



# Treatment Modalities of Displaced Extra Articular Distal Tibia Fracture and Possible Complications

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## Abstract

**Background:** Assessment of patient with fractures of the distal tibia should be carried out in a systematic fashion to assure full evaluation and so other injuries are not over looked. Particular attention must be paid to the contralateral lower extremity and the lumbar and thoracic spines, particularly when these injuries occur as a result of a fall or motor vehicle accident. Fractures of the lower third tibia resulted from low energy trauma or high energy trauma with good skin condition. In this method can access anatomical reduction but may result in extensive soft tissue dissection, disruption of blood supply, nonunion, delayed union and wound complication and infection. So, minimal invasive plate fixation (MIPO) is recommended to limit this complication and given more stability. The basic principles of this technique include in direct closed reduction, extra periosteal dissection, anatomic alignment. Plate length and screw density are key factors for the stability of fixation

**Keywords:** Displaced, Extra Articular Distal Tibia Fracture, Management

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## Introduction

Distal tibial fractures are the most common long bone fractures. An incidence of 17 per 100 000 person per years, although more recent data indicate that the incidence may be declining. In most cases, they are due to a force directed from the foot towards the leg in high energy traumatic events, as fall from height, traffic accident, motorcycle accident or sport injury.(1)

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Assessment of patient with fractures of the distal tibia should be carried out in a systematic fashion to assure full evaluation and so other injuries are not over looked. Particular attention must be paid to the contralateral lower extremity and the lumbar and thoracic spines, particularly when these injuries occur as a result of a fall or motor vehicle accident (2).

### Treatment of displaced extra articular Distal Tibia fracture

#### 1-Minimal Invasive Plate Osteosynthesis (MIPO):

##### Indication:

Fractures of the lower third tibia resulted from low energy trauma or high energy trauma with good skin condition. In this method can access anatomical reduction but may result in extensive soft tissue dissection, disruption of blood supply, nonunion, delayed union and wound complication and infection. So, minimal invasive plate fixation (MIPO) is recommended to limit this complication and given more stability. The basic principles of this technique include in direct closed reduction, extra periosteal dissection, anatomic alignment. Plate length and screw density are key factors for the stability of fixation. (3).

##### Contraindication:

Any soft tissue injury at fracture site or patient liable to incidence of infection (4).

##### Complication:

The risk of wound dehiscence and infection which occurs as a consequence of the minimal soft tissue cover over the anteromedial side of the tibia (4).

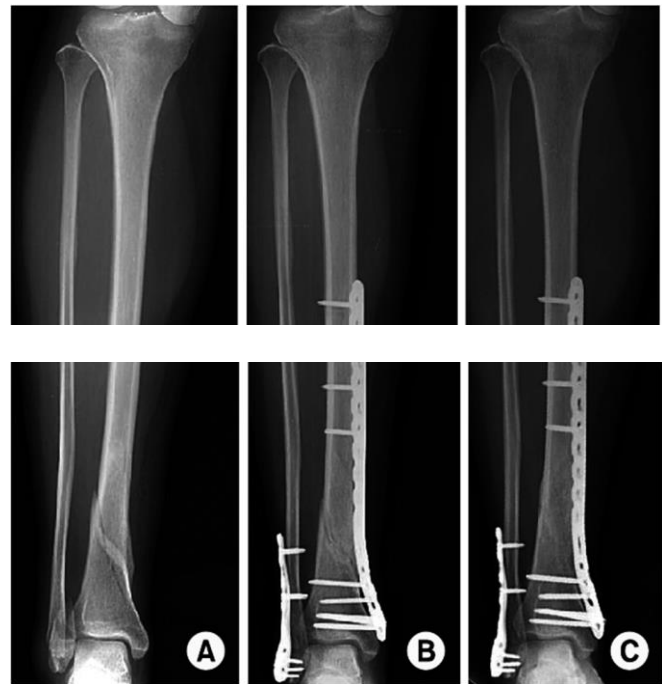


Fig. (1): Fracture of distal tibia treated by MIPO technique (4).

#### 2- Interlocking nail:

##### Indication:

Fractures of lower third tibia resulted from low energy trauma or high energy trauma with distal fragment allowing to insert distal locking screws, no severe soft tissue damage, or no bone exposed. In this method can limit the soft tissue damage, protect blood supply through minimal invasive technique but may result in difficulty in distal nail fixation, mal union, breakage of locking distal screws and risk of nail propagation into the ankle joint. So, Expert nail is recommended to limit this complication and given more stability (5).



**Fig. (2): fracture being managed by locked nailing showing adequate reduction and fracture union (5).**

**Contraindication:**

Difficult fracture reduction, fracture propagation into the ankle joint, and inadequate distal locking options (6).

**Complication:**

Mal union, nail propagated into ankle joint, and breakage of distal locking screws (6).

**2-Fixation of fracture fibula:**

The need for fibular fixation is unclear in extra-articular fractures of the distal tibial metaphysis, especially if the concomitant fibular fracture occurs above the level of the distal tibiofibular syndesmosis. Fibula is fixed first when the fracture is simple (not comminuted) by open anatomic reduction and plate fixation using 1/3rd tubular plate or by locked plate. (7)

Comminuted fibular fractures fixed with MIPO technique using a long bridging plate, or intramedullary fixation of the fibula with a small diameter flexible nail (8).



