



Management of Open Fractures in Low-Income Countries: A Daunting Task

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Abstract

The management of open fractures was a challenge from antiquity to the present day. The objective of this study is to report the difficulties of the management of open fractures of long bones in low-income countries. This was a prospective study of the files of patients admitted for open fracture of long bones in the Department of Orthopedic Surgery and Traumatology of the Anosiala University Hospital Center for four years. Forty-two open long bone fractures were collected. The average age of the patients was 36.3 years of which 73.8% were subject of working age in the age group of 20 to 60 years and 73.8% of the cases where following the accident of the road. Most of the wounded had arrived at the hospital by bush taxi. The tibia was the most affected bone (71.4%). Gustilo IIIA type open fractures were the most observed (38.1%). Only 26.3% of patients had received surgical debridement before the sixth hour. 76.2% had no care before arriving at the hospital, 14.3% had emergency care at the basic health center and 9.5% were already being treated by the traditional healer. Definitive treatment of the fracture was dominated by the external fixator (38.1%) and orthopedic treatment (26.2%). In low-income countries, the management of open fractures remains a daunting task. The main factors limiting the management of open fractures were the poverty of the population, the lack of health insurance coverage, and the retard in arriving at the hospital.

Introduction

The management of open fractures has been a challenge from Antiquity to the present day for the orthopedic surgeon (Giglio et al., 2015). Due to the exposure of the fracture site to the environment, there is an increased risk of infection, non-union, delayed union, neurovascular complications, and increased amputation rate (Odatuwa-Omagbemi, 2019). The standard principles that must be followed to achieve a satisfactory result in the management of open fractures are good wound irrigation, complete debridement, appropriate antibiotic coverage, and early bone stabilization (Odatuwa-Omagbemi, 2019). Despite advances in orthopedic surgeries, access to modern medicine is still limited in low-income countries and the management of open fractures remains a great challenge for the Malagasy orthopedic surgeon. The objective of the present study is to report the difficulties of the management of open fractures of long bones at the Anosiala Antananarivo University Hospital Center (CHU Anosiala).

Methods

This was a prospective study of the files of patients admitted for open fracture of long bones for four years from January 2016 to December 2019 in the Department of Orthopedic Surgery and Traumatology of CHU Anosiala. Included in this study were all patients admitted with an open fracture of long bones, and not included closed fractures, open fractures of the bones of the foot and hand. The parameters studied were: age, gender, cause of trauma, treatment received before arriving at the hospital, means of transporting the injured to hospital, time between accident and debridement, definitive treatment of the fracture.

The general guidelines for the care of patients in our center were as follows: First, in the Emergency Department the injuries were clinically assessed by the emergency doctor to rule out life-threatening emergencies, then the wound was subjected to simple cleaning and in place of a sterile dressing. Administration of the antibiotic Amoxicillin-Clavulanic Acid and anti-tetanus prophylaxis was performed on admission. Surgical management included debridement and systematic washing of the wound regardless of the type of skin lesions, skin closure was done for all fractures if it was possible without tension. Definitive stabilization of the fracture was performed according to the surgeon's practice, the available implant, and the socio-economic class of the patient.

The osteosynthesis materials available in the hospital were the Hofmann-type external fixator placed free of charge to patients who agreed to make a letter of commitment to hand them over. Screw plates, Kuntscher's nail intramedullary, Kirchner's pins, and Locked nail intramedullary since 2019; their costs were all the responsibility of the patient (Figure1).

