ORIGINAL ARTICLE

Soft tissue complications associated with distal tibia fractures and role of Minimally Invasive Plate Osteosynthesis: A prospective series

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Abstract

Introduction: Distal tibial fractures are not uncommon these days, and the open technique of fixation is associated with wound complications such as infection.

Objectives: The purpose of the study was to determine the frequency of wound complications in distal tibial fracture managed by Minimally Invasive Plate Osteosynthesis (MIPO).

Material and Methods: A descriptive case series was conducted at the Orthopedic Department, GTTH Lahore. Written informed consent for inclusion in this study was obtained. 60-cases undergoing Minimally Invasive Plate Osteosynthesis (MIPO) tibia were assessed for the incidence of wound complications 3 months post-operatively.

Results: Among these cases, almost more than half of the cases were males 42(70.0%). The sample's average age was 38.92±11.22, ranging from (18-65) years. According to the distribution of patients, the majority of cases, 39(65%), were between 18-40 years. Majority of cases, 32(53.3%) had right-sided fracture, and majority, 50(83.3%), had a history of RTA. The mean union time was 9.53±2.12, ranging from (6-12) weeks, the union was achieved in most of the cases between 9-12 weeks 41(68.3%). Primary outcome wound infection was noted in only 8(13.3%) of cases, while 52(86.7%) had no wound infections. The results indicated that male cases had more incidence of wound complications 7(16.7%); however, the association between gender and wound complications was not significant. Similar insignificant results were observed between age, mode of injury, side affected, and union time.

Conclusion: For distal tibia fractures, Minimally Invasive Plate Osteosynthesis is a safe and effective method. This treatment lowers the incidence of wound complications and allows early return to daily lifestyle activities.

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Introduction:

Distal tibial fractures are not uncommon these days and account for less than 10% of all lower extremity fractures. These fractures are found to be more common in males as compared to females. The average patient age is 35 to 40 years. These injuries are most commonly seen in patients due to Road Traffic Accidents (RTA)/ motor vehicle accidents or falls from height. The severity of these injuries, complexities, and drawbacks of various surgical approaches have been well demonstrated in the literature. Still, good outcome on long term follow-up continues to get away from the patients experiencing these fractures.[1]

Managing distal tibia fractures remains a subject of debate and discussion. The goal of tibial fixation is to restore tibial architecture, correct the epi-metaphyseal block with the diaphysis, and avoid associated systems complications. The treatment methods include closed reduction followed by cast or external fixation, as well as open reduction and internal fixation. Thus, a variety of osteosynthesis procedures may be employed, including open reduction and inter-

Figure 1: Distal tibia fracture fixed by MIPO. On the left is the pre-operative X-ray. The middle picture shows a post-operative X-ray. The right-sided picture depicts the minimally invasive plate osteosynthesis (MIPO) surgical wound.

nal fixation (ORIF), external fixation with or without limited internal fixation, intramedullary nailing, and, more recently, minimally invasive plate osteosynthesis (MIPO). All these methods have benefits and drawbacks, and the treatment of these fractures is inconsistent. Despite operating procedures, results are not always outstanding, and 20-50% of patients are affected by complications following tibial fixation in general. Limited invasion for either treatment modality has been considered in almost all the domains of every surgical field. The same goes for orthopaedics including long bone fractures.

Minimally Invasive Plate Osteosynthesis (MIPO) plays a vital role in today's orthopaedics in distal tibial fractures. It has been proven to be a safe approach with acceptable anatomical as well as functional results. Since the minimally invasive approach gives limited access to the fracture site, the concept of absolute fixation has been modified to a relative fixation of biological osteosynthesis by maintaining osseous and soft tissue vascularity. Biological plating provides relative stability and conserves fracture vascularity. Indirect closed-down reduction, extra-periosteal dissection, and relative stabilization are the minimally invasive procedure concepts, facilitating restricted regulated movement at the fracture with secondary bone healing with callus formation.[2] This is achieved by minimally invasive technique (figure 1).

