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Functional Outcome of Distal Tibial Fractures Fixed with Distal Tibial Locking Plate using MIPPO Technique

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Abstract

Introduction: *Because of the extensive list of potential consequences, treating extra-articular distal tibia fractures is a daunting task for an orthopedic surgeon. This study was designed to evaluate the clinical and functional outcomes of minimally invasive plating for the treatment of distal tibial fractures.* ***Materials and Methods:*** *This prospective study was conducted at the Department of Orthopedic Surgery, Popular Medical College and Hospital, Dhaka during June 2021 to May 2022. A total of 20 patients with distal tibial fracture were selected for surgery and treated with minimally invasive plating. Afterwards, the patients' clinical and radiological outcomes were recorded. The ankle-hindfoot score developed by the American Orthopedic Foot and Ankle Society (AOFAS) was used to assess the functional outcomes.* ***Results:*** *In 15 of the 20 cases, radiological union took place between 18 and 22 weeks (mean 20.5 weeks); however, in 5 cases, union was delayed and required almost 26 weeks to establish. Four of the 20 cases experienced a superficial infection, while the remaining patients showed no further complications. According to the AOFAS score, our research showed that, out of 20 patients, 9 had excellent outcomes, 8 had good results, and 3 had acceptable results.* ***Conclusion:*** *Treatment of distal tibia fractures with locking plates by MIPPO technique is an effective method of therapy to achieve union and excellent functional results since it aids in the early restoration of ankle movement while reducing ankle stiffness.*

Keywords: *American Orthopedic Foot and Ankle Society (AOFAS) ankle hindfoot score, Distal tibial fracture, Distal tibial locking plate, minimally invasive percutaneous plate osteosynthesis (MIPPO).*

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Introduction:

Road traffic accidents, fall from height, and other powerful traumas commonly result in distal tibial fractures. These fractures are frequently unstable and comminuted. Nevertheless, they may be linked to serious closed or open soft tissue damage. Therefore, treating complicated distal tibia fractures is difficult to accomplish[1]. Distal tibia fractures are common and account for 10%–13% of all tibial fractures, according to research[2]. Distal tibial fractures were typically treated with open reduction and internal fixation using a compression plate. However, the high frequency of complications with this technique, including post-operative infection, inadequate wound healing, and non-union, are frequently viewed as an important concern to the surgeon[3,4]. The management of distal tibia fractures with minimally invasive methods like using locking plate with MIPPO (Minimally invasive percutaneous plate osteosynthesis) technique has been documented in recent years which is a reliable method for preservation of osseous and soft tissue vascularity[5,6]. Management of distal tibial fractures might be difficult because of the insignificant metaphyseal blood flow in the distal region of the tibia. Because of this, the use of locking compression plates for fracture fixation has become more popular. This procedure seeks to protect bone biology, lessen iatrogenic soft tissue damage, and compromise bone vascularity[7,8]. Therefore, this prospective study represent the surgical management of distal tibial fractures using MIPPO and assess its functional result in terms of fracture and soft tissue recovery, incidence of infection, and other complications.

Materials and Methods:

This prospective study was conducted from June 2021 to May 2022, which consisted of 20 cases of distal tibial fractures admitted in the

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Department of Orthopedic surgery at the Popular Medical College and Hospital, Dhaka. Each patient gave informed written consent prior to participating in the clinical research study and the study was approved by the Ethical Review Committee of Popular Medical College & Hospital. In this study, patients who met the following criteria were included: age of more than 18 years; valid informed consent; presence of a distal fragment of at least 3 cm in length; injury duration of less than 2 weeks; and intact neurological and vascular status of the affected limb. Patients with open fractures, pathological fractures, associated other injuries, neurovascular injuries, intra-articular extension, pathological fractures, immune-compromised patients, or those who refused to give consent were not allowed to participate in this study.

Preoperative Management:

After receiving the patients at Emergency Room; the name, age, sex, occupation, and address were recorded as general information. Then, information about the manner of injury, family history and previous medical conditions were also noted. The patients' physical condition, including their blood pressure, pulse, and respiratory rate was assessed. Following the traumatized patient's stabilization, analgesics, antibiotics, intravenous fluids, and tetanus prophylaxis were given in accordance with protocol. Standard antero-posterior, and lateral, and radiographic images of the affected limb were taken and the leg was immobilized with a posterior splint until the operation and routine preoperative tests were completed. Following the pre-anaesthestic check-up, the patient was taken in for surgery. All cases were categorized as category A in accordance with the AO classification.

