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Open fractures of the lower limb in Nigeria

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Abstract During an 18-month period we studied prospectively 63 consecutive patients (42 males, 21 females) with an open fracture of the lower limb. Their mean age was 32 years (range: 4–78 years) and 58 patients with 59 fractures were available until the conclusion of the study. Forty-seven had tibial fractures, 12 had femoral fractures and the majority of the patients were either students or traders. According to Gustilo and Anderson's grading, 21 fractures were of type II and 16 of type IIIA. On arrival all the wounds were irrigated and debrided and the patients also received tetanus prophylaxis and intravenous antibiotics. Of the 47 tibial fractures 39 were managed with an above-knee plaster of Paris cast which was windowed so as to allow wound care. Of the 12 femoral fractures ten were treated with skeletal traction on a Bohler frame. The time taken for soft tissue healing was not significantly different between the tibial and femoral fractures. There were, however, significant differences with respect to (1) the time interval between injury and debridement, (2) the incidence of wound infection, (3) the occurrence of osteomyelitis, (4) fracture union time, and (5) time spent in hospital. The most common complications were wound infections (27 cases) and delayed union (26 cases). The time interval between injury and wound debridement was a major prognostic factor.

Résumé Pendant une période de 18 mois nous avons étudié 63 patients (42 hommes, 21 femmes) présentant des fractures ouvertes du membre inférieur. Leur âge moyen était 32 ans (4–78 ans): 5 des patients ont été perdus de vue et 58 patients avec 59 fractures ont été étudiés; 47 patients avaient des fractures du tibia, tandis que 12 avaient des fractures du fémur. Les étudiants et les commerçants représentaient la majorité des cas. En utilisant la classification de Gustilo et Anderson: 21

fractures étaient de types II et 16 de type IIIA. Tous les patients ont reçu une prophylaxie anti-tétanique, des anti-biotiques par voie veineuse et le débridement et l'irrigation des blessures. 39/47 des fractures du tibia ont été immobilisées par un plâtre cruro-pédieux, fenêtré pour permettre les soins locaux. La traction tibiale sur cadre de Böhler a été utilisé pour 10/12 fractures du fémur. La durée de cicatrisation des parties molles n'était pas différente selon la localisation au tibia ou au fémur. Par contre il y avait des différences significatives en considérant: (1) l'intervalle de temps entre l'accident et le débridement; (2) l'incidence de l'infection des plaies; (3) l'occurrence de l'ostéomyélite; (4) le temps de consolidation des fractures et (5) la durée d'hospitalisation. Les complications communément observées étaient les infections des plaies (27 cas) et le retard de la consolidation (26 cas). Le délai entre le traumatisme et le parage de la plaie était un facteur majeur de pronostique.

Introduction

The aims of treatment for open fractures include achieving sound bone union, avoiding infection and regaining full functional recovery of the limb [8, 13]. The basis of treatment includes immediate, meticulous and repeated wound debridement with copious irrigation using normal saline, stabilisation of the fracture, 'closure' of the wound, early parenteral administration of broad-spectrum antibiotics, and early bone grafting when indicated [2, 6, 7, 13]. Patterns of fractures vary within different communities as their occurrence depends on the type and the 'speed' of activities in the area. Similarly, the outcome of treatment will depend on the type of care given to the patient [6, 7, 10, 13].

The aim of this study was to determine the pattern of open fractures of the long bones of the lower limbs presenting to our hospital. It has also helped us to understand the problems they present and to improve our management of these difficult injuries.

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Patients and methods

This was a prospective hospital-based study with patients recruited during a period of 18 months. Patients presenting with open fractures of the femur, tibia or fibula were included. Patients who were not included, however, were those with pathological fractures, those who did not know when their injury had occurred, those who had received their initial wound debridement before arrival at our hospital, those with intra-articular fractures and those who required lower limb vascular repair. A total of 63 patients who fulfilled the inclusion criteria were initially entered into the study but unfortunately four (three tibial and one femoral fracture) were lost to follow-up. Thus we were able to study 58 patients with 59 open fractures. There was one example of combined ipsilateral femoral and tibial fractures. The protocols for the treatment of these fractures were established prospectively and followed with only minor alterations.