However, it is important to note that not all distal tibial fractures can be treated by this minimally invasive approach and that a range of procedure-specific complications do occur if proper precautions are taken before, during, and after surgery.[3-4] This technique's beauty lies in the fact that it has reduced complications soft tissue complications,which is the biggest concern in traumatic distal tibia fractures as the skin here is friable with not much soft tissue coverage of the bone. Among the complications associated with minimally invasive plate osteosynthesis fixation are wound dehiscence, deep and superficial infection, the ankles' rigidity, malrotation, palpable implants, inadequate reduction, and hardware failure.[5] In a study conducted by Law TW et al. on complications of minimally invasive percutaneous plating for distal tibial fractures, the inferential analysis showed that 7(14.6%) of patients reported back with superficial wound infection.[6]

Since the literature on minimally invasive plate osteosynthesis fixation and its complications is scarce in our part of the world, so this study will generate guidelines for evidence-based medicine from our population. Following this study, we will be able to anticipate the outcome among our patients, and hence, the decision regarding the best fixation method for the distal tibial fracture esp. in cases of friable soft tissue, would become easier.

The purpose of the study was to determine the frequency of wound complications in distal tibial fracture managed by Minimally Invasive Plate Osteosynthesis (MIPO) and look into factors associated with the wound complications.

Material and Methods:

It was a prospective case series conducted over a period extending from 1st June to 1st December 2022 at Ghurki Trust Teaching Hospital, Lahore. A sample size of 60 was calculated by taking a 95% confidence level and a 9% margin of error while taking a superficial infection incidence (wound complication) of 14.6%.[6] Approval from the Ethical Review Board (ERB) of the hospital was obtained. All the patients

of either gender, aged between 18 to 60 years, presenting with closed extra-articular distal end tibia fractures and undergoing minimally invasive plate osteosynthesis fixation, were included in the study.

Exclusionary criteria included patients with other ipsilateral fractures, head injuries, pathological fractures, and old ankle fractures. Open fractures were also excluded and so were the patients that were lost during follow-up. Written informed consent for inclusion in this study was obtained. After written informed consent, the patients were operated on under spinal anesthesia. All the patients were operated on with the minimally invasive plate osteosynthesis technique. The tourniquet was applied in the supine position. A small incision was made on one end of the fractured comminuted area without disturbing the fractured fragments' soft tissue envelope. The incision extended right up to the bone with the periosteal tube. A sub-periosteal tract was made along the surface where the plate was to be applied and extended across the fracture to the other side. The track is made with a special doubly angled periosteal elevator available in different sizes. At times, the track was made with the plate to be used itself. The plate was used depending on the anatomy and location of the fracture. A narrow tibia DCP was used for fractures of the diaphysis, and either a T-buttress or a cloverleaf plate was used for the distal tibia fractures. Once the tract was made, an appropriate length plate was selected so that at least 6–8 cortices could be obtained on each side. A contoured plate was made to slide along the previously created tract. With the plate in-situ and some traction given manually, the alignment was checked using the standard anterior superior iliac spine-center of the patella-second toe guideline. An X-ray was taken to check the alignment radiologically and confirm the plate's length if it is appropriate. The plate was fixed at one end with appropriate screws (4.5mm cortical or 6.5mm cancellous). Initially, only one screw was passed, and maintaining the plate bone contact and the alignment, the retaining screws were passed. With the fracture reduced by indirect means without opening the fractured area by gentle external manipulations, the plate's distal end was marked. The plate was fixed distally with percutaneously introduced screws. The alignment was checked all the time.

The use of bone-holding forceps was avoided. Careful handling of the soft tissues and judicious use of the retractors was a must. No primary bone grafting was done, irrespective of the comminution. All patients received cefuroxime 1.5g at induction, followed by 750mg at 8 hours and 16 hours post-operatively and analgesia. Physical therapy was commenced on the first day post-operatively. Post-operative radiographs were done on the day following surgery. Radiographs were taken for evidence of the union. Patients were assessed at three months post-op follow-up for superficial infections, dehiscence, skin necrosis, wound slough, and persistent drainage. Presence of any one or more of these defined complicated wounds. All data were recorded on a preformed proforma.

