-operative stay which were 8 and 10 days respectively. Patients were followed up for average duration of 6 months.

Immediate post-operative complication of wound infection was found in six patients; four superficial and two deep wound infections. Four superficial wound infections healed with extended period of intravenous antibiotics but two patients with wound breakdown needed repeated debridemet & implant removal. Three patients had ankle stiffness requiring extensive physiotherapy to regain range of movement.

The mean Oleur and Mollander score were 45, 64 and 80 at 12, 18 and 24 weeks respectively. The mean radiological score were 7, 9 and 12 at 12, 18 and 24 weeks respectively.

68 % of the patients had radiological union at 18 weeks of follow-up while 20 % had radiological union at 12 weeks and the remaining 12 % had radiological union at 24 weeks of follow-up.

64 % of the total patients had excellent result according to Oleur and Mollander score, 28 % had good result and 8 % had fair result at the end of 6 months of follow –up.

Limitation:

Sample size of our study was small and follow up period was short and therefore more multicentric studies need to be conducted for validation of this procedure.

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