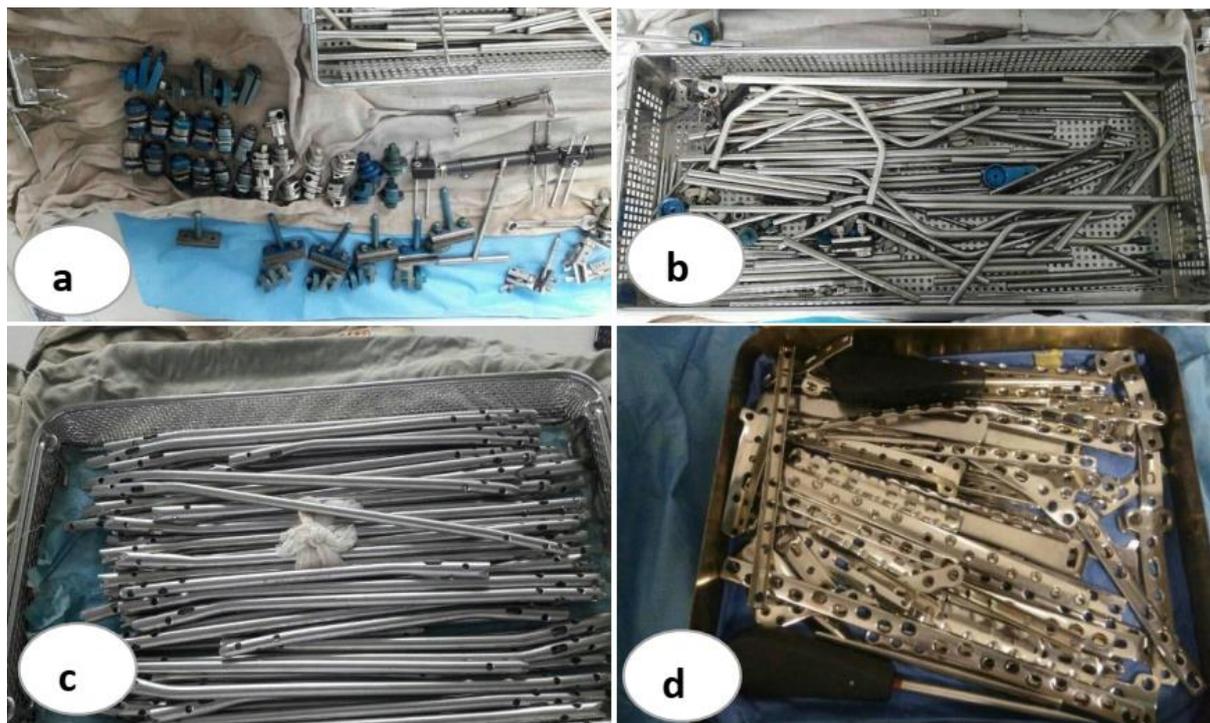


Figure 1. Materials available at the hospital: (a) (b) external fixator, (c) locked nails, (d) plates

The Gustilo-Anderson classification was used to classify tissue damage (Kim et al., 2012). The data were recorded on Microsoft Excel 2013 software then processed and analyzed with Epi-info 7.0 software.

Result and Discussion

Forty-two open fractures of long bones were collected on 42 patients' records. The average age of the patients was 36.3 years of which 73.8 % were subject of working age in the age group of 20 to 60 years. There is a male predominance with a sex ratio of 3.2. 73.8 % of the

cases were due to traffic accidents. For the transport of patients to the hospital, no injured were transported by the ambulance, 69 % were transported by the bush taxi, 21.4 % by the personal car, and 9.5 % by the city taxi. The tibia was the most affected bone (71.4%; n = 30), followed by the forearm bone (14.3 %; n = 6), the femur (9.5 %; n = 4), the humerus (4.8 %; n = 2). According to Gustilo's classification, type IIIA was the most observed (38.1%) and type II (31 %). The time between the accident and arriving at the Emergency Department varied from three hours to five days. Only 26.3 % of patients had received treatment before the sixth hour of the trauma and 73.7 % were after the sixth hour. Before arriving at the hospital, 76.2 % (n = 32) had no care, 14.3 % had emergency care at the basic health center and 9.5 % were already treated by the traditional healer (Figure 2).



Figure 2. Open Fracture of the Bones of the Forearm, Arriving at the Hospital Five Days after the Injury

Definitive treatment of the fracture was dominated by the external fixator and orthopedic treatment (Figure 3).