**Fig. (3): Fixation of fibula (42)**



**Fig. (4): 1/3rd tubular plate (7)**



**Fig. (5): locked plate of fibula (7)**

## Complication of Distal Tibial Fracture

### I- Complication of Fracture Distal Tibia:

#### 1-Compartment syndrome:

**Incidence:** Ranges from 2% to 9% of all tibial fractures, occurs where there is excessive swelling within a closed fascia-bone space leading to increased pressure within one of the leg's compartments results in insufficient blood supply to tissue within that space (9).

**Predisposing factor:** Young men with relative muscle hypertrophy (compared with older patients with muscle atrophy) have less residual space for muscle expansion, which could potentially increase acute coronary syndrome (ACS) risk (9).

**Diagnosis:** There are five characteristic signs and symptoms related to acute compartment syndrome: pain, paralysis, paresthesia (reduced sensation), pallor, and pulselessness. Pain and paresthesia are the early symptoms of compartment syndrome (10).

**Prevention:** Prophylactic anti-inflammatory anti edematous of risky patients can be helpful. Early diagnosis and early fasciotomy, Good results can occur if compartment syndrome is recognized early. A missed compartment syndrome can lead to muscle fibrosis, nerve damage, and loss of function (11).

**Treatment:** Surgical fasciotomy is indicated to decompress the compartments (11).

#### 2-Vascular injury:

**Incidence:** Very rare, but may occur with blunt trauma associated with stretching of vessels or crushed injuries (12).

**Diagnosis:** Doppler signals.

**Clinical finding:** (pulsatile bleeding, expanding hematoma, thrill at injury site, and pulseless dorsalis pedis and posterior tibial arteries) may be subtle (12).

#### Complication:

- 1- Blood loss.
- 2- Compartmental syndrome.
- 3- Tissue necrosis.
- 4- Infection.
- 5- Amputation.
- 6- Death (13).

#### Treatment:

##### 1- Emergency management:

- Control bleeding by compressive dressing.
- Fluid resuscitation.
- Reduce and splint of fracture.

**2-Prompt arterial repair** is essential for limb salvage, requires an initial recognition of arterial injury (13).

##### 3-Thromboembolism (TA):

**Incidence:** Vary significantly based on the level of injury, fracture pattern, and inherent patient factors (14).

**Predisposing factor:** Hypertension, smoking history, diabetes, respiratory disease, alcoholism, obesity, bleeding disorder, dependent status, steroid use and angina (14).

**Prevention:** The use of thromboembolic prophylaxis (LMWH) after incidence of trauma and after the fixation surgery (15).

**Diagnosis:** Two third of cases of thromboembolism were a symptomatic, one third of these patients had clinical sign of DVT



(swelling of foot and ankle, cramping pain, skin of affected area turning pale, a reddish or bluish color and warmer than surrounding area) (15).

**Complication:** Pulmonary embolism (16).

**Treatment:** Medications (anticoagulant), In severe cases may be used thrombolytic drugs (16).

#### 4-Fat embolism:

##### Incidence:

Fat embolism is not common phenomenon following limb fracture. It develops in 0.5% to 2% of all patients with fractures of the long (17).

**Diagnosis:** The onset is then sudden, with breathlessness & chest pain, high pulse rate, petechial rash present in conjunctivae. Central nervous system symptoms, disorientation, confusion, renal oligouria and drowsiness are common (17).

**Predisposing factor:** Obese patient, longer injury surgery interval, long time of reamed nailing (18).

**Prevention:** Early fracture fixation and patient mobilization (18).

**Treatment:** Admission of intensive care unit, O2 supply if needed (some patients may need mechanical ventilation), IV fluids (19).

#### II-Complication of fixation of fracture distal tibia:

##### 1) Infection:

**Incidence:** 1.6% in closed fractures distal tibia and 8.0% in open fractures of distal tibia. Infection is a serious complication that may occur after open method of treatment. It may

result in osteomyelitis of the tibia, septic arthritis of the ankle joint or loosening of the screws and plate (20).

**Source of infection:** Organisms may be introduced directly into the wound from the atmosphere, the instruments, the patient, or surgeon, or indirectly by hematogenous spread from distant focus (21).

##### Diagnosis:

- **Clinical:** Pain, fever, sign of inflammation (hotness, erythema, tenderness, swelling, and limitation of ankle joint), limping with weight bearing, and draining sinus tract in osteomyelitis and may be present with full-thickness skin slough and plate exposed. (22)



**Fig. (6): Full-thickness skin slough and plate exposed (22).**

##### Laboratory:

- **Leukocyte count (WBC):** Increased
- **ESR and CRP:** Increased.
- **Culture and sensitivity from draining sinus.**
- **Blood culture.**
- **Bone biopsy:** Gold-standard for guiding antibiotic therapy (20).

### **Radiological:**

- **Osteolytic region** surrounded by an area of sclerosis.

