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Treatment of Neglected Tibial Fractures Using Locked Intramedullary Nailing in a Precarious Setting without Image Intensification. Experience at Brazzaville University Hospital. About 84 Cases

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Abstract **Original Research Article**

***Introduction**:* Leg fractures, especially tibial fractures, are a major public health problem linked to road accidents, affecting working-age people. They are often open and complex (soft tissue, infection), with locked intramedullary nailing (LIMN) as the standard treatment, but limited by the lack of equipment (fluoroscope) in poor countries where external fixators are sometimes preferred for managing open fractures, despite frequent infectious complications. ***Patients and Methods**:* This was a retrospective, single-centre descriptive study of 84 cases in the orthopaedic and trauma department of Brazzaville University Hospital. It involved analysing the records of patients with neglected tibial fractures that had developed into malunions and who underwent locked intramedullary nailing surgery between June 2022 and July 2025 and who were operated on for neglected leg fractures (open or closed) that had been neglected and treated between the 2nd and 6th month following their trauma. ***Results**:* 84 cases (approximately 24.35%) were hospitalised and treated between the 2nd and 6th month after the trauma. The average age was 38 years +/- 20, with extremes ranging from 20 to 70 years. The majority (82.14%) of patients resided in the department of Brazzaville. Road accidents were the main cause in 75 cases (89.28%), followed by falls in the context of accidents at work in 3 cases (3.57%), and sports or domestic accidents in 6 cases (7.14%). Our study found 62 cases (73.80%) of closed fractures, including 21 cases (25%) of tibia-fibula fractures, 12 cases (14.28%) of isolated tibia fractures, 18 cases (21.42%) of middle third fractures and 11 cases (13.09%) of fractures of the lower third), compared with 22 cases (26.19%) of open fractures, including 17 cases (20.23%) of fractures of the middle third and 5 cases (5.95%) of isolated tibial fractures. ***Conclusion**:* Tibial fractures are common and severe injuries, often caused by road accidents, with significant consequences and complex management, especially in low-resource settings.

Keywords: leg fracture, Cauchoix and Duparc classification.

INTRODUCTION

Leg fractures are the most common type of long bone fracture, mainly affecting the tibia [1]. They have become increasingly frequent due to the rise in road accidents in our country and pose a public health problem as they mainly affect the working population. They most often occur as a result of significant trauma and account for about a quarté of all fractures observed. The majority of them are extra-articular fractures and the risk of infection is high, as nearly half of these fractures can be open due to the proximity of the tibia to the skin. According to Merle d'Aubigné, these are fractures where the fracture line is located between an upper horizontal line passing through the tibial nourishing hole and a lower horizontal line located three finger widths above the tibio-talar joint. [2] They are called open when the fracture site communicates with the outside through a skin opening, and closed when the fracture site does not communicate with the outside. They are very often open and expose the tibia, a subcutaneous bone that is poorly vascularised and easily infected. These fractures frequently pose a problem in terms of treating the soft tissues and fixing the fracture site [3]. Leg fractures are common, serious and potentially complex injuries that require treatment due to their often complicated progression, such as bone infections (osteitis) and

malunions. The lack of protective measures and poor prevention increase the severity of road accidents [4]. Developing countries account for 90% of fatal road accidents worldwide, with 20 to 50 million injuries each year, the majority of which are serious and disabling [5]. Fractures of long bones (humerus, femur, tibia) resulting from high-energy kinetic accidents are difficult to treat in precarious environments due to the complexity of the injuries, the risk of open fractures and bone displacement. Locked intramedullary nailing (LIMN) is generally considered the gold standard in the surgical treatment of long bone diaphyseal fractures [6]. These fractures require precise surgical procedures with locked intramedullary nailing to ensure proper stabilisation. This is an osteosynthesis technique that stabilises a fractured long bone using a nail inserted into the medullary canal and then anchored to the bone with transfixing screws. This method is an evolution of Küntscher's intramedullary nailing [7], where locking with screws has been added to improve stability and treatment effectiveness. The performance of this type of surgery is limited in low- and middle-income countries due to a lack of equipment, such as fluoroscopes (image intensifiers), and the absence of an adequate surgical environment. In Congo, the fact that general hospitals have limited osteosynthesis resources leads to inadequate initial care, and patients are transferred to specialised centres such as the Brazzaville University Hospital. This problem is exacerbated by the high cost of surgery, due to the unavailability of emergency osteosynthesis equipment, which delays treatment and makes it inaccessible to the poorest populations. No specific studies have been conducted on these injuries in our context, which justifies the interest of our study in evaluating the clinical and therapeutic aspects as well as the possible complications of these leg fractures.