Surgical Procedure:

Under general or spinal anesthesia, all patients were operated in supine position. Preoperative antibiotics were administered right away once the patient was draped and prepared. Close reduction was attempted using traction and manipulation. The attempt at close reduction using traction and manipulation was done and then validated by C-arm guidance. The proper plate size was chosen for fixation once satisfactory reduction and alignment were accomplished. The fracture site was exposed using the usual medial approach, in the occasion when an adequate reduction could not be accomplished and open reduction and internal fixation were performed in accordance with standard protocols. The great saphenous vein was meticulously safeguarded throughout the oblique incision that was made at the medial malleolus' tip for plate fixation. The extra-periosteal channel for the plate was made using percutaneous elevators. C-arm imaging was used to confirm that the plate made it to the fracture site. A towel roll under the fracture site was placed to prevent displacement of the distal fragment before fixing the plates with screws. A Kirschner wire that was introduced via a fixation bolt was used to secure the plate to the tibial surface. In order to accomplish compression osteosynthesis, nonlocking screws were first placed; afterwards locking screws were then placed once an appropriate reduction had been achieved. The fracture is stabilized with at least three locking screws on either side. Following the removal of the initial K-wires, all screws were tightened once more before being closed. Nonabsorbable sutures were used to close the wound in layers after the surgery. For two weeks, a good dressing over the incision and a plaster slab below the knee were used.

Figure 1A and B: (A) Preoperative radiograph of a 44-year-old male patient showing fracture of both leg bones, distal and ;(B) postoperative radiograph of same patient with fracture fixed with distal tibial locking plate

Postoperative Management:

In order to establish that the fracture portions had been properly reduced and fixed, a postoperative X-ray was carried out. Depending on the patient's health and degree of fixation, ankle mobilization began as soon as possible. The use of antibiotics was continued until the wound had completely healed. The patient underwent routine follow-up in the outpatient department, radiographs were obtained at intervals of four weeks up to 6 months to assess healing and alignment and functional outcome was assessed using the ankle-hindfoot scoring system [American Orthopedic Foot and Ankle Society (AOFAS) score]. Following surgery, six weeks of non-weight-bearing movement was carried out followed by training with some weight bearing.

Data Analysis:

The study's data were all entered into Microsoft Excel (version 2013). Following the export of the data into SPSS version 20, statistical analysis was performed. Continuous data are given as means with their standard deviation, and categorical variables were described in terms of frequencies and percentages.

Results and observations:

Twenty patients with distal tibial end fractures, with a mean age

of 35.61± 5.42 years ranging in age from 19 to 70 years, were included in the current study. Among 20 patients, 17 (85%) were men and 3 (15%) were women, indicating there was a greater likelihood of these injuries in men. Table 1 displays the age and gender distribution of patients. The most frequent cause of injury in this study was road traffic accident. Out of 20 patients, 14 patients (70%) experienced trauma due to road traffic accident, 4 (20%) due to physical assault and 2 (10%) due to fall.

Table-I: Distribution of patients according to age and gender

Characteristics	No. of affected patients
Sex	
Female	03 (15%)
Male	17 (85%)
Total	20
Age (in years)	
19-29	05 (25%)
30-39	09 (45%)
40-49	04 (20%)
50-70	02 (10%)
Total	20
Mean Age (yrs)	35.61± 5.42

Table-II: Summary of Injury Patterns of Study Population (n=20)

Injury Mode	No. of affected patients
Road traffic accident	14 (70%)
Physical assault	04 (20%)
Fall from height/vehicles	02 (10%)
Total	20

In this study, every patient obtained union of the bones. The findings showed that the majority of fracture unions occurred between 16 and 23 weeks. Three (15%) fractures healed within 16 weeks, 12 (60%) fractures healed within 20, and five (25%) instances recovered before 30 weeks. There were no instances of nonunion (Table III).

Table-III: Distribution of subjects according to time by bony union

Time	No. of patients	Percentage
By 16 weeks	03	15%
By 20 weeks	12	60%
By 30 weeks	05	25%
Non union	00	00%
Total		20

Using the Ankle-Hindfoot Scale (AOFAS), patients were evaluated for their functional outcome: nine patients received excellent ratings, eight received good ratings, and three received fair ratings and overall mean AOFAS score was 86.85 in our study.

