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# TIBIAL DIAPHYSEAL FRACTURE, PANORAMIC REVISION

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## SUMMARY

***Introduction:*** *Tibial fractures are quite common injuries. Since the tibia has a subcutaneous location, it is more likely to show exposed fractures. Exposed fractures of the tibial diaphysis are serious injuries that can result in significant long-term disability if not managed correctly.*

***Objective:*** *to detail current information related to tibial diaphysis fractures, etiology, epidemiology, anamnesis, physical examination, assessment, treatment, differential diagnosis, prognosis and complications.*

***Methodology:*** *a total of 29 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 17 bibliographies were used because the other articles were not relevant for this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: tibia fractures, osteosynthesis, tibia fracture, intramedullary nails, leg trauma, exposed fractures.*

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***Results:*** *tibial diaphysis fractures present an incidence of 16.9 per 100,000 individuals per year, being more common in the male sex, with 21.5 per 100,000 individuals per year, compared to 12.3 per 100,000 in the female sex. The most common triggers in males of tibial diaphysis fractures are motor vehicle accident injuries and sports.*

***Conclusions:*** *It is important to recognize the management of tibial fractures since they have a relatively high incidence. It is not uncommon to encounter an exposed tibial diaphysis fracture, so it is essential to identify, as well as perform damage control and appropriate management. The individual should undergo a complete examination and it may be necessary to implement the trauma life support protocol. In this type of fracture it is crucial to assess the neurovascular situation. In addition, complementary examinations should be requested to allow the best diagnosis, classification and treatment of the injuries. The treatment of tibia diaphysis fractures will depend on the specific situation and the patient's condition; however, external fixators are usually used for damage control and later intramedullary nails are used. Tibial diaphysis fractures may be accompanied by compartment syndrome and other complications.*

**KEY WORDS:** *trauma, fractures, tibia, treatment.*

## INTRODUCTION

Tibial fractures are quite common injuries. The tibia having a subcutaneous location is more likely to show exposed fractures. The musculature of the lower leg is divided into four compartments separated by fascial tissue, of importance in case the injury causes compartment syndrome. Radiographs are important in the initial evaluation of fractures. In the case of a lower extremity injury or fracture, fascial tissue release by fasciotomy may be required to prevent the sequelae of compartment syndrome. Treatment methods may be conservative for minimally displaced fractures and surgical fixation is preferred for displaced and open fractures(1).

Exposed fractures of the tibial diaphysis are serious injuries that can result in significant long-term disability if not managed correctly. These fractures usually result from high-energy trauma, such as motor vehicle accidents or falls from a height. The management of these fractures can present some difficulty and sometimes requires a multidisciplinary approach. The main goal of treatment of exposed tibial shaft fractures is to achieve fracture healing while minimizing the risk of infection. Treatment usually involves surgical debridement of the wound, followed by stabilization of the fracture through internal or external fixation and wound coverage. The choice of treatment will depend on the importance of the fracture and the presence of related injuries(2,3).

## METHODOLOGY

A total of 29 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 17 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: tibia fractures, osteosynthesis, tibia fracture, intramedullary nails, leg trauma, exposed fractures.

The choice of the bibliography exposes elements related to tibia diaphysis fractures; besides this factor, the etiology, epidemiology, anamnesis, physical examination, assessment, treatment, differential diagnosis, prognosis and complications of the disease are presented.

## DEVELOPMENT

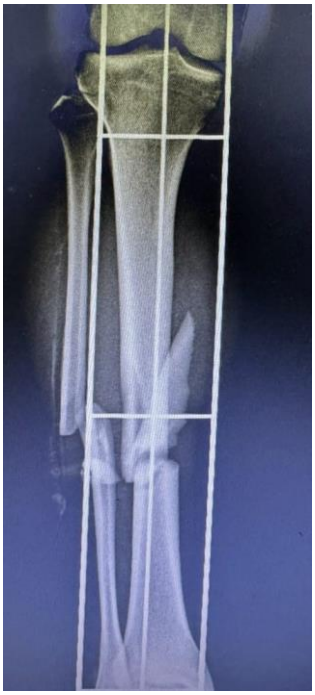
### Etiology

Fracture of the tibial diaphysis usually results from falls, indoor activities, motor vehicle accidents, sports and other outdoor activities, with the most common triggers of tibial diaphysis fractures in males being motor vehicle accident injuries and sports(1,4,5).