PATIENTS AND METHODS

This was a retrospective, single-centre descriptive study of 84 cases (approximately 24.35%) in the orthopaedic and traumatology department of Brazzaville University Hospital. It focused on analysing the records of patients with neglected tibial fractures that had developed into malunions over time and who underwent delayed surgery with locked intramedullary nailing between June 2022 and July 2025, a period of three years. Our study included the files of patients who underwent surgery for neglected leg fractures (open or closed) because they were treated between the second and sixth month following their trauma, i.e.: after refusal of care, problems with delays in immediate treatment by insurers in public hospitals in our country, financial problems related to the cost of surgery, cultural problems related to traditional medicine, or lack of information. Patients were identified from medical records, hospitalisation registry data, and operating theatre data. Records that could not be found and patients who underwent emergency surgery and treatment within the first month were excluded from the study. The parameters studied were : age, gender, medical history, time to surgery, type of implant, length of hospital stay and complications. The AO classification was used for closed diaphyseal fractures of the leg and the Cauchoix and Duparc classification as the key reference for open fractures of the leg. The modified Ketenjian criteria [8] were used, in particular to assess anatomical and functional outcomes after intramedullary nailing. These criteria compared outcomes as: Excellent, Very good, Good, Fair and Poor.

Surgical technique and post-operative care

Surgical protocol

First stage: at the junction between the middle and distal thirds of the fibula

- Patient positioned supine under local anaesthesia (spinal anaesthesia), standard operating table;
- Disinfection and placement of conventional drapes;
- Anterolateral external approach of approximately 8 cm opposite the fibula;
- Plan-by-plan dissection until the fracture site is exposed;
- Preparation of the distal and proximal fracture ends;
- Anatomical reduction of the fracture site using a compression screw and placement of an 8-hole tubular neutralisation plate, then screwing from distal to proximal;
- Perfect control of haemostasis;
- Abundant irrigation with saline solution;
- Layer-by-layer closure;

Second stage: at the level of the tibial diaphysis

- Positioning in supine position under local anaesthesia (spinal anaesthesia), on a standard operating table adapted with popliteal support and knee flexion;
- Anterior approach to the leg approximately 8 cm;
- Plan-by-plan dissection until exposure of the fracture site, revealing a malunion;
- Osteoclasia of the bone callus is performed, followed by preparation of the distal and proximal fracture ends;
- Provisional reduction of the fracture site is successfully achieved using Verbrugge forceps;

Third stage: at the upper third of the tibia

- Longitudinal subpatellar incision of approximately 10 cm;
- Disection of the right patellar tendon;
- Minimal resection of Hoffa's fat pad;
- Preparation of the nail entry hole using a pigtail reamer;
- Progressive reaming of the diaphyseal shaft up to size 12;
- Preparation of the fracture ends;
- Successful attempt to reduce the fracture site;

- Insertion of a 11/36 intramedullary nail under visual control without image intensifier (distal fragment split during nail insertion)
- Perfect haemostasis control ;
- Abundant lavage with saline solution ;
- Layer-by-layer closure with a Redon drain and dressing.

Duration of the procedure: 2 hours 30 minutes

Post-operative care

- Post-operative hospitalisation : maintenance of intravenous access via SSI 500 ml/day
- Monitoring: of the surgical wound; Redon drain and vital signs (temperature, pulse, BP, RR) and elevation of the injured limb.
- Analgesic: paracetamol 1 g x 3 IVL; tramadol 100 mg x 2/day IVL
- Antibiotic therapy: cefuroxime 750 mg x 2/day IVL for 72 hours
- Anticoagulant: enoxaparin 4000 IU/day SC for 7 days
- Drain removal after 48 hours and sutures removed after 15 days.
- The patient is placed in a chair the following day and assisted with crutches or a walking frame as soon as their condition allows.
- Discharge: between 48 and 72 hours post-operatively.

