Treatment of Open Tibial Fracture by Ilizarov External Fixator versus Unreamed Interlocking Nail

A Systematic Review of Literature

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

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List of Abbreviations

Abb.	Full term
AP	*Anteroposterior*
ASAMI	*Association for the study and application of the method of Illizarov*
DM	*Diabitus Mellitus*
DVT	*Deep venous thrombosis.*
EuroQol	*Europian Quality of life*
GA Classification	*Gustilo-Anderson classification*
IEF	*Illizarov External fixation*
IM	*Intramedullary*
Lat	*Lateral*
LLD	*Leg Length Discrepancy*
MIPO	*Minimally invasive plate osteosynthesis*
OM	*OSteomyelitis*
PE	*Pulmonary Embolism*
PTB Cast	*Patellar tendon bearing casting*
RCT	*Randomized control trail*
ROM	*Range of motion.*
RSD	*Reflex Sympathetic Dystrophy*
SD	*Standard deviation*
SE	*Standard error*
UTN	*Unreamed Tibial Nail*
VAS	*Visual Analog score.*

Abstract

``The objective of this study is to compare the radiographic results and clinical outcome of unreamed tibial nailing (UTN) and Ilizarov external fixation (IEF) for the treatment of open fractures of the tibia. Patients with open tibial shaft fractures were treated with an IEF or UTN. Both groups were compared for union time, nonunion, infections, mechanical failure of the implant, and malunion..

We searched numerous sources and eventually included studies, totaling participants.

Key word:

- Open Tibial Fracture
- Ilizarov External fixator
- Unreamed Interlocking Nail
- Systematic review

INTRODUCTION

The tibia is the most commonly fractured long bone owing to its location and the tenuous soft tissue coverage. The open type of fractures is showing an increasing trend due to road traffic accidents and firearm injuries [1].

Open tibial fractures are classified according to Gustilo-Anderson classification which has been the most widely used system and is generally accepted as the primary classification system for open fractures. This system classify open tibial fractures into 3 types (I,II, III) and type III is subclassified into IIIA,IIIB, and IIIC [(2-3)].

We will focus on surgical management of type II & type IIIA open tibial fractures.

The optimal treatment of severe open fractures of the tibia remains controversial although Ilizarov external fixators (IEF) and unreamed tibial nailing (UTN) have been used as treatment of choice for these fractures. [(4-17)] Modern day management of this injury has focused on primary care of wound including debridement of devitalized bone and tissue, removing any foreign material, washing the wound with saline, stay suture to cover any exposed bone if possible then sterile dressing is applied and splint is done and immediate bony stabilization to enable early mobilization and restoration of optimum function. [(18)]

The choice between UTN and IEF depend on pattern of fracture, degree of wound contamination & shape of wound after debridement.

Both techniques offer the advantages of minimum operative trauma, high union rates, and an early range of motion after surgical intervention.

There are potential advantages to using IEF, such as the ease of fracture reduction and the fixation of the fracture fragments that can be achieved with almost no soft-tissue exposure or blood loss. Moreover, this treatment does not leave implants in situ when the fracture is healed. The adjustment of the alignment with compression or distraction of the fracture fragments is easily performed both during and after primary surgical intervention and the fixator is stable enough to allow early weight-bearing irrespective to fracture type.(19)

The complications of treating open fractures of the tibia include infection, nonunion and malunion. The complication rate has been reduced following improvement in techniques to obtain primary soft tissue cover and wound healing, and improvement in techniques of fixation.

Aim of the Work

The purpose of this study is to systematically review the available evidence to compare clinical and surgical outcomes among patients undergoing fixation of open tibial fracture GII & GIIIA by Ilizarov external fixator (IEF) Versus Unreamed tibial nail (UTN).

