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Centro-Medullary Nailing of Open Leg Fractures in N'djamena (CHAD)

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ABSTRACT

Open fractures are any disruption of continuity where the fracture site communicates with the outside. The aim of this study was to evaluate the treatment of open leg fractures by intramedullary nailing. This was a single-center, cross-sectional, retrospective study carried out over a continuous period of 4 years, from January 2020 to December 2023. Open fractures were classified according to Gustillo/Anderson, and anatomical and functional outcomes were evaluated using the modified Ketenjian criteria. Twenty-eight patients, including 3 women aged 18 to 60 years (mean 38.14 years), were collected. They represent 6.15% of open leg fractures and 0.96% of all fractures in the orthopedic and trauma surgery department. The etiologies were dominated by road traffic accidents (88%). We recorded 15 cases (53.6%) of type I, 6 cases (21.4%) of type II, 6 cases (21.4%) of type IIIa, and one case of type IIIb (3.6%). The average time to management was 35.5 hours, with extremes ranging from one hour to 240 hours. Thorough debridement plus antibiotic prophylaxis was performed in all our patients. The complications consisted of one case of surgical site infection, one case of osteitis and joint stiffness, and one malunion. The average consolidation time was 4.75 months. Functional and anatomical results were satisfactory in 82.2%. Immediate intramedullary nailing in open leg fractures allows for good results.

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1. Introduction

Open traumatic injuries of the leg are common and account for 8 to 10% of injuries of the musculoskeletal system [1]. They are becoming increasingly frequent in resource-limited countries like ours, and their incidence is around 35% [2]. These fractures affect young adults following road traffic accidents with significant economic implications. They constitute a medical-surgical emergency and are prone to complications. The healing time can be long, averaging two months compared to closed fractures, with the risk of non-union multiplied by 3 and the risk of infection by 15[3]. The management of these injuries is a challenge for the entire surgical team and involves meticulous debridement combined with antibiotic prophylaxis.

Bone stability in open fractures is a crucial step that determines the prognosis. Intramedullary nailing has gradually become established as the reference technique in the surgical treatment of diaphyseal fractures of long bones [4]. For a long time, the external fixator remained the reference treatment for open leg fractures [2]. Currently, there is no clear consensus on primary fixation using an intramedullary support in open leg fractures.

However, several studies have shown good clinical results with surgical site infection rates comparable in some series with external fixation, regardless of the stage of skin opening according to the Gustilo classification [3,5]. This stabilization method reduces complications and improves the outcomes of open fracture treatment. The aim of our work was to evaluate

the treatment of open leg fractures treated by intramedullary nailing.

2. Patients and method

This was a retrospective descriptive cross-sectional study spread over a period of 4 years, written in accordance with the recommendations of the Declaration of Helsinki. Included were all patients aged 18 years or older of both sexes admitted to our department during the study period and having a complete clinical record with a minimum follow-up of one year. Lesions of Type I to IIIB according to Gustillo and Anderson (figure 1) were involved ; only Type IIIC were excluded, as well as patients treated with external fixators, and those who had undergone debridement and Secondary nailing after Healing was ruled out. Anteroposterior and lateral radiographic examination allowed for diagnosis (picture 1). The AO classification enabled us to classify the bone lesions. The results were evaluated according to the modified Ketenjian criteria.

The treatment strategy was standardized, always beginning with meticulous debridement followed by intramedullary nailing and then coverage of the fracture site. Antibiotic prophylaxis was systematically administered using amoxicillin-clavulanic acid, and tetanus prophylaxis was administered according to the patient's serological status.

3. Results

During our study period, 453 cases of open leg fractures were recorded, and only 28 patients underwent intramedullary nailing, representing a hospital frequency of 0.96%.

Males were predominant, with 25 cases (89%), resulting in a male-to-female ratio of 8.3. The mean age was 38.14 years, ranging from 18 to 60 years. The 18-30 age group was the most represented, accounting for 42.9% (n=12). Students were the most affected group, representing 25% (n=7). Fourteen (14) patients, or 50% of cases, presented with medical attention within the first six (6) hours. Direct injury was the most common cause, accounting for 85.7% (n=24). Road traffic accidents were the most frequent etiology, representing 64% (n=18) of cases.

The fracture was most often located on the left side, with 64% (n=18) versus 36% (n=10) on the right. We did not observe any bilateral involvement. Type A according to the AO classification was the most frequent, accounting for 57.2% (n=16) of cases. In our study, type I according to Gustillo and Anderson (Figure 2) was the most represented, with 53% (n=15) of cases. The average time to treatment was 35.5 hours, with a range from one hour to 240 hours. All our patients underwent meticulous debridement, antibiotic prophylaxis with amoxicillin/clavulanic acid, and tetanus immunoglobulin vaccination. The fixation was dynamic in most cases (82.1% (n=23)).

We recorded one case of early infection controlled by copious irrigation after sampling and appropriate antibiotic therapy; one case of osteitis associated with joint stiffness; and one case of malunion. The most frequent time to union was 16 to 20 weeks, representing 35.7% (n=10) of cases. The average duration of union was 19 weeks, with a range from 12 to 36 weeks. Anatomical and functional results were satisfactory (very good to excellent) in 82.2% of patients.