All the collected data were entered and analyzed through SPSS version 22. For numerical variables, age and union time were presented by mean±SD. Categorical variables like gender, mode of injury, the side affected, and wound complications were presented by frequency and percentage. Data were stratified for age, gender, union time, the side affected, and mode of injury to address effect modifiers.

Post-stratification, a chi-square test of the association was applied, taking p-value ≤0.05 as significant.

Results:

In this study, a total of 60 patients diagnosed with distal tibia fractures and undergoing minimally invasive plate osteosynthesis were studied. Among these cases, almost more than half of the cases were males, 42(70.0%), and fewer were females, 18(30%), with an average age of 38.92±11.22 ranging from (18-65) years. According to the distribution of patients, the majority of cases, 39(65%), were in between 18-40 years, while 21(35%) were in between 41-65

Table 1: Distribution of quantitative variable among the study sample

Variable	Mean	SD
Age (years)	38.92	11.22
Union time (weeks)	09.53	2.12

Table 2: Distribution of categorical variables among the sample

Variable	Categories	sub frequency	percentages
Gender	Male	42	70
	Female	18	30
Side involved	Right	32	53.3
	Left	28	46.7
Mode of injury	RTA	50	83.3
	Fall	10	16.7
Union time (weeks)	6 -8	19	31.7
	9 - 12	41	68.3

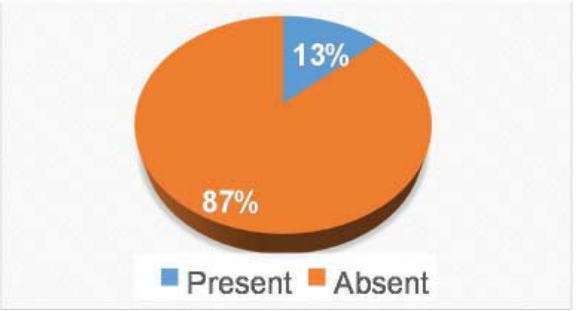

Figure 2: Presence or absence of wound complications

Table 3: Association of studied variables with wound complications

	Wound complication		
Variable	Present	Absent	p-Value
Age groups (18-40/41-65 years)	7/1	32/20	0.241
Gender (male/female)	6/2	36/16	1.0
Side involved (right/left)	23/29	5/3	0.454
Mode of injury (RTA/fall)	5/3	45/7	0.12
Union time (6-8/9-12) weeks	3/5	16/36	0.69

years. Majority of the cases, 32(53.3%) were affected from the right side rather than the left side, 28(46.7%). Almost more than half of cases, 50(83.3%), had a history of RTA, and the rest sustained trauma by a fall 10(16.7%). The mean union time was 9.53±2.12 weeks and ranged from (6-12) weeks. Union was achieved in most of the cases between 9-12 weeks in 41(68.3%) and 6-8 weeks in 19(31.7%) cases as shown in table 1 and 2.

According to the frequency of wound complications, only 8(13.3%) had wound infections, while 52(86.73%) had no wound infections as shown in figure-2. Stratification of the frequency of wound complications concerning the demographic profile of patients is shown in table 3, and the results indicated that male cases had more incidence of wound complications 6(14.3%) than females 2(11.1%). However, no significant association between gender and wound complications was observed as p>0.05. Similar insignificant results were observed between the age group and side affected, with p-values of 0.241 and 0.454. Mode of trauma (RTA/fall) also had non-significant distribution in terms of wound complications with a p-value of 0.12. effect of wound complications on union and vice versa were also studied; however, no significant association was inferred. (p>0.69) as shown in table 3.