RESULTS

Epidemiological aspects

The total number of patients admitted during the study period with a leg fracture to the Orthopaedics and Traumatology Department was 2,736 hospitalisations, and 345 cases were recorded with a diagnosis of leg fracture. Of these, 84 cases (approximately 24.35%) were hospitalised and received late treatment, occurring between the 2nd and 6th month after the trauma, highlighting a significant proportion of neglected fractures in our sample. In Table I, 64 men represent a certain proportion compared to 20 women, for a sex ratio of 3.2. The average age was 38 years +/- 20, with extremes ranging from 20 to 70 years. The age groups [18-28 years] and those between 40 and 50 years were the most represented in 76.19% of cases. In terms of place of residence, the majority (82.14%) of patients lived in the department of Brazzaville, compared to (17.85%) who came from other departments of the country. Schoolchildren/students followed by motorbike taxis were in the majority in 45.28% of cases. With regard to health coverage for patients, we found that 76.19% were affiliated with insurance companies that paid for damage (claims) caused to others, albeit with significant delays, and in the remaining cases, coverage was provided by the families of accident victims.

Table 1

	Distribution by age group	
	STAFFING LEVELS	PERCENTAGE
18-28 years	43	51,19%
29-39 years	13	15,47%
40-50 years	21	25%
> 65 years	7	8,33%
TOTAL	84	100 %
	Distribution by gender	
	STAFFING LEVELS	PERCENTAGE
Men	64	76,19%
Women	20	23,80%
TOTAL	84	100%
	Distribution by place of residence	
	STAFFING LEVELS	PERCENTAGE
Brazzaville Department	65	77,38%
Other departments	19	22,61%
TOTAL	84	100%

Distribution by occupation		
	STAFFING LEVELS	PERCENTAGE
Motorcycle taxis	26	31%
Taxi driver	8	9,52%
Civil servant	9	10,71%
Retired persons	6	7,14%
Workers/Traders	18	21,42%
Sans emploi	5	5,95%
Pupils/Students	12	14,28%
TOTAL	84	100%