The guidelines were as follows: all open fractures were to be treated as surgical emergencies; wound swabs were to be obtained for culture and sensitivity tests before commencement of antibiotics and whenever there was established suppuration; plain radiographs were to be taken of the affected long bones after temporary splintage; anti-tetanus prophylaxis as well as ampicillin, cloxacillin and gentamicin were to be given in divided doses for 72 h in order to cover a broad spectrum of micro-organisms; the importance of thorough wound debridement and copious fluid irrigation was emphasised; wounds that could be cleaned adequately by surgical debridement were to be closed primarily; dirty and contaminated wounds were to be closed by delayed primary wound closure after they had responded to appropriate repeated wound debridement and irrigation and had become sufficiently 'clean'; the methods for stabilising the fractures included plaster of Paris, proximal skeletal traction, Steinmann's pins incorporated in a plaster of Paris cast, and external fixation.

We analysed the outcome of treatment in respect to the speed of fracture union and the presence of complications. Fracture union was assessed clinically and radiologically at 6 weeks and 3 months and then subsequently at monthly intervals. The fracture was considered to have united when there was no pain, tenderness or abnormal movement at the fracture site and when bridging callus was visible on a radiograph. Delayed union was recorded when the fracture united between 4 and 6 months, while non-union was noted when union had not occurred after 8 months of treatment. All our patients were followed up for at least 12 months.

The results were analysed on a computer using the SPSS (statistical package for social scientists) software, release 5.0.

Results

Of the 59 'cases' in the study 47 had open tibial fractures and 12 had open femoral fractures. The average age of the patients was 32 years (range: 4–78 years). There were 40 males and 18 females. The majority of the patients were students (16) or traders (15); the others were mainly artisans and a few were civil servants.

Motor vehicle accidents were the major cause of open fractures and accounted for 35 of the cases. Both sides were equally affected. The majority of the fractures (25) were comminuted, and there were 15 oblique, 14 transverse and only two segmented fractures. In 26 cases the distal third of the tibia was involved, in 14 it was the middle part and in seven the proximal part. Of the femoral fractures, five involved the proximal part, four the middle part and three involved the distal third.

According to the Gustilo-Anderson classification of open fractures [6], type II and type IIIA were most fre-

Table 1 Complications in the open fractures

Complications	Tibia (n=47)	Femur (n=12)
Compartment syndrome	2	0
Delayed union	18	8
Limb length discrepancy	3	1
Wound infection	24	3
Malunion	5	1
Non-union	5	2
Osteomyelitis	9	1
Pin tract infection	4	2
Fracture re-displacement	7	0
Others	8	2
Total	85	20
No complications	12	2

quent in the tibia with 16 and 15 cases respectively. There were eight of grade I and the same number of grade IIIB. In the femur there were five examples of grade I and grade II.

Wound debridement was performed in all the patients. Sequestrectomy was necessary in eight tibial fractures and one femoral fracture where osteomyelitis had developed. Fasciotomy, partial fibulectomy and bone grafting were necessary in two cases. Tibial fractures required all four procedures. A partial fibulectomy was performed in open tibial fractures with intact fibula.

An above-knee plaster of Paris case was the most common method of stabilisation for tibial fractures (39 cases) but of these seven suffered re-displacement of the fracture which required re-manipulation. Proximal tibial skeletal traction was used for 11 of the 12 femoral fractures. One femoral fracture and six tibial fractures were immobilised by external fixation.