Chapter 1

ANATOMY AND BIOMECHANICS

Anatomy

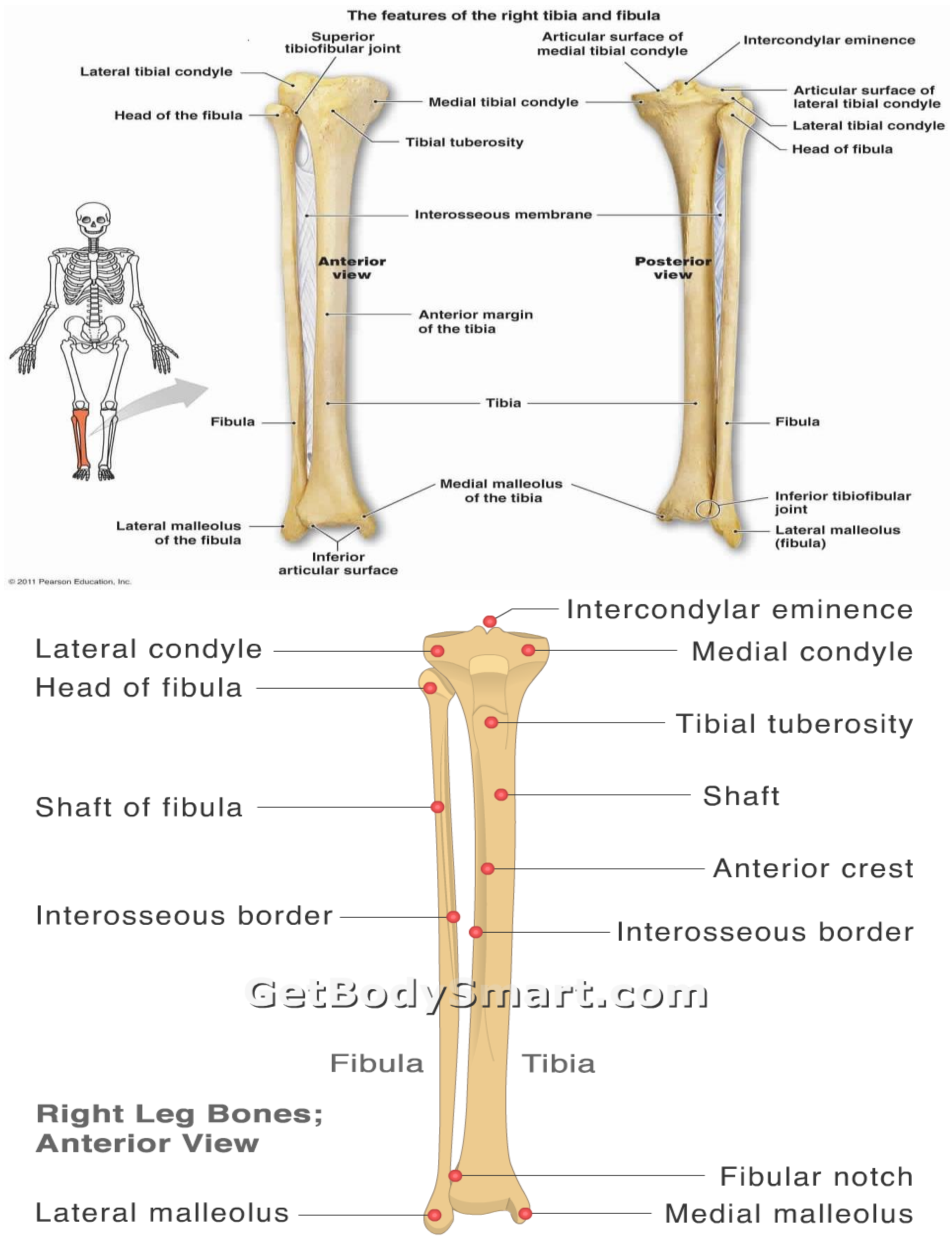

Fig. (1): Anatomy.

- The tibia is a long tubular bone with a triangular cross section. It has a subcutaneous anteromedial border and is bounded by four tight fascial compartments (anterior, lateral, posterior, and deep posterior).
- Blood supply: The nutrient artery arises from the posterior tibial artery, entering the posterolateral cortex distal to the origination of the soleus muscle. Once the vessel enters the intramedullary (IM) canal, it gives off three ascending branches and one descending branch. These give rise to the endosteal vascular tree, which anastomose with periosteal vessels arising from the anterior tibial artery. (20-23)
- The anterior tibial artery is particularly vulnerable to injury as it passes through a hiatus in the interosseus membrane.
- The peroneal artery has an anterior communicating branch to the dorsalis pedis artery. It may therefore be occluded despite an intact dorsalis pedis pulse. The distal third is supplied by periosteal anastomoses around the ankle with branches entering the tibia through ligamentous attachments.
- There may be a watershed area at the junction of the middle and distal thirds (controversial).
- If the nutrient artery is disrupted, there is reversal of flow through the cortex, and the periosteal blood supply becomes more important. (20,23) This emphasizes the importance of preserving periosteal attachments during fixation.

- The fibula is responsible for 6% to 17% of a weight-bearing load. Its major function is for muscle attachment. [24,25]

- The common peroneal nerve courses around the neck of the fibula, which is nearly subcutaneous in this region; it is therefore especially vulnerable to direct blows or traction injuries at this level.

Biomechanics[26].

a) Intramedullary nail I

An intramedullary (IM) nail acts as an internal splint to stabilize bone fragments. It is contoured typically to the profile of the bone.

Biomechanics of intramedullary nail

The IM nail is a cylindrical tube; therefore its stiffness is proportional to its radius to the fourth power. Therefore, a small increase in the radius has a big effect on the stiffness of the implant.

A solid nail is stiffer than a hollow nail of the same diameter. However, a hollow nail has a number of benefits.

- Less material is required to make a hollow nail than a solid nail. It is therefore also lighter.

- The central canal of the hollow nail can be used to guide the nail into position over a guide wire.

Hollow nails are therefore used routinely in the management of long bone fractures. The size of the central canal is carefully determined to limit the reduction in stiffness; although the outer radius of the nail has a far greater impact on stiffness than the thickness of the wall.

Biomechanics of bone–nail construct

Proximal and distal interlocking screws, referred to as ‘bolts’ in this role, provide rotational stability to the construct. Bolts are placed closer to the ends of the nail, which extends the zone of fractures that can be treated with a nail, but this is at the expense of construct stability. The rotational alignment of fragments is set when the first bolt is introduced into the second fragment after interlocking the first fragment. Bolts can be used in ‘static’ or ‘dynamic’ settings to control motion at the fracture.

The working length of the nail is the segment of nail around the fracture that is unsupported by bone. This is inversely related to construct stability:

- The nail is supported by bone where it is press-fixed to bone cortices, and the nail and bone both support the applied load. This is mainly in the diaphyseal region, where bone has the narrowest diameter, which therefore limits the maximum diameter of nail that can be used.

- The nail is not supported by bone at the fracture site, and the load is supported by the nail only. The nail is ‘off-loaded’ at