Primary Unreamed And Unlocked Intramedullary Nailing For Open Tibial Fractures

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Summary

Objective: The purpose of this study is to present our experience with the use of primary unreamed and unlocked nailing by the curved Küntscher nail for open tibial fractures.

Design: A retrospective study carried out between 1993 and 2003.

Setting: Department of Orthopaedics Surgery, Yopougon Teaching Hospital, Abidjan, Côte-d'Ivoire.

Patients and methods: A total of 154 open tibial shaft fractures in 149 patients were operated on by primary stabilisation with an unreamed and unlocked Küntscher nail. Postoperatively, patients wore a leg plaster cast.

Results: There were 124 men and 25 women with a mean age of 35 (16 to 72) years. Fractures were caused in the majority of cases (130 cases, 87.2%) by traffic accidents. Fractures were classified according to Cauchoix system into 96 grade I, 55 grade II, and 3 grade III. The duration of follow-up averaged nine (3 to 25) months. Infections (soft-tissue and bone) were encountered in 30 (19.5%) fractures. 113 fractures (86.25%) were primarily united with an average of 4.7 (two to six) months. Bone union was delayed for seven (5.3%) fractures. Eleven (8.45%) fractures developed nonunion. Malunion in valgus >10° was seen in three patients and in varus >10° in two. Rotational malalignment >10° was encountered in five patients.

Conclusions Our results suggest that in low-income countries, appropriate handling of traumatic wounds combined with simple methods of bone stabilisation such as Küntscher nail properly performed can lead to gratifying outcomes for surgeon and patient alike in the management of less severe open tibial fractures.

Key words: Küntscher, Open fracture, Tibia, Unreamed unlocked intramedullary nail

Introduction

Consensus on the optimal procedure of bone stabilisation, mainly the use of intramedullary nail with or without reaming for open tibial fractures has still not been reached. The different alternatives have their own pros and cons and accurate comparison with the various treatment options reported in the literature is open to questions. However, intramedullary nailing without reaming has become increasingly popular for the treatment of most open tibial fractures. In some developing countries, early debridement and unreamed interlocking nailing have emerged as important modalities for the management of open tibial fractures, since nails with interlocking capabilities and image intensifier are provided to surgeons.

In our service, the Küntscher nail is still available for the treatment of femoral as well as tibial fractures. This implant has been used by Shah et al. in Nepal until the second generation nails with interlocking capabilities were provided to them from 2000.

Because many cases of open tibial fractures are presented late to the emergency department in low-income countries, the results of the management of open fractures are likely to be different from those reported in the Western literature. This retrospective study describes our experience with the use of unreamed and unlocked intramedullary Küntscher nail while treating open tibial fractures, by focusing on primary results obtained employing this surgical implant with particular reference to infective complications, the worst and most dreaded complications of handling such fractures.

Patients And Methods

Patients

One hundred fifty-four open tibial shaft fractures in 149 patients were operated on in our department from 1993 through 2003 by primary stabilisation with an unreamed and unlocked tibial Kü-
ntscher nail. We included in this study shaft extra-articular fractures located 5 cm below the knee and above the ankle joints. Fractures as a result of a gunshot injury were excluded as it is unclear whether the majority of gunshot wound to the tibia can be classified like other open fractures and assigned to categories defined by Gustilo or Cauchoix. Patients who could not be operated on within the five days following the injury were also excluded. The severity of the open injury was determined with use of the classification of Cauchoix quoted by Ramadier et al. This classification focuses only on the skin wound (Table 1). There was no vascular injury. One hundred twenty-three (89.3%) of the 149 patients presented to emergency room within 24 hours of the injury.

Management protocol
The wound was covered with a sterile dressing as quickly as possible. But this dressing was sometimes removed before the patient was taken to the operating theatre. All patients received tetanus immune globulin and were given injectable cephalosporins and aminoglycosides. We kept using these antibiotics after surgery for three weeks and five days, respectively. Metronidazole was added for seven days. Operation was performed under general anaesthesia on an ordinary table. Tourniquet was not used during the debridement. As part of the debridement protocol, saline solution was used for irrigation copiously. In all cases osteosynthesis was performed with resort to open operative reduction of the fracture.