### Epidemiology

Fractures of the tibial diaphysis have an incidence of 16.9 per 100,000 individuals per year, being more common in males, with 21.5 per 100,000 individuals per year, compared to 12.3 per 100,000 in females. Males tend to suffer tibial diaphysis fractures at a younger age, with the highest incidence at 43.5 per 100,000 per year between 10 and 20 years of age; on the other hand, the most common age group in females is between 20 and 30 years of age(1).

**Figure 1. Fracture of the diaphysis of the right tibia and fibula, anteroposterior view.**



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**Pathophysiology**

The tibia is a long bone with a triangular cross section and is responsible for about 80% of the weight bearing load for the lower limb. When there is a fracture of the proximal tibial diaphysis, deforming forces play an important role in the misalignment. Deforming forces involving the proximal tibia can cause the proximal fragment of the patellar tendon/extensor mechanism to extend, the distal fragment of the gastrocnemius to flex, and the proximal fragment of the goosefoot to flex in varus(1,6).

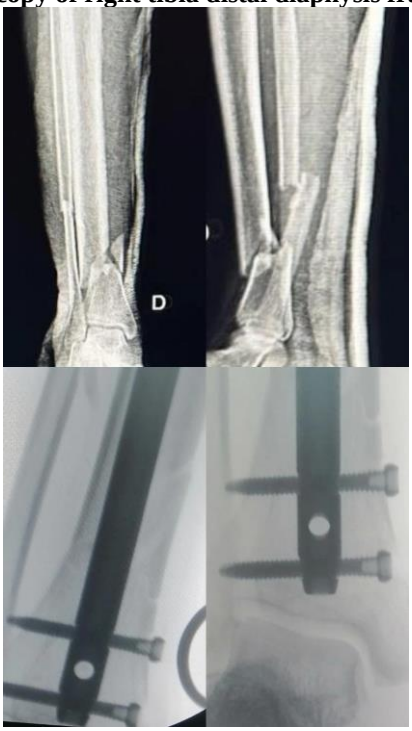
**Anamnesis and Physical Examination**

A proper history should be taken to determine how the injury occurred. Falls and high-energy trauma are frequently the causes of tibial diaphysis fractures. If the falls are due to syncope, additional studies are sometimes necessary.When due to high-energy trauma, the affected individual should undergo a complete examination and implement the trauma life support protocol. The affected extremity should undergo a thorough examination for any ipsilateral injury. The skin examination should look for any lacerations that may communicate with the fracture site, which would show an open fracture. In addition, a complete neurovascular examination of the affected extremity is necessary(1).

It is crucial to assess the neurovascular situation. Therefore, the situation of the pulses of the dorsal pedial artery and posterior tibial artery should be explored and documented, especially in open fractures in which vascularized flaps may be required a posteriori. In addition, the integrity of the peroneal and tibial nerves should be documented.

Evaluation of soft tissue injuries is also required. In periarticular fractures, the presence of phlyctenas secondary to the fracture may contraindicate early open reduction. The likelihood of compartment syndrome should also be considered. Pain disproportionate to the injury is the most reliable sign of the presence of compartment syndrome. If the difference between compartment pressure and diastolic pressure is less than 30 mm Hg, fasciotomy of all four compartments of the leg is indicated. Deep posterior compartment pressure may be increased in the presence of a soft superficial posterior compartment. Tibial fractures are associated with a high incidence of ligamentous injury. About 5% of all tibial fractures are bifocal, with two independent traces(7,8).

**Figure 2. Preoperative and intraoperative radiography and radioscopy of right tibia distal diaphysis fracture.**




**Source:** The Authors.

**Assessment**

Complementary examinations such as AP and lateral radiographs of the tibia showing the joint above and below, i.e. the knee and ankle, may be requested. CT scans are usually not necessary, however, they are often used to assess intra-articular lesions that extend to the tibial plateau. The medical evaluation of all surgical individuals should include basic tests such as complete blood count, BMP and PT/INR, as well as other complementary studies such as chest x-ray and electrocardiogram. In addition to the above mentioned it is essential to request imaging studies of the affected extremity, being the most common the AP and lateral radiography of the leg, which should include both the proximal and distal joint, sometimes other complementary studies such as tomography are necessary, however they are not usually requested. Elderly individuals with diagnosed or suspected cardiac disease may benefit from a cardiological evaluation prior to surgery.