Table-IV: Functional outcome of study subjects according to Ankle-Hindfoot Scale (AOFAS score)

AOFAS Score	Outcome	No. of patients
>89%	Excellent	09 (45%)
80-89	Good	08 (4%)
70-79	Fair	03 (15%)
<69	Poor	00 (0%)
Total		20

In this study of all patients, 5 (25%) experienced delayed union and 4(20%) patients experienced superficial infection which was managed by broad spectrum antibiotics. Other patients report any other complications besides these. In the present research, 2 patients experienced postoperative ankle stiffness that gradually subsided and by 25–26 weeks, functional range of ankle motions was obtained with the aid of physiotherapy. While radiological union occurred between 16 and 20 weeks in 15 of the 20 cases, it took 23 weeks to establish union in 5 cases.

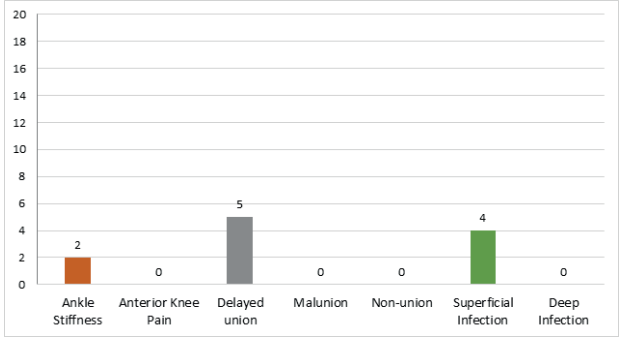

Figure 2: Complications in the study population (n=20).

Discussion:

Due to the distal tibia's unique form, lack of soft tissue coverage, and typically inadequate blood flow, treating distal tibia fractures is a challenging task for orthopedic surgeons. Extensive soft tissue dissection is required for open reduction and internal fixation, which has a higher risk of complications such as infection, delayed union, and nonunion. Without extensive dissection and surgical stress to the bone and surrounding soft tissues, MIPPO permits reliable fracture bridging osteosynthesis. In addition, it offers a number of benefits over the traditional open plating method, including a lower infection rate and improved fracture healing. In comparison to similar studies by Mauffry et al.[9] and Bahari et al.[10] where the average patient age was 35 years and 46 years, respectively, the average patient age in our study was 35.61±5.42 years. In our study, 85% of the patients were male and 15% were female, compared to 66% male and 34% female participants in Mauffry et al.'s study [9] and 65% male and 35% female participants in Guo et al.'s study [6].

Depending on radiological union, 15 patients in our study (75%) achieved full extent mobility by 23 weeks; however 5 patients (25%) gained such by 25–28 weeks after physical therapy. This result was consistent with the study of Illur et al. [11] in which 80% of patients achieved complete mobility by 24 weeks, whereas 20% of patients did so between 26 and 28 weeks. In our study, the average time for

fracture union was 20.5 weeks. Fracture unification following MIPPO in distal tibial fracture was reported to take an average of 23 weeks by Redfern et al. [12], 17.6 weeks by Guo et al. [6], and 22.4 weeks by Bahari et al. [10]. In the present research, the mean AOFAS score was used to assess functional outcome and the average was 86.85, whereas the mean AOFAS score obtained in the studies by Guo et al. was 83.9 [6] and Collinge et al. was 85 [13]. In our investigation, all fractures resolved together and no abnormalities were seen. However, 2 (10%) of the patients experienced ankle stiffness, and 4 (20%) experienced superficial infections that required appropriate management. However, lower infection rates were reported by Bahari et al. [10] (7.14%) and Guo et al. (14.6%)[6].

Conclusion:

The MIPPO approach with a locking plate is efficient and safe in attaining union and an outstanding functional outcome in distal tibial fractures. However, infection can further be prevented by carefully handling soft tissues during surgery and cutting down on time. However, the study's limitations are its small sample size and lack of a control group. In bigger, multi-centered randomized controlled studies, the effectiveness of plating via the MIPPO technique in treating distal tibial fractures should be further evaluated

Conflict of Interest: None.

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