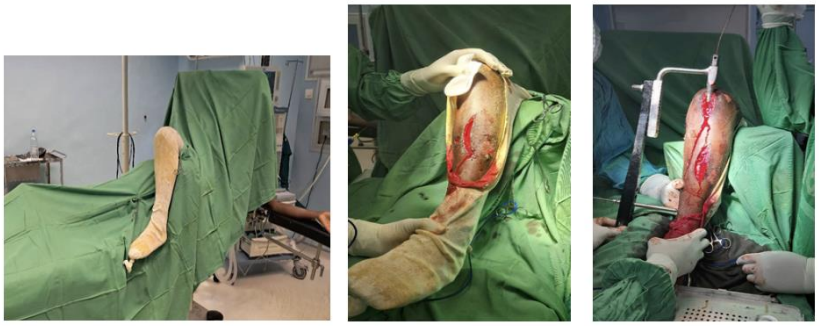
Diagnostic and treatment aspects

Our study highlighted a population of patients with few known medical histories : 66 cases (78.57%) had no medical history, but there were 14 cases of hypertension (16.66%), 2 cases of smoking (2.38%) and 2 cases of alcohol and tobacco use (2.38%) respectively. Road accidents were the main cause in 75 cases (89.28%), followed by falls in the context of accidents at work in 3 cases (3.57%), and sports or domestic accidents in 6 cases (7.14%). The majority of injuries were located in the middle third of the diaphysis (94.04%), often on the left side (81%), with few cases at the junctions (3 cases in the middle/upper third, 2 cases in the lower third). All patients (100%) underwent temporary immobilisation of the injured limb with a posterior cruropedious splint, a pre-anaesthetic consultation, received tetanus serum and analgesics, and were hospitalised in the Orthopaedic Surgery and Traumatology Department of the Brazzaville University Hospital. Thus, in our study, we obtained: 62 cases (73.80%) of closed fractures, including 21 cases (25%) of tibia-fibula fractures, 12 cases (14.28%) of isolated tibial fractures, 18 cases (21.42%) of mid-third fractures and 11 cases (13.09%) of lower-third fractures, compared to 22 cases (26.19%) of open fractures, including 17 cases (20.23%) of mid-third fractures and 5 cases (5.95%) of isolated tibial fractures converted to closed fractures after suturing in the emergency department and healed without plastic surgery. Thus, according to the AO classification, we obtained the following results in terms of type and complexity : simple closed extra-articular fractures type A : A1 = 16 cases (19.04%), A2 = 9 cases (10.71%), A3 = 17 cases (20.23%); simple closed extra-articular fractures type B : B2= 11 cases (13.09%), B3=6 cases (7.14%) and complex closed segmental fractures type C : C3=3 cases (3.57%). According to the Cauchoix and Duparc classification : type I in 15 cases (17.85%) and type II in 7 cases (8.33%). Standard X-rays of the injured and contralateral limbs, knees and pelvis were performed systematically in all patients (100%). In terms of the time to surgery, the majority of patients, 59 (70.23%), underwent surgery between 45 and 90 days post-trauma, while a minority, 25 (29.76%), underwent surgery later, between 120 and 150 days. All patients underwent surgery under local anaesthesia (spinal anaesthesia) and mobilisation under anaesthesia of the knee was performed before surgery to treat post-operative stiffness. With regard to anaesthesia risk according to the ASA classification, we obtained : ASA1 in (78.57%) and ASA2 in (21.42%). Open surgical treatment was performed in all patients (100%) : a malunion was found intraoperatively in all patients, and osteoclasia followed by reduction and stabilisation by open tibial intramedullary nailing was also performed in all patients. A tibial resection osteotomy of approximately 1 and 2 cm was performed in 29 patients (34.52%) prior to stabilisation by locked intramedullary nailing. Depending on the segment and location of the fracture, we obtained the following results : both bones of the leg were most affected in 90.47% of cases in 76 patients, tibial osteosynthesis was performed using intramedullary nailing (IMN) and fibular osteosynthesis was performed using an 8-hole 1/3 neutralisation plate or an intramedullary pin at the fibula. The implant used was a locked intramedullary nail in the tibia in all patients (100%) with an antegrade insertion technique at the upper end of the tibia. Locking was static in 74 patients (88.09%) and dynamic in 10 patients (11.90%). It should be noted that there were 9 cases (10.71%) of isolated tibial fractures in the middle third and 4 cases (4.76%) in the lower third.

Progressive aspect

The surgical wound healed in the third week in 71 cases (84.52%) and in 13 cases (15.47%) we observed signs of infection at the surgical site, including three cases of recurrent infection (3.57%) despite appropriate antibiotic therapy, which prompted us to perform a culture and antibiogram to identify the responsible organisms and treat them with targeted therapy instead of empirical therapy. Other complications were also found : one case of equipment failure and three cases of pseudarthrosis, or 16.7%. In our study, the majority of cases, (61.90%), or 52 cases, had a short hospital stay of between 1 and 15 days and a long stay of 30 days in patients who developed a post-operative infection at the surgical site. Convalescence was managed with home support upon discharge to reduce the length of hospitalisation while maintaining the quality of care to ensure proper healing. Anatomical and functional results according to Ketenjian's modified criteria were satisfactory in 95.23% (n= 80) and are listed in (Table 2). The results observed show that 46.42% had a limp, 11 patients had muscle atrophy, 8 suffered from occasional mechanical pain, and 4.76% had significant complications with a poor prognosis.

Figure 1



A B C

A - Positioned supine under local anaesthesia (spinal anaesthesia) on a standard operating table adapted with popliteal support and knee flexion.

B - Anterior approach to the leg of approximately 8 cm for preparation of the fractured fragments of the tibia prior to reduction.

C - Insertion of an intramedullary nail under visual control without image intensifier after progressive reaming of the diaphyseal shaft.

Figure 2

A B

A- Preoperative X-ray of the leg showing a closed fracture of both bones of the leg, type II according to Cauchoix and Duparc.

B - Follow-up X-ray of a patient four months after surgery involving locked intramedullary nailing for a closed fracture of both bones in the leg.