A transtendinous approach was always performed and the biggest diameter of nail possible used. The nail was driven in only by hammering. Wounds of grade I and most grade II were closed primarily over suction drain. In some fractures grade II closure was not free-tension so either a delayed primary closure or a free skin grafting was performed. Grade III fractures healed secondarily with free skin grafting. No flap procedure was performed in this series. At the completion of the procedure a leg cast with anti rotation for four weeks was applied in all cases. Patients with isolated leg fractures were mobilised on crutches. They were discharged non weight bearing and followed in the outpatient clinic. The below-the knee cast was worn for a mean of four weeks after the operating procedure. The time to weight-bearing was determined on the basis of the stability of the fracture, the progression of healing, the comfort of the patient, and the associated injuries. Patients who had multiple injuries were mobilised and discharged as soon as the other injuries allowed it.

Evaluation method
There was no protocol for routine follow-up of the patients. In general patients were seen every two weeks for a minimum of eight weeks after the injury and monthly intervals thereafter. The duration of follow-up averaged nine (three to 25) months. Sixteen patients were lost to follow-up and five died during the hospitalisation leaving 128 patients with 131 fractures for the final assessment. Infection, union, delayed union, non-union, and malunion were defined according to the criteria used by Shah et al. Superficial infection was defined as local erythema, which resolved with antibiotic therapy. Deep infection was defined as continuing wound drainage of pus or a positive bacteriological culture. Delayed union was defined as lack of significant union within six months postoperatively and nonunion as having no signs of union after eight months. Radiographic evidence of union was defined by the presence of bridging callus. Malunion was defined as a rotational deformity of more than 10°, an angulation deformity of more than 10° or shortening by more than 10 mm.

Table 1. Cauchoix classification for open fractures

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Small puncture or linear wound without skin contusion Closure without undue tension after debridement</td>
</tr>
<tr>
<td>2</td>
<td>Wound with skin contusion High risk of necrosis, closure under tension</td>
</tr>
<tr>
<td>3</td>
<td>Extensive loss of skin before or after debridement immediate skin wound closure impossible</td>
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Results

Injury data
Of the 149 patients, five had bilateral fractures. There were 124 men and 25 women with a mean age of 35 (SD: 4.9; range 16 to 72) years. Road traffic accidents had caused the injuries in 130 (87.2%) patients, 65 of whom were pedestrians, 28 motorcyclists, and 37 occupants of cars. Eleven (7.4%) patients had been injured at work. Falls while walking were the cause of fractures in three (2%) patients whereas five patients (3.4%) had been injured while playing basketball (n=1) and football (n=4). Forty-four (28.6%) fractures were within the proximal third of the tibia, 73 (47.4%) within the middle third, and 37 (24%) within the distal third. According to the Cauchoix classification, there were 96 (62.3%) grade I, 55 (35.7%) grade II, and 3 (2%)
important finding was the high incidence of the use of external fixators as definitive method of fixation. In another study performed in this country no patient with open tibial fractures had benefited from nailing procedure.

In selecting patients for intramedullary nailing in the event of open fractures, many factors that affect the outcome such as the severity of injuries to the soft-tissue should be considered. Indeed the incidence of infection, the most voiced concern of open fractures correlates directly with the extent of soft-tissue damage. There were few grade III fractures in the current series which were predictably more problematic. Reaming was not performed in open fractures as well as in closed fractures in our clinical practice due to the unavailability of all sizes of reamers. The plaster cast in addition to the nailing was designed to minimise or avoid mechanical complications related to fracture instability such as angulation into an unacceptable position. For unstable tibial shaft fractures, Graf et al had propose Küntscher nail after reaming followed by bracing using the Sarmiento technique. In their series made up of 51 patients, they had found one case of malunion in varus of more than 10°, five of shortening of more than 10 mm, and two of rotational malalignment of more than 10°.

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Nailing was not performed after reaming in our study but anatomical results gathered compared with those reported by these authors. Late delay in

<table>
<thead>
<tr>
<th>Table 2. Complication</th>
<th>Grade 1*</th>
<th>Grade 2</th>
<th>Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial early infection</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Deep infection</td>
<td>4</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Haematoma</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Delayed union</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Aseptic non-union</td>
<td>2</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Septic non-union</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Osteitis</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Shortening &gt;1cm</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Valgus &gt;10°</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Varus &gt;10°</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Rotational malignment &gt;10°</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Knee stiffness</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ankle stiffness</td>
<td>7</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Nail breakage</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Compartment syndrome</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Anterior knee pain</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

*: Classification of Cauchoox

grade III cases. The fracture pattern included transverse fractures (n=46; 28.6%), spiral (n=18; 11.7%), oblique (n=25; 16.2%), butterfly (n=28; 18.2%), comminuted (n=27; 17.5%), and segmental (n=10; 6.5%). Associated injuries were lower limbs fractures (n=30), upper limbs fractures (n=17), polytrauma, head and chest injuries (n=37).

