

## Treatment of Open Leg Fractures by Intramedullary Nailing

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### Abstract

**Introduction:** Open fracture is a loss of bone continuity that puts the bone in contact with the external environment through the wound. Open tibia shaft fractures are one of the most devastating orthopedic injuries. The aim of this current study is to analyze the results of the management of these series of recent open fractures of the leg.

**Patients and methods:** This was a retrospective study over a period of 18 months involving 27 cases of open fractures of the leg treated with intramedullary unreamed nailing. Type I and II of Gustillo Anderson open fractures were included in this study, and were treated at the hospital during the period of the study by this nailing technique. The cases included 20 males (74.8%) and 7 females (20.2%), and the average age was 31 years (17-60 years).

**Results:** The average duration of hospitalization was 16 days (12-30 days). On leaving the hospital, patients received the combination oxacillin-Lincocine oral antibiotics. The average time for bone consolidation was 115 days (90-140 days). Some complications were reported: 2 cases of secondary drifting of suture occurred postoperatively among 2 type II fractures. Local care and a secondary suture using U points led to wound healing without removal of the nail. A case of late infection occurred without impact on consolidation.

**Conclusion:** Treatment of open fracture of the leg remains controversial. But increasingly, the idea of an early internal fixation by intramedullary unreamed nailing is gaining ground.

**Keywords:** Intramedullary; Nailing; Open tibia fracture; Unreamed; Wound healing; Contamination

### Introduction

Open fracture of the leg is a communication between the external environment and the fracture and has been defined as injury of soft tissue complicated by a break of the bones of the leg. Major advances over the last century have moved the focus of management of such injuries beyond the preservation of life and limb to the concept of preservation of the function and complications Lange et al. [1]. According to their findings the frequency of open fractures observed in any area varied according to geographical and socioeconomic factors, population size and trauma delivery systems [2]. In their study the highest rate of diaphyseal fractures was seen in the tibia (21.6%), followed by the femur (12.1%), radius and ulna (9.3%) and the humerus (5.7%).

Moyikoua et al. reported that out of 150 open fractures of the limbs, 81% involved the lower limb with 50% being lesions on the leg [3].

There is little debate about the need for reduction and stable fixation in the management of open fractures. The type I fracture seen before the 8th hour may be treated in the same way as a comparable closed fracture. However, the Gustillo Anderson fractures II and III, often displaced and unstable, require surgical treatment. The restoration of the limb to its normal length, alignment and rotation as well as providing good stability make an ideal environment for soft tissue healing and greatly reduces the risk of wound infection. Locked intramedullary nailing has been established as the treatment of choice

for most diaphyseal fractures in the lower extremity [4-6]. The technique has a particular value for open fractures. Intramedullary nails can be inserted with no further disruption of the already injured soft-tissue envelope and preserves the remaining extra osseous blood supply to the cortical bone. There are few published studies on the African continent on the subject. Lelei et al. have used the SIGN intramedullary nailing in the treatment of forty-three open fractures in forty-one patients [7].

We carried out a retrospective study on 27 cases of open fractures of tibia shaft fractures treated by unreamed tibial nailing. The aim of this retrospective study was to analyze the results of the management of these series of recent open fractures leg.

### Patients and Methods

#### Patients

We studied 27 cases (20 men and 7 women) of open fractures of the leg treated in the orthopedics and traumatology Department of Lamordé Teaching Hospital.

#### Method

This was a retrospective study conducted from early November 2012 to May 31st 2014, i.e. 18 months.

Included in this study were Gustillo Anderson type I and II open leg fractures received in the orthopedics and traumatology Department 6

to 8 hours within their accident. These open leg fractures were stabilized with intramedullary unreamed nailing.

Excluded in this study were open leg fractures treated in the orthopedics and traumatology Department beyond the eighth hour from the accident, Gustillo Anderson type III open leg fractures, and open leg fractures treated by orthopedic methods, bone plate or external fixator.

The 27 patients in our study had received at their admission, extensive and careful washing with antiseptic and saline, with hydrogen peroxide, underwent surgical debridement, tetanus therapy and bi-antibiotherapy (Mespurin 2 g - Oxacilline 200 mg per kg of body weight per day). We reduced and contained the fractures by Kuntscher or locked intramedullary nails without reaming.

Fractures of the lower third of the tibia were treated with a locked intramedullary nailing. The locked nail was not possible on site (delivery on demand). These patients had a temporary restraining by plaster splint and the nailing was done between 7-8 days after admission.

We regularly examined all patients in the department within a minimum period of follow-up of 12 months. This monitoring was clinical, and para-clinical (blood count, C reactive protein, regular X-rays). All received at least 15 functional rehabilitation sessions. We assessed in each patient, mal-union, delayed union or non-union, early and delayed infection, joint stiffness, and leg length discrepancy.

## Results

There were 20 (74.8%) male patients and 7 (20.2%) female. The average age was 31 (17 to 60 years) years, the age group of 21 to 40 years accounted for 53.3% of the study population.