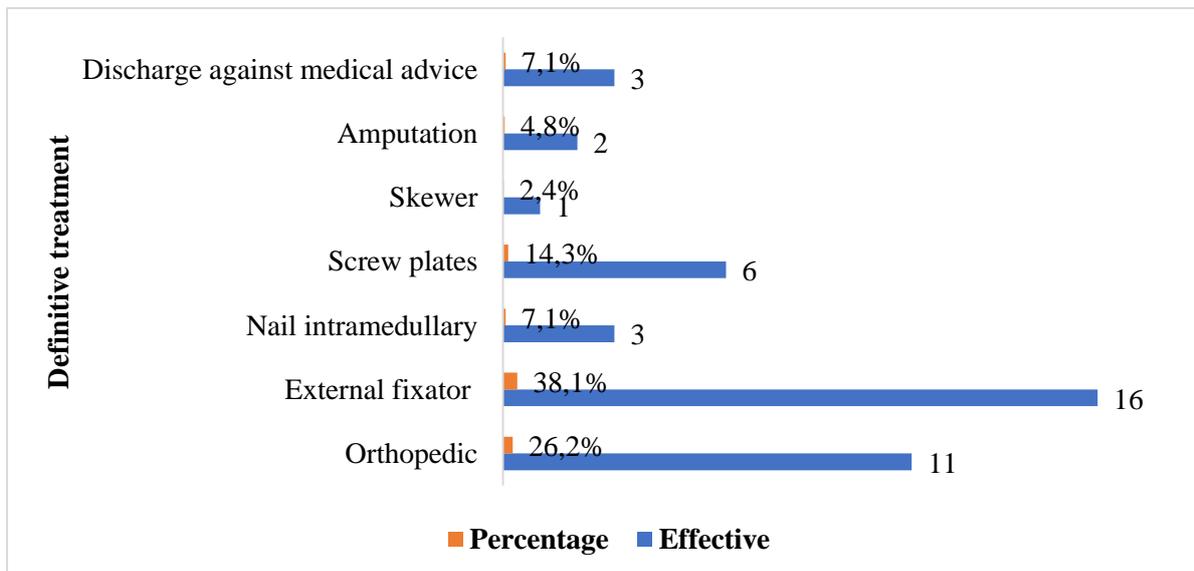


Figure 3. Definitive treatment of the fracture

Despite the enormous progress in orthopedic surgery, the management of open fractures has been a challenge from Antiquity to the present day (Giglio et al., 2015). Open fractures are always associated with significant morbidity and disability (Halawi et al., 2015). The standard principles that must be followed to obtain a satisfactory result in open fractures are good wound irrigation, complete wound debridement, appropriate antibiotic coverage, and early bone stabilization. Other factors that certainly play a role important are the timing of the initial surgery, early wound closure, method of fixation, and treatment of wounds with negative pressure or vacuum-assisted closure (VAC) (Bhat et al., 2019). Access to modern medicine is still limited in sub-Saharan Africa, Mathieu et al. (2014) said that the main reason is the lack of

local medical facilities and the difficulty of travel due to poor roads, limited means of transport in rural areas, and the poverty of the general population including the urban population making it difficult to pay hospital costs (Mathieu et al., 2014).

Primary assessment and management of patients. In Madagascar, functional emergency medical services are often non-existent and patients did not receive care at the scene of the accident. The wounded were rarely brought to the hospital by medical transport, most of the wounded arrived at the hospital either by bush taxi or by city taxi so they arrived late in the Emergency Department. In this study, 69% of the wounded were transported by bush taxi because our hospital is located 17 km on the outskirts of the city center of the capital. In emergencies, the injured were taken care of according to the principles of the Advanced Trauma Life Support (ATLS). The principles of ATLS are that the injured should be assessed and dealt with appropriately. Having such major musculoskeletal injuries suggests that these patients suffered high energy trauma, so proper assessment and management is paramount to identifying any other potential life-threatening threats. The resuscitation priorities remain the same. Careful examination of the wound can be performed after ruling out life-threatening emergencies (Henry, 2018). Antibiotics and tetanus prophylaxis which should be assessed based on the patient's vaccination history should be administered urgently (Ferris de Assunção et al., 2020).