One way to classify tibial fractures is to use the AO/OTA classification. The tibial diaphysis is denoted as bone segment 4. The fracture is considered A-simple fracture, B-wedge fracture, C-complex fracture. Despite the above, there are other sub-classifications of the AO/OTA classification system based on the location and presence of associated fibula fracture. In addition, there are other methods to classify this type of fractures, especially when they are exposed fractures, where the Gustilo-Anderson system can be used. Fractures can also be subdivided descriptively. The fracture can be open or closed. The location

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can be proximal, diaphysis or distal, or categorized according to the pattern: transverse, oblique, spiral or comminuted(9).

**Treatment**

In case of exposed fracture, the most notable factor in decreasing the rate of infection is the early administration of antibiotics. Bedside debridement of the affected individual and temporary splinting should be performed.

Acceptable alignment parameters:

- <5 degrees of varus/valgus.
- <10 degrees.
- >50% cortical apposition.
- <1 cm of shortening.
- <5-10 rotational deformity.

Alignment is acceptable when the fracture is within the parameters previously listed. In fractures with moderate displacement, closed reduction can be performed to achieve acceptable alignment. Non-operative treatment is an alternative depending on the type of fracture, for which a long leg cast is used(1,10,11).

In isolated, closed, low energy fractures with minimal displacement and comminution, the fracture can be reduced and the injury immobilized with an inguinopedic cast with progressive weight bearing. The knee should be immobilized in 0° to 5° of flexion to allow weight bearing with English canes as soon as the affected individual tolerates it, with progressive transition to full weight bearing between the second and fourth weeks. After 3 to 6 weeks it is possible to replace the inguinopedic cast with a suropedic functional cast or functional orthosis. Healing rates of about 97% have been reported, however, if loading across the fracture is delayed, delayed healing or pseudarthrosis may occur. Occasionally, ankle stiffness is evidenced, becoming the most common(7,8).

Within the surgical treatment, we find different alternatives to be used, depending on the individual case of each affected individual, some alternatives are described below.

**Intramedullary rod or nail.**

This is the most common treatment for diaphyseal fractures of the tibia. It is the treatment method of choice for closed fractures and low-grade exposed fractures. Intramedullary nails have the advantage of preserving periosteal vascularization and limiting soft tissue injury, as well as the biomechanical advantage of controlling alignment, translation and rotation. Therefore, they are the standard treatment for most fracture patterns.

- Locked nailing: provides rotation control; in comminuted fractures and fractures with significant bone loss, it is important to prevent shortening. If necessary, locking screws can be removed in the later stages of evolution to dynamize the fracture site.
- Non-locking nailing: this allows fracture impaction during weight bearing, but it is difficult to control rotation. Non-locked nails are less commonly used.
- Reamed nailing: this is indicated for most closed and open fractures. It achieves an optimal intramedullary fit of the fracture and uses larger diameter, stronger nails.
- Unreamed nailing: thought to preserve intramedullary vascularization in open fractures where the periosteal vasculature has been destroyed. It is currently used in high-grade open fractures. However, it has some disadvantages, such as the implant being significantly less strong than large reamed nails, as well as having a higher risk of fatigue failure. There is evidence that it is an acceptable treatment technique for closed tibial fractures(1,7,8).

**Internal fixation with open reduction.**

Can be used to treat tibial fractures, but is more common when the fracture extends to the articular surface or is not amenable to intramedullary fixation. It is usually left for fractures extending to the metaphysis or epiphysis. A healing rate of up to 97% has been reported. Although they present a rate of complications, such as infection, malpositioned healing, wound dehiscence and pseudoarthrosis(1,8).

**External fixation**

It is very useful in case of significant swelling and especially in extensive soft tissue damage. An external fixator is used as a temporary surgery until internal fixation can be performed if possible. Alignment should be performed as anatomically as possible with the external fixator because it can sometimes serve as definitive treatment in cases where the particular circumstances of the affected individual do not permit internal fixation. The external fixator or tutor is mainly used in severe open fractures, although it may also be indicated in closed fractures complicated with compartment syndrome, in addition to tibia fractures associated with cranioencephalic trauma or burns. Studies show a healing rate of up to 90%, with an average of 3.6 months to achieve healing. The incidence of infections in the fixator nail trajectory is around 10% to 15%(1,7).