Table 1 shows the results of treatment in terms of fracture union and complications. There were seven examples of non-union, 26 of delayed union, six of angular malunion and four of shortening. The average time for fracture union in tibial fractures was 20 weeks (range: 8–36 weeks) and in femoral fractures it was 17.5 weeks (range: 10–32 weeks). Fracture union time was significantly shorter in the open tibial fractures ($P=0.002$) whereas there was no significant difference in the wound healing time between the tibial (6.7 ± 5.1 weeks) and the femoral (7.2 ± 5.1 weeks) fracture groups. The duration of the hospital stay in the tibial group (8.6 ± 6.3 weeks) was significantly shorter than in the femoral group (20.0 ± 6.3 weeks). The occurrence of more severe wound infection and osteomyelitis in the tibial and femoral groups was related to a 'higher' Gustilo and Anderson grade of the open fracture [6]. The average delay between injury and debridement in the cases with wound infection occurring in the tibial and femoral groups was longer (7.8 ± 3.8 h and 13.7 ± 4.0 h, respectively) than in those without infection in the tibia (6.1 ± 3.2 h) or the femur (5.1 ± 2.1 h). These differences were significant ($P=0.008$).

Wound infection was the most common complication with *Staphylococcus aureus* being cultured in 13 wounds and coagulase-negative *Staphylococcus* in 14. Gram-negative rods (*Proteus mirabilis*) were isolated from nine

patients and *Pseudomonas aeruginosa* from eight. Multiple organisms were commonly isolated from the wounds but all were very sensitive to gentamicin, cloxacillin and ofloxacin.

Other complications were wasting of the quadriceps, oedema and ankle stiffness and these were controlled with limb elevation, the use of tubigrip and active exercises.

Discussion

The most common cause of morbidity and mortality in the most productive period of life world-wide is a road traffic accident [5, 10] and this accounted for 71% of the fractures in our study. It is not surprising, therefore, that open fractures of the femur and tibia were most common in people aged between 20 and 50 years. Our sex ratio also agrees with other reports [10] and further emphasises the greater vulnerability of males to trauma.

In our study the tibia was more frequently involved than the femur and, in previous reviews at our hospital, Alabi [1] has recorded 23 open fractures out of 83 fractures of the tibia while Oginni et al. [9] recorded an incidence of only four open injuries in a series of 71 femoral fractures.

The treatment given to our patients was standard as regards wound debridement and antibiotic prophylaxis. The removal of foreign material and other contaminants as well as excision of devitalised tissues is crucial in avoiding wound infection [7, 8, 10, 11, 13] and should be done no later than 6 h after injury. However, delay in presentation was a problem in our patients and the average time interval between injury and wound debridement was about 6 h. Delayed wound debridement was due mainly to late presentation at the hospital rather than to any delay while in hospital. However there is a need to provide an efficient ambulance service along with improved communications in order to ensure prompt transfer of injured patients to hospital. It is hoped that our proposed National Health Insurance Scheme will substantially address this problem.

The next most common complication we encountered was delayed fracture union. This is a common problem with open fractures especially when in the tibia which may take 6 to 12 months to unite [1]. The incidence of delayed union of 44% in this study is rather high when compared with most other studies where an average incidence of 26% has been reported [4]. Adequate maintenance of reduction was also a problem in our patients because when a large window was cut in a plaster cast, the immobilisation provided could not always prevent rotational movement or actual displacement of the fracture and possibly allow soft tissue interposition. A plaster cast with an appropriate window was the method most often used for fracture splintage in our study because it is cheap and readily available. The same reasons apply to regular use of skeletal traction for femoral fractures.

External fixation is best for grade II and grade III open tibial fractures as it provides stable reduction and easy access for wound care. In practice, most of these wounds are dressed regularly until it becomes possible to

effect secondary closure by skin grafting. However, with the advances in reconstructive surgery close cooperation with plastic surgeons will often expedite wound closure, and this is another area of care that can be improved further in our environment.

In conclusion, of our 59 open fractures only 14 healed without complication while over 75% were complicated and this is a very high proportion. Out of a total of 105 complications the most common were wound infection, delayed fracture union and osteomyelitis. This high morbidity can lead to a longer hospital stay, increased cost of care for patients and increased loss of working hours [3, 6, 12, 14]. This may have a serious economic consequence to the families of the affected patients as over 75% of our patients were workers and there is no social security provision for most Nigerians. Prompt transport of accident victims to centres equipped for prompt and appropriate treatment will go a long way toward reducing the morbidity and mortality of open fractures. The conventional methods of treatment used for these patients were associated with a higher incidence of delayed union and a longer hospital stay for patients with open femoral shaft fractures despite their better wound grading.

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