Discussion:

Tibial distal metaphyseal fractures are frequently linked with substantial soft tissue damage. Recognizing the relevance of the soft tissue component is crown itical in the treatment of this injury. Failure to recognize the soft tissue condition would almost always result in infection, wound dehiscence, or nonunion.[7] Bridging plate osteosynthesis has been developed for multifragmentary shaft fractures over the last 10 years. The approach reduces soft tissue stress to the wounded region, allowing for better blood flow surrounding the fracture site.[8] More rapid fracture healing is possible due to less significant injury to the soft tissues and blood supply.[9] Initial osteosynthesis using locking compress plates has been considered contraindicated in open fractures, deep abrasion with skin or muscle contusion, crush injury with major damage to the underlying muscle, subcutaneous avulsion, and heavy contamination with substantial soft tissue damage (LCP) by Hasenboehler E. et al.[10] In some circumstances, a temporary repair was performed using an external fixator. When the soft tissue permitted it, and the 'wrinkle sign' was visible, first plate osteosynthesis or exchange external fixator by locking the plate was recommended.

In this study, a total of 60 patients who were diagnosed with distal tibia fractures and underwent the minimally invasive plate osteosynthesis fixation were included. Among these cases, almost more than half of the cases were males, and fewer were females, with samples' ages ranging from 18 to 65 years. The majority of cases had fractures on the right side rather than the left. Almost more than half of the cases had a history of RTA. Union was achieved in most cases between 9-12 weeks. According to the frequency of wound complications, only 10(16.7%) had wound infections, while 59(83.3%) had no wound infections. Insignificant results were observed between gender, age, mode of injury, the side affected, and union time.

The study conducted by Lau et al. to investigate the incidence of wound complications following minimally invasive plate osteosynthesis in distal tibia fractures revealed that an equal number of male and female patients, ranging in age from 21 to 87 years, were included in the study. In 48 instances, one acute infection (2%) and seven late infections (14.5%) were discovered.[8] According to the research, the average infection rate ranged from 5 to 15%. Delaying surgery if a limb is swollen and bruised, using careful soft-tissue handling, and shortening the operating duration all assist in lowering infection rates.[11,12]

The effects and complications of minimally invasive medial plate osteosynthesis for distal metaphyseal tibial fractures were explored by Van et al. Only one fibular plating wound was badly infected, and the rest of the wounds recovered well. There was no subsequent displacement in any of the tibial fractures.[7] Late infection was defined as an infection that occurs after at least one month of full wound healing with no signs of infection. Infection rates of plating have been reported to range from 0% to 6% in the literature. Because the degree of soft tissue injury differs in various studies, some include open fractures needing soft tissue restoration while others only include closed injuries; thus, the range varies.[13,14]

Because of their subcutaneous position, distal tibia fractures are linked with severe edema, skin damage, and blisters. The state of the skin determines the time of surgery. When surgery is performed on patients with poor soft tissue conditions, problems such as wound dehiscence and infection might occur. Splinting, cooling packs, and delaying the surgery all aid in preventing future soft tissue damage and improving preoperative soft tissue health. When the edema subsided, and the wrinkle indicator appeared, surgery was performed. Dorsiflexion of the ankle is performed while looking for skin creases on the anterior portion of the ankle; the lack of a skin crease or wrinkle indicates significant edema.[15,16]

Malunion is a rare complication following LCP. Malunion rates in the literature range from 0 to 5%. According to various research, the percentage of delayed union and nonunion is between 5 and 16 percent. Collinge et al. found a 5% reoperation rate, including supplementary procedures such as bone grafting for the delayed union.[17] At rates ranging from 3.8% to 35%, secondary procedures for delayed union, nonunion, or hardware modification have been observed. Implant failure rates have been estimated to range between 2 and 6%. Here, the plate bending or breaking is typically associated with misalignment, delayed union, or non-union.[18,19]

Conclusion:
It is concluded that for distal tibia fractures, minimally invasive plate osteosynthesis is a safe and effective method. Thus, alongside careful management, a minimally invasive fixation technique lowers wound complications and allows an early return to work.

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Role and contribution of authors:
Bilaluddin, collected the data, references and did the initial writeup.

Kamran Sabir, collected the data and helped in introduction writing.

Mariam Haider, collected the references and helped in interpretation of data.

Muhammad Murtaza, collected the references and helped in discussion writing.

Zain Muhammad, went through the article and did the useful changes.

Shahzad Javed, critically review the article and made final changes.

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