- **Sequestrum:** Devitalized bone that serves as a nidus for infection.

- **Involucrum:** Formation of new bone around an area of bony necrosis **(21)**.

**The basis of classification of infection is as follows:**

#### **A. Early infection:**

1-Superficial.

2-Deep.

3-Both superficial and deep **(23)**.

#### **B. Late infection:**

1-Following early infection.

2-Hidden infection appearing later.

3-Following a long period **(24)**.

#### **Factors that favor bacterial invasion are:**

1. Soft-tissue damage and bone death.

2. Poor contact between the implant and bone.

3. Loosening of the implant.

4. Corrosion of the implant **(25)**.

#### **Factors that predispose to infection are:**

1. High-energy injuries.

2. Open fractures.

3. Extensive surgical dissection that compromises osseous vascularity.

4. Prolonged time of open surgical wound.

5. Inadequate fixation **(25)**.

#### **Treatment:**

-**Superficial infection:** IV antibiotic followed by oral antibiotic.

- **Deep infection:** Irrigation and debridement should be performed to remove all necrotic tissue and sequestrum. Deep cultures should be obtained. Strong IV antibiotic should have administered until culture result will appear **(26)**.

#### **Prevention:**

- Careful preoperative screening of any focus of infection.

- Careful handling of the soft tissue. Intermittent irrigation of the operative wound with saline through the procedure

help to remove contamination and debris. Prophylactic antibiotic should be administered and then continued 48 hours after surgery at least **(26)**.

#### **Non-union:**

**Definition:** permanent failure of healing following a broken bone.

**Incidence:** constitute 2-10% of all tibial fractures **(27)**.

#### **Predisposing factors :**

##### **Related to patient:**

1- Old age.

2- Poor nutrition.

3- Smoker, alcohol intake.

4- Patients have metabolic disease **(27)**.

##### **Related to fracture:**

1- The fracture moves too much after trauma.

2- Poor blood supply.

3- Infection.

4- Soft tissue damage surrounding it.

5- Bone loss at the fracture **(28)**.

##### **Related to fixation:**

1- Inadequate reduction.

2- Inadequate stability.

3- Improper fixation device **(28)**.

##### **Diagnosis:**

**Clinical:** Persistent pain at the fracture site and may also notice abnormal movement or clicking at the level of the fracture **(29)**.

**Radiological:** Plate of the fractured bone shows a persistent radiolucent line at the fracture **(29)**.

##### **Classification:**

**1- Hyper vascular (hypertrophic):** Callus is formed, but the bone fractures have not joined.

**2-A vascular (atrophic):** No callus is formed **(30)**

##### **Treatment (surgical):**

1- Removal of all scar tissue from between the fracture fragments.

2- Immobilization of the fracture with internal fixation.

3- Bone grafting(30)



**Figure (7): Non-union for distal tibia fractures. (30)**

**Delayed union:**

**Definition:** Delayed union is absence of complete radiological union at 6 months or if do not show enough bridging callus to achieve clinical stability by 16 weeks (31).

**Incidence:** 5-10 % of cases of fixation of fracture distal tibia (31).

**Diagnosis and treatment:**

**Diagnosis:**

- **Clinical:** Persistent pain at the fracture site and may also notice abnormal movement or clicking at the level of the fracture.

- **Radiological:** Plate of the fractured bone shows a persistent radiolucent line at the fracture (32)

**Treatment (surgical):**

1- Removal of all scar tissue from between the fracture fragments.

2- Immobilization of the fracture with internal fixation.

3- Bone grafting (32)



**Fig. (8): Delayed union for distal tibia fractures after 6 months. (32)**

**Malunion:**

**Types of malunion (33):**

- Varus of more than 10°.
- Valgus of more than 15°.
- Shortening of more than 1 cm.
- Anterior or posterior angulation of more than 15°.
- External rotation more than 10°.
- Internal rotation more than 5°.

**Incidence:** Constitute 8 % of cases of fixation of fracture distal tibia (33).

**Diagnosis and degree of tibial mal alignment and varus /valgus:**

**Grade 1:** 2.5° malalignment&1cm shortening.

**Grade 2:** 5° malalignment&2cm shortening.

**Grade 3:** 10° malalignment&3cm shortening.

**Grade 4:** > 10°malalignment >3cm shortening.

**Treatment:** Surgical intervention (34).

**Neurovascular injury:**

Because of the saphenous vein (SV) and saphenous nerve (SN) lie in the medial facet

of the distal tibia, and cross the tibia from anterior to posterior (35).

#### **Secondary osteoarthritis:**

Mal-reduction is main cause of secondary osteoarthritis. Many patients can be successfully treated with anti-inflammatory medication (21).

#### **Implant failure (plate or distal screws of ILN):**

Factors predispose to loss of fixation include:

- 1- Fracture comminution.
- 2- Increased patient age and osteopenia.
- 3- Poor patient compliance with premature loading and weight bearing.
- 4- Infection.
- 5- Inadequate poor fixation technique.
- 6- Improper manufacturing material

(36).



**Fig. (9): Implant failure (71).**

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