Hospital data
Diameter of nail used was 8 or 9 mm (n=109), diameter =10 mm (n=45). Five cases of breakage of the posterior cortex during the insertion of the nail were noted. Wound healing was obtained at an average of 12 (three to 23) days. The average length of hospital stay was 15 (five to 70) days. Of the 131 fractures 113 (86.25%) were primarily united. In this group, bone union was obtained at an average of 4.7 (two to six) months. Bone union was delayed for seven (5.3%) fractures. Eleven (8.45%) fractures developed nonunion. Main complications are depicted in Table 2.

Discussion
The optimum treatment for open tibial fractures remains controversial in developing countries, with immobilisation using cast with or without pinning being carried out for the overwhelming of these lesions. The high costs of implants, the lack of availability of equipment for emergency situations, and the technical difficulties regarding use restrain the use of intramedullary nails. In the cross-sectional study conducted by Balbachevsky et al in Brazil, a medium-income country, the most
the surgical management of patients is a weak point in studies performed in developing countries. Patients presented to hospital as soon as possible but the surgical intervention was not performed from their admission for socioeconomic and logistic reasons. It is widely recognised that the time interval between injury and wound debridement is known to be a major prognosis factor but not an absolute contraindication to intramedullary nailing. In the study conducted by Joshi et al in India, 98% of their patients were operated on after 24 hours of the injury because of delay in setup. Infection occurred in six of 56 (10.7%) patients, all of which was in grade III open fractures according to Gustilo and Anderson. They recommended using unreamed locked tibial nailing for grade I and grade II open fractures of the tibia even with delayed presentation. In another series from India, the average time elapsed from time of injury until reaching the operating room was five days. The authors of this study comprising 36 cases had found three cases of infection, of which two superficial occurring in open grade II fracture and one deep infection in the setting of grade III fracture according to Gustilo & Anderson. The recommendations of Joshi et al are in line with those proposed by Ramadier et al from aggregating data from five orthopaedics departments located in the Paris area. They had used the same classification and performed osteosynthesis like us with the same implant. In their series constituted of 447 cases of nailing, the rate of infection was 3%. Even if the study by Ramadier et al was conducted in the 1980s, there is no doubt that patients were transported to hospitals soon after the injury and benefited from care in centres where many operating rooms were allocated to orthopaedics. The current report identifies infection as a continuing and very significant problem. To lower the infection rate which was 19.5% in our work, the following principles are relevant for the management of these fractures. First, a photograph of the open wound that helps to document its characteristics prior to the application of a dressing should be taken. The dressing can then remain undisturbed until the definitive surgical debridement is performed in theatre. Such practice reduces nosocomial infection.

Secondly, in our practice, we routinely favour primary wound suture. Primary closure in Gustilo grade I and II open fractures is frequently performed by most surgeons in Brazil. The rate of infection in this study was not available. This approach to wound management shows the need of a definitive initial treatment, minimising hospital costs. Suction drainage was often not efficient in our context. This situation leads to haematoma with the risk of infection. We should be used to leaving open the compound wound at the end of the procedure as recommended by several authors and close it secondarily according to the appropriate method of skin closure. This is by far the safest course of action because of the difficulty and the uncertainty of evaluating tissue viability in emergency situation.

Thirdly repeated debridement is therefore a way of assessing tissue viability. We are aware that any deviation from the regimen of treatment adopted in this work leads to incremental cost. Finally anatomical results can be improved if jig that enables interlocking as performed by Shah et al working in environment nearly similar to ours where there are scare resources is provided to us. In conclusion, since one of the main objectives of this study was to analyse the occurrence of complications, we can postulate that crude anatomical results were acceptable but one must become alarmed at the number of infective complications.

However following the aforementioned guidelines in the management of less severe open tibial fractures, appropriate handling of soft tissue lesions associated with simple methods of bone stabilisation such as Küntscher nail properly performed can lead to gratifying outcomes for surgeon and patient alike in low-income countries.

References