**Irrigation and debridement.**

Necessary for all open lesions.

**Fasciotomies.**

Should be performed when compartment syndrome is suspected. A Stryker monitor can be used to measure compartment pressures, especially in sedated patients, otherwise the decision can be made with a classic compartment syndrome clinic (1,12,13).

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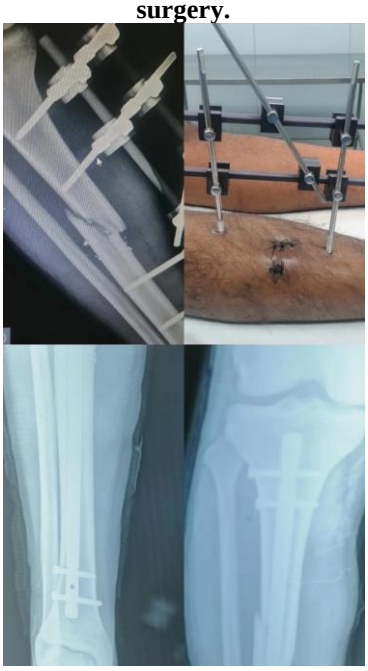
**Figure 3. Images of right tibial diaphysis fracture showing the use of external fixator for damage control and subsequent placement of intramedullary nail as definitive surgery.**



**Source:** The Authors.

**Proximal Tibia Diaphyseal Fractures**
They make up about 7% of all tibial diaphyseal fractures. They are difficult to stabilize with a nail because they are relatively frequently misaligned, being the most common deformity in valgus and with an angulation of the anterior vertex. Nailing often requires special techniques such as locking screws, placement of unicortical plates, intraoperative use of external fixators or a lateral entry point.

**Distal Diaphyseal Fractures of the tibia.**
The use of intramedullary nails is associated with a likelihood of malalignment. When using intramedullary nails, placement of a plate on the fibula or use of locking screws may improve malalignment.

**Tibial fracture with intact fibula.**
When a tibial fracture is not displaced, treatment consists of inguinopedic casting with early loading. Strict monitoring is required to detect any tendency to varus deviation. Some literature considers using intramedullary nailing even if the tibial fracture is not displaced. There is a risk of varus consolidation of about 25%, especially in individuals older than 20 years.

**Differential Diagnosis.**
Hematoma originating from direct trauma to the lower leg without fracture and compartment syndrome may be part of the differential diagnosis of the traumatic picture.

**Prognosis**
Following a tibial fracture, there is evidence that several affected individuals have an initial decline in function that gradually improves over 6 to 12 months. At five years, the functional score may not return to baseline. At 12-year follow-up after surgery by intramedullary nailing, persistent knee pain was noted in 73% and subjective leg swelling in 33%(1,14).

**Complications**
- Pseudarthrosis: usually defined as the inability of a fracture to heal without surgical intervention or the absence of radiographic healing after six months.
- Malunion: proximal tibial fractures, in particular, have a tendency to malalignment in the valgus deformity and anterior apex (procurvatum).
- Compartment syndrome: the first and most sensitive sign of compartment syndrome is disproportionate pain or pain with passive stretching. In addition the other classic signs are palpable swelling, pallor, absence of pulse and paresthesias, however, many of the other signs will form later. In children, the signs and symptoms of compartment syndrome are more anxiety, agitation and an increased need for narcotics.
- Anterior knee pain: this is the most frequent complication following intramedullary nail insertion(15-17).

## CONCLUSIONS
It is important to recognize the management of tibial fractures because of their relatively high incidence. It is not uncommon to encounter an exposed tibial diaphysis fracture, so it is essential to identify, as well as perform damage control and appropriate management. The individual should undergo a complete examination and it may be necessary to implement the trauma life support protocol. In this type of fracture it is crucial to assess the neurovascular situation. In addition, complementary examinations should be requested to allow the best diagnosis, classification and treatment of the injuries. The treatment of tibia diaphysis fractures will depend on the specific situation and the patient's condition; however, external fixators are usually used for damage control and later intramedullary nails are used. Tibial diaphysis fractures may be accompanied by compartment syndrome and other complications.