Regarding antibiotic prophylaxis, the British Orthopedic Association and British Association of Plastic, Reconstructive, and Aesthetic Surgeons (BOA / BAPRAS) guidelines suggest the start of broad-spectrum antibiotics within three hours of injury, which should continue until at the first debridement (Elniel et al., 2018). For the duration of the antibiotic, a recent meta-analysis carried out by Messner J et al in 2017 did not show a significant difference in the incidence of septic complications with a treatment prolonged more than 72 hours or of short duration less than 72 hours (Messner et al., 2017). Regarding the local antibiotic, the results of a meta-analysis on "The effect of local antibiotic prophylaxis during the treatment of open fractures of the limbs" carried out by Morgenstern M et al in 2018 suggest a strong reduction in the risk of infection with the use of additional local antibiotics; they found that open fractures that received local antibiotic prophylaxis had an infection rate of 4.6%, while open fractures treated with standard systemic prophylaxis alone had an infection rate of 16.5% (Morgenstern et al., 2018).

Early and accurate wound debridement is the most important surgical procedure for open limb fractures, it involves excision of all devitalized tissue except the neurovascular bundles (Griffin et al., 2012). Logically, primary assessment and debridement should be done as soon as possible after injury and traditionally within six hours following a philosophy that the earlier bacterial contamination is reduced (Diwan et al., 2018). The respect with the six-hour rule remains difficult in our context, 73,7 % of our patients were treated after the sixth hour. The main reasons are, functional emergency medical services are often non-existent and the injured arrive late in hospital, families waiting to buy, remoteness geographical with poor road conditions making it difficult to travel, and first resort to traditional healers. Currently, the six-hour rule does not show a clear evidence base regarding surgical debridement. Many studies do not show significant differences in the incidence of infection, whether debridement is performed early or delayed (Konbaz et al., 2019). Kamat (Kamat, 2011) found an infection rate of 11 % for patients brought to the operating room within six hours and 12 % for those who brought in after six hours. Singh et al. (2012), in their study on "The relationship between the time to surgical debridement and the incidence of infection in open grade III fractures" had found a 13,1 % rate of those who had benefited from a surgical treatment within six hours and 10.8% of those who received it after six hours.

Definitive stabilization is done either by external fixators or by internal osteosynthesis. In this study, the methods of definitive stabilization of the fracture were very variable because they

were dictated by the experience and the habit of the surgeon, the availability of implants, and especially the patient's ability to buy the implants adapted to his type of fracture. . Regarding the external fixator, it was the most widely used implant. This type of implant was neither cheap nor easily available, but our hospital is equipped with free Hofmann type external fixators, this implant is placed to patients who agree to make a letter of commitment to submit it to the ablation of materials and who did not have the means to buy the implants for the ideal fixation of their fractures. Currently, the use of external fixators is no longer a mainstay in the definitive management of open fractures due to the high rate of infection of the pin site and the potential risk of vicious callus (Elniel et al., 2018) and it does not provide adequate mechanical stability of the fracture (Ifesanya et al., 2012). Griffin et al., (Griffin et al., 2012) suggested the external fixator for definitive stabilization of fractures is better when there is a significant amount of bone loss.

Regarding internal fixation, the screw plates, the Kuntscher's nail intramedullary was the type of nail used before 2019, the locked nail intramedullary was available in our center since 2019 and the skewer were the materials of internal osteosynthesis available in our center. The cost of these implants is all the responsibility of the patient, therefore the indication of their use was limited by the socio-economic level of the patients who most could not afford to buy them. For this reason, the screw plates were only used in 14.3 % of all fractures and of 7.1 % nail intramedullary. For Ifesanya et al (Ifesanya et al., 2012), screw plates were the most used (39.8%) regardless of the type of lesions but with an average expectation of 73.5 days. Singh et al. (2018) in their study on the analysis of the rates of infection and nonunion in open fractures of the tibia Gustilo IIIB did not observe any difference in the time the union between intramedullary, extramedullary implants, and the external fixator used as the final fixation, and no difference was also observed in terms of infection (Singh et al., 2018).

Orthopedic treatment a little indication for the definitive treatment of open fractures in adults due to the difficulty of wound monitoring and the literature does not speak of orthopedic treatment of open fractures in adults; unfortunately, he was in second place for the definitive treatment of the fracture in this study. In contrast, in children, a study non-operative treatment of pediatric type I open fractures appears to be safe (Bazzi et al., 2014).