## Circumstances

Road traffic accident (RTA) was the main cause of the open leg fractures, i.e. 25 (92.5%) cases. In two cases (7.5%), it was due to a domestic accident. The two-wheeled vehicles were involved 21 times out of 27 accidents. 20 patients out of the 27 were taken to hospital by medical transport means (ambulance, firefighter), these ones had anti-septic cleaning and a compression wound dressing made aseptically at the accident site.

## The type of open fractures

The fractures were classified Gustillo type II and type I in respectively 20 cases (74.8%) and 7 cases (25.2%) (Figure 1).

## The location of the fracture

The fracture was located on the middle 1/3 in 12 cases, the lower 1/3 in 8 cases, and the upper 1/3 in 7 cases.

## The fracture line

The line was transverse in 13 cases (48.1%); oblique in 7 cases (25.9%), and spiral in 3 cases (11.1%), with a third fragment in 3 (11.1%) cases. In 1 case (3.8%) it was a bifocal fracture (Figure 2). The fractures involved the two bones of the leg 25 times out of 27.



**Figure 1:** Open type fracture 1 Gustillo channed emergency one hour after the accident.



**Figure 2:** Bifocal fracture open leg type 2 Gustillo.

## The surgery

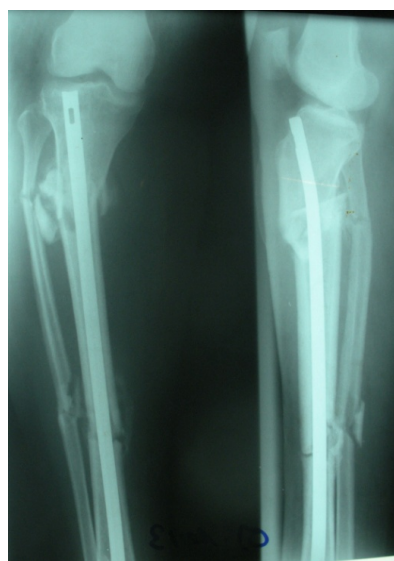
19 intramedullary nailing by unreamed Kuntscher nails were performed. These patients had an additional temporary

immobilization (for analgesia) with a long leg splint over a period of up to 10 days.

Eight intramedullary nailing by locked nails were done in 8 patients with fractures of the lower third of the tibia.

The average length of hospitalization was 16 days (12-30 days). On leaving the hospital patients received an oral combination of 2 antibiotics (Oxacillin 500 mg, de 2 capsule 3 times daily and Lincocine one tablet of 500 mg 3 times per day). The antibiotics were stopped when the CRP became normal and with complete wound healing.

The average time for bone consolidation was 115 (90-140 days) days (Figure 3).



**Figure 3:** Bifocal fracture of the processing results of the leg treated with intramedullary nail Kuntcher.

## Complications

Two cases of wound dehiscence occurred postoperatively in 2 type II cases. These were managed with local care and a secondary suture using U points leading to wound healing without removal of the nail. A case of late infection occurred in a bifocal fracture. The infection did not hamper the process of consolidation. After consolidation, the removal of the nail helped to control the infection. At the last follow-up, we reported no knee stiffness nor non-union of the open tibia fracture. The intramedullary nail was removed in 15 patients after a perfect healing and consolidation.

## Discussion

In developing countries, lower limb fractures are very common due to the large number of pedestrians and users of two-wheelers, who are mostly the young active patients. Thus in our series, the average age of the victims was 31 years (17 to 60 years). The age group of 21 to 40 years accounted for 53.3% of the cases. Road traffic accident (RTA) was the main cause of the open leg fractures in 25 cases (92.5%). These results are comparable to those reported by Moyikoua et al. [3] who found over 150 open fractures, 52% were open leg fractures, with a predominance of young men (72.8%) for 28.2% women. The cause of

open fracture was road traffic accident (RTA) in 56% of cases. The predominant circumstance was RTA especially among pedestrians and riders of two-wheels.

For Le Nen, the treatment of open tibia fractures remains a genuine challenge [8]. An adapted treatment in emergency, an anticipation of additional operating procedures remains paramount. According to Clary et al. open tibia shaft fractures are one of the most devastating orthopedic injuries [9]. Surgical treatment options include reamed or unreamed nailing, plating, Ender nails, Ilizarov fixation and another external fixation. For several years, we have applied the principle that the treatment of an open fracture of the leg is with the external fixator. But the external fixator does not only have advantages, it requires a long hospitalization, bi-daily care (to prevent infection), poor acceptability by the patients. We conducted a previous study on the management of open fracture of the leg by external fixator of Hoffmann Souma et al. [10]. We recorded in this study 6% of infections, 5 cases of nonunion with an average time of consolidation of 7.5 months (4-11 months). However, in our present study (open fractures fixed by intramedullary unreamed nailing), we have recorded only two cases of secondary wound dehiscence, and an average time of consolidation of 115 days (from 90 to 140 days).

The choice between reamed intramedullary nailing and unreamed for the treatment of open and closed tibia fractures is an ongoing controversy.