DISCUSSION

In our study of 64 men and 20 women, the sex ratio of 3.2 indicates an overrepresentation of men. The average age is 38 ± 20 years (20-70 years), and the 18-28 and 40-50 age groups each represent 38% of the study population. Males accounted for 76.19% of our series, which can be explained by the fact that the population of Congo is predominantly young. This result is significantly higher than that of Lamine A [9], who found 68.6% of males. Trauma occurred in 89.28% of cases following road traffic accidents, an aetiology consistent with the literature, given that Moyikoua A *et al.,* [10] and Lamine A [9] report in their series 84% and 97.1% of cases respectively caused by road traffic accidents. This could be explained by the increase in the number of vehicles on the road and the proliferation of two-wheeled vehicles used for public transport in large cities such as Brazzaville and Pointe-Noire, but also and above all by users' failure to comply with the highway code and men's exposure to violent trauma. The socio-professional groups most affected were: motorbike taxi drivers (31%), followed by labourers/traders (21.42%) and pupils/students (14.28%). This result differs from that of Koné J [11], whose study found 33.3% among civil servants. This could be explained by the fact that motorbike taxis are used as a means of public transport in our large cities by pupils/students and workers/traders, who are therefore more exposed to accidents. Fractures of two leg bones were the most common, accounting for 90.47% of cases. This differs from the results in the study by Pouramine et al [12], where fractures of the tibia or

fibula accounted for 23-7% of cases and the middle third was the most affected with 41.66%, a rate similar to that found by Diallo. H [13] found 51%. This could be explained by the fact that the middle third is the segment most exposed to trauma. Our study reveals a predominance of closed fractures (73.80%) over open fractures (26.19%), the latter being initially treated by suturing in the emergency department and healing well without plastic surgery, highlighting the good progress of these 'converted' cases and their good skin healing, indicating good post-emergency management and the absence of major wound complications [14]. Surgical treatment was performed on all patients despite the delay in treatment due to the fact that the majority of patients were victims of road traffic accidents who, for administrative reasons, could not be treated immediately. In other cases, socio-economic and cultural issues were the cause of the delay. Bone resection osteotomy was performed mainly to correct the deformity of the injured limb and realign the mechanical axis of the leg before intramedullary nailing in 34.52% of cases due to retraction of the leg muscles encountered during surgery. Proximal locking was static in 88.09% of cases, a higher result than that found in the study by Farij Amina [15] and Bouramdane [16], who found 66% and 77.3% static assembly, respectively. Reaming was systematic in our series and we obtained satisfactory results in 95.23% of cases in terms of consolidation at four months, which is higher than the results found in the study by Douirek, who obtained 91% of patients [17] who consolidated at three months. Static locking of the tibial intramedullary nail is a surgical technique that neutralises rotational and shortening forces, stabilising the fracture for optimal healing and early resumption of mobilisation. This result could be explained by the fact that the majority of fractures were unstable A3 (transverse) fractures. Our study reveals a general trend where the majority of patients (60.8%) have short hospital stays (1-15 days), but highlights that open fractures systematically result in long stays, which is to be expected given the complexity of care and the increased risk of infection and complications. Post-operative infections are common in Africa, accounting for 9.59% of complications, a high rate due to local conditions (overcrowding, quality of care) [18-19] that exceed the ideal threshold of 5% often cited by references such as the National Research Council [20], and they are common in young people. Early infection of leg fractures is a serious complication occurring in the first month after surgery, linked to the initial skin condition, and represents a major risk of severe functional sequelae, sometimes requiring several reoperations to control the infection before the fracture can heal. In our study, early infection was 4.46%, a rate that is consistent with the data in the literature. In our study, we did not note any cases of compartment syndrome.

Conclusion

Leg fractures are common, serious injuries that mainly affect young, active men, often as a result of road accidents, and have a significant socio-economic impact. They can lead to sequelae, but their prognosis depends on the severity, speed and quality of care (surgery or orthopaedics), even though orthopaedic treatment remains crucial, especially in regions with limited resources.

Recommendations

At the end of this work, we make the following recommendations: a plan for the overall improvement of surgical services in general and orthopaedic and trauma surgery in particular at the Brazzaville University Hospital, a plan focused on equipment (dedicated operating theatres, image intensifiers, osteosynthesis equipment), training of specialists in orthopaedics and traumatology to promote ECMV for femoral and tibial fractures. Road safety: compliance with the highway code and use of specialist care to improve trauma management in Congo, drawing on international best practices.

Conflicts of interest: The authors declare no conflicts of interest.

Authors' contributions

All authors contributed to this work and have read and approved the manuscript.

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