## BIBLIOGRAPHY
1. *Kazley J, Jahangir A. Tibia Diaphyseal Fracture. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Aug 26]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK537173/*
2. *Court-Brown CM, Hughes SPF. Hughes External Fixator in Treatment of Tibial Fractures. J R Soc Med. 1985 Oct;78(10):830–7.*
3. *Soni JK, Kulkarni S, Khodnapur G, Bagewadi R, Nandi SS. Management of Open Tibial Diaphyseal Fractures by Limb Reconstruction System As Primary and Definitive Treatment: A Prospective Cohort Study. Cureus [Internet]. 2023 May 31 [cited 2024 Aug 26]; Available from:*

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*https://www.cureus.com/articles/153394-management-of-open-tibial-diaphyseal-fractures-by-limb-reconstruction-system-as-primary-and-definitive-treatment-a-prospective-cohort-study*

4. *Weiss RJ, Montgomery SM, Ehlin A, Dabbagh ZA, Stark1, A, Jansson KÅ. Decreasing incidence of tibial shaft fractures between 1998 and 2004: Information based on 10,627 Swedish inpatients. Acta Orthop. 2008 Jan;79(4):526–33.*
5. *Larsen P, Elsoe R, Hansen SH, Graven-Nielsen T, Laessoe U, Rasmussen S. Incidence and epidemiology of tibial shaft fractures. Injury. 2015 Apr;46(4):746–50.*
6. *Gosman JH, Hubbell ZR, Shaw CN, Ryan TM. Development of Cortical Bone Geometry in the Human Femoral and Tibial Diaphysis. Anat Rec. 2013 May;296(5):774–87.*
7. *Koval KJ, Zuckerman JD. Fracturas y luxaciones. 2 ed. Madrid: Marban; 2003.*
8. *Bucholz RW, Heckman JD, Rockwood CA, Green DP. Rockwood & Green's fracturas en el adulto. Madrid: Marbán; 2003.*
9. *Marsh JL, Slongo TF, Agel J, Broderick JS, Creevey W, DeCoster TA, et al. Fracture and Dislocation Classification Compendium - 2007: Orthopaedic Trauma Association Classification, Database and Outcomes Committee. J Orthop Trauma. 2007 Nov;21(Supplement):S1–6.*
10. *Anderson LD, Hutchins WC, Wright PE, Disney JM. Fractures of the tibia and fibula treated by casts and transfixing pins. Clin Orthop. 1974;(105):179–91.*
11. *Sarmiento A, Gersten L, Sobol P, Shankwiler J, Vangsness C. Tibial shaft fractures treated with functional braces. Experience with 780 fractures. J Bone Joint Surg Br. 1989 Aug;71-B(4):602–9.*
12. *Melvin SJ, Dombroski DG, Torbert JT, Kovach SJ, Esterhai JL, Mehta S. Open Tibial Shaft Fractures: II. Definitive Management and Limb Salvage: Am Acad Orthop Surg. 2010 Feb;18(2):108–17.*
13. *Bhandari M, Guyatt GH, Tornetta P, Swiontkowski MF, Hanson B, Sprague S, et al. Current Practice in the Intramedullary Nailing of Tibial Shaft Fractures: An International Survey: J Trauma Inj Infect Crit Care. 2002 Oct;53(4):725–32.*
14. *Lefaivre KA, Guy P, Chan H, Blachut PA. Long-Term Follow-up of Tibial Shaft Fractures Treated With Intramedullary Nailing. J Orthop Trauma. 2008 Sep;22(8):525–9.*
15. *Bae DS, Kadiyala RK, Waters PM. Acute compartment syndrome in children: contemporary diagnosis, treatment, and outcome. J Pediatr Orthop. 2001;21(5):680–8.*
16. *Toivanen JAK, Väistö O, Kannus P, Latvala K, Honkonen SE, Järvinen MJ. ANTERIOR KNEE PAIN AFTER INTRAMEDULLARY NAILING OF FRACTURES OF THE TIBIAL SHAFT: A PROSPECTIVE, RANDOMIZED STUDY COMPARING TWO DIFFERENT NAIL-INSERTION TECHNIQUES. J Bone Jt Surg-Am Vol. 2002 Apr;84(4):580–5.*
17. *Willis RB, Rorabeck CH. Treatment of compartment syndrome in children. Orthop Clin North Am. 1990 Apr;21(2):401–12.*

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