Thus, Clary et al. conclude their meta-analysis study by stating that current evidence suggests that intramedullary nailing may be superior to other fixation strategies for open tibia shaft fractures [9]. The use of unreamed nails over reamed nails also may be advantageous in the setting of open fractures, but this remains to be confirmed. Unfortunately, these conclusions are based on trials that have had high risk of bias and poor precision. Larger and higher-quality head-to-head randomized controlled trials are required to confirm thesis conclusions and better inform clinical decision-making.

Indeed, Bogdan et al. in their observational prospective study, which aimed to identify whether or not reaming of the tibia shaft fractures has benefits over unreamed locked intramedullary nailing, tried to highlight this dilemma [11]. Eighty-four adult patients with recent open and closed tibia shaft fractures were treated with reamed or unreamed intramedullary locked nail gold fixing. They were reviewed at their 12 months' follow-up, 39 of 43 patients in the unreamed and 38 of 41 patients in the reamed group, respectively. There were no significant differences between the two groups with respect to the average time to healing for both clinical (3.2 vs. 3.4 months,  $p=0.65$ ) and radiological (4.1 vs. 4.5 months,  $p=0.43$ ) evaluations. The mean duration of surgery was shorter ( $p=0.025$ ) for the unreamed group 43 min (SD 18) compared to 55 (SD 27), but the main determinants were the fracture type and the surgeon's experience. They concluded that reamed nailing proved beneficial, the profit impact on overall outcome is not superior to unreamed nailing.

Similarly, Deting et al. compiled six eligible randomized controlled trials. Three reviewers independently assessed methodological quality and extracted outcome data [12]. Analyses were performed using Review Manager 5.0. The results showed lower risks of tibial fracture nonunion and implant failures with reamed nails compared to unreamed nails in closed tibial fractures (relative risk (RR): 0.41, 95% confidence interval (CI): 0.21-0.89,  $P=0.008$  for nonunion and RR: 0.35, 95% CI: 0.22-0.56,  $P<0.0001$  for implant failures), but no statistical differences in risk reduction of malunion, compartment



syndrome, embolism and infection. They produced results suggesting no statistical differences in risk reduction of all the complications evaluated between reamed and unreamed nails in open tibial fractures. In their conclusion their study recommended reamed nails for the treatment of closed tibia fractures. However, the choice for open tibia fractures remains uncertain.

Furthermore, Seng et al. in their study on management of ballistic fractures in civil practice, stated that the use of internal fixation is not responsible for over-morbidity, provided, however the requirement to make debridement and washing should be adopted [13].

We treated our 27 open fractures based on this attitude which explains our satisfactory results in this series (Figure 4a and 4b).



**Figure 4a and 4b:** Results of treatment of an open fracture type 1 Gustillo locked intramedullary nail.

The shortcoming of our study is that we have voluntarily limited our case management to intramedullary nailing for the Gustillo type I and II open fractures; the type III were treated with external fixation systematically, even when the fracture was taken care of in the 6 to 8 first hours. This attitude is motivated by the fear of severe infectious complications.

Lelei et al. treated in the same tropical environment forty-three open fractures in forty-one patients using SIGN intramedullary nailing for the fracture stabilization [7]. All patients received surgical antibiotic and tetanus prophylaxis. Antibiotic therapy was maintained post operatively up to a period of two weeks. Thirty-seven (90.2%) patients turned up for follow up. Sixteen per cent had superficial infections which responded to antibiotic treatment and dressings. Four (11%) had deep infection (3 femurs and 1 tibia), 1 in Gustillo IIIB, 2 Gustillo IIIA and 1 Gustillo II. Exchange nailing was done in three patients and one patient had the nail removed and fracture fixed with an external fixator. This study shows good results of intramedullary nailing for grade I, II and IIIA-fractures. Given these good results of Lelei et al. we recommend treatment of these injuries by adequate debridement followed by immediate or delayed intramedullary nailing, especially when as in this case, the intramedullary nail is cheap (25 to 30 USD for the Kuntcher nail and 55 to 60 USD for the locked

intramedullary nail) whereas the cheapest external fixator is around 130 USD.

However, some authors Joyce et al. and Papakostidis et al. argue that the risk of developing a deep infection with intramedullary nailing of open fractures including Gustillo type III, can be reduced by the combination of systemic antibiotic treatment to direct local antibiotic therapy in wound [14]. These authors say that the combination of systemic antibiotics and direct antibiotics in the wound not only reduces the risk of infection, but also the risk of further surgery for other local complications, they made this observation in comparing a patient group that received systematic and local antibiotic therapy to another group that received only systemic antibiotic therapy. This idea deserves further consideration by randomized comparative studies.

Currently, there is no more debate on washing, surgical debridement in the management of open fractures, but on the other hand the choice of the fixation system remains controversial.

## Conclusion

With the advent of medical transport in the capital cities of our developing countries, internal fixation with intramedullary nailing is becoming feasible in the treatment of some recent open fractures. The first results are encouraging. It seems preferable compared to external fixation which has many disadvantages.

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