For soft tissue reconstruction, in this context, to minimize patient expense, primary closure was performed if possible if not directed wound healing with fatty dressings was performed as most patients did not have the means to go back to the block for the secondary closure. Although a large number of current studies have shown the extreme effectiveness of therapy with negative pressure dressings (VAC) to aid in the healing of wounds, non-healing ulcers, and soft tissue defects (Bhat et al., 2019), this device was not available in our hospital and in to be able to do so the patient has to order from a foreign country usually in France and the majority of patients cannot afford this expensive modern equipment. Skin coverage for open fractures is another topic with a diversity of opinions. One option is to perform immediate primary closure in small, lightly contaminated wounds, provided there is no tension on the wound edges; if not, it could be delayed 48-72 hours; second-line closure is rarely performed but has recently shown better results (Giglio et al., 2015). In the study Moola et al., (2014), time to closure was not significantly associated with postoperative development of infection.

According to this study, although studies are being done to improve the management of open fractures, the achievement of some recent recommendations was limited in Madagascar. Many factors limit the good management of open fractures in our center like all developing countries one of the main causes of which is that most of our patients are poor and do not have health insurance coverage. Apart from that, the delay in arriving at the hospital either because of the geographical distance with poor road conditions, or the first resort to traditional healers for the population in rural areas and the scarcity of medical services emergency functions in urban areas.

Table 1. Recapitulation of the results and Discussion

	OUR STUDY	LITERATURE	ISSUES IN OUR CONTEXT
Primary management of patients	<ul style="list-style-type: none"> Following the principles of ATLS 	<ul style="list-style-type: none"> Recommends the principles of ATLS (Henry, S., 2018) 	<ul style="list-style-type: none"> Absences from functional emergency medical services 76.2% of patients had no care before arriving at the hospital
Antibiotic prophylaxis	<ul style="list-style-type: none"> Administration of antibiotics and anti-tetanus prophylaxis given on admission. 	<ul style="list-style-type: none"> The BOA / BAPRAS guidelines suggest the start of broad-spectrum antibiotics within three hours of injury, which should continue until the first debridement (Elniel et al., 2018). 	<ul style="list-style-type: none"> The time between the accident and arriving at the Emergency Department varied from three hours to five days, only 14.3% had emergency care at the basic health center
Debridement of the wound	<ul style="list-style-type: none"> 73.7% of our patients were treated after the sixth hour 	<ul style="list-style-type: none"> Should be done as soon as possible after injury and traditionally within six hours (Diwan et al., 2018) No significant differences in the incidence of infection, whether debridement is done early or delayed. (Singh et al., 2012) (Kamat A.S., 2011) 	<ul style="list-style-type: none"> Delay of arrival at the hospital Waiting for families to buy drugs Non availability of health insurance Geographical distance with poor road conditions making it difficult to travel First resort to the traditional healer
Definitive stabilization of the fracture	<ul style="list-style-type: none"> Dominated by the external fixator (38.1%) and orthopedic treatment (26.2%) 	<ul style="list-style-type: none"> External fixators not recommended due to the high rate of infection of the pin site, the potential risk of vicious callus, and it does not provide adequate mechanical stability of the fracture (Elniel et al., 2018) 	<ul style="list-style-type: none"> The cost the Internal osteosynthesis materials is all the responsibility of the patient Free external fixators, but with a letter of commitment from the patient to deliver it.
Soft tissue reconstruction	<ul style="list-style-type: none"> Primary closure if possible, if not directed wound healing with fatty dressings 	<ul style="list-style-type: none"> Immediate primary closure in cases of small wounds with little contamination, if not, delay 48 to 72 hours. Therapy with negative pressure dressings 	<ul style="list-style-type: none"> Device for therapy with negative pressure dressings is not available Minimize patient expenditure as much as possible

		(VAC) (Bhat et al., 2019) <ul style="list-style-type: none"> • Time to closure was not significantly at postoperative development of infection (Moola et al., 2014) 	<ul style="list-style-type: none"> • Most patients could not afford to go back to the operating room for secondary closure
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Conclusion

In low-income countries, the management of open fractures remains a daunting task. Although studies are currently being carried out to improve their care, many factors limit the management of open fractures in Madagascar, the main ones being the poverty of the population, the lack of health insurance coverage, and the delay in arriving at the hospital.

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