4. Discussion

In this study, we reviewed 28 cases of open leg fractures treated by intramedullary nailing. Men were the most affected. This result is consistent with those of Koné et al. [6] in Bamako and Diallo et al. [2] in Bobo-Dioulasso, who found rates of 73% and 81.82%, respectively; this could be explained by the fact that men constitute the most active group and are therefore the most exposed to road traffic accidents. The mean age was 38.14 years, higher than that reported by Diallo et al. [2]. The treatment of open leg fractures by intramedullary nailing has been reported by several authors in the literature [9].

Bone stability in these lesions is a crucial step that determines the prognosis. This nail stabilization method reduces complications and improves the outcomes of open fracture treatment. The majority of open leg fractures were located on the anteromedial aspect, known as Vilain's "cursed quadrilateral," which predisposes them to open wounds.

Currently, there is no clear consensus on primary fixation with an intramedullary nail in open leg fractures; however, several studies have shown good clinical results with comparable surgical site infection rates in some series compared to external fixation, regardless of the stage of open wound according to the Gustillo classification [1,9,10]. The results found in our series were lower than those reported in the literature for deep infection rates after first-line intramedullary stenting in open oscillating leg fractures, ranging from 6.5% to 12.9% [11-15]. This could be explained by the small size of our sample and by strict adherence to the management protocol adopted in our study. We recorded only one case of a type IIIB (figure 3) open fracture, whereas the study by Laigle et al. [9] noted 10 type IIIB cases where skin coverage over the fracture site was not possible and a suction dressing was applied. In our patient, a soleus flap was used for wound coverage after directed healing failed. The average time to treatment was longer than that reported by Laigle et al. [9] but shorter than that reported by Adrien et al. [16], who reported 25 hours and 8.5 days, respectively. This difference could be explained by delayed consultation and the strong belief in traditional treatment in our Chadian context. It is true that the time between injury and admission to the operating room should be less than 6 hours according to the literature. However, some authors question this timeframe [17]. In our series, patients treated after the first 6 hours did not develop infectious complications or delayed union. The majority of type I lesions encountered in our series could explain this, as could systematic antibiotic prophylaxis and wound appropriation, which also contributed positively to this result. The meta-analysis by Bhandari et al. [18] conducted in 2001 reported that intramedullary nailing in open fractures is preferable to external fixation. The results were satisfactory (very good to excellent) in 82.2% of patients. This result is close to those of Joshi et al. [19] and Abdelaal et al. [20], who reported 85.7% and 83.6%, respectively. This result could be explained by the predominance of bone lesions classified as type A osteoarthritis, the regular follow-up of our patients, and strict adherence to the established protocol. Our study demonstrated a lower rate of infectious complications, a reasonable consolidation time, and satisfactory functional and anatomical outcomes.

5. Conclusion

These injuries are relatively frequent and serious in our setting; intramedullary nailing, due to its ease of execution and low complication rate, can be a reliable alternative for osteosynthesis of open leg fractures.



Figure 1 : A) Type IIIB open fracture, Type IIIA open fracture, B) Type A3 fracture of the AO, C) Closure, D) Control radiograph

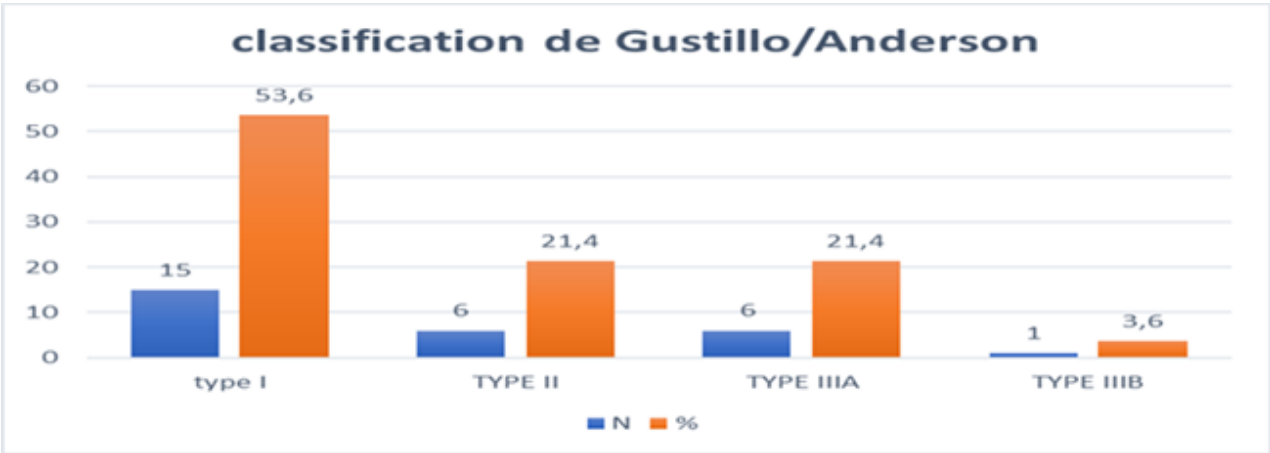


Figure 2 : Gustillo/Anderson classification



Figure 3: Bone exposure after open fracture type IIIB, solar flap for coverage

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Reference

1. Toure L, Terna T, Kalifa C, Sidy HDB, Sidiki SA, Mahamadou TD, et al. Traitement des Fractures Ouvertes Diaphysaires de Jambe par des Clous d'Ende dans un Hôpital de Seconde Référence. Health Sci Dis [Internet]. 2020 [cité 26 déc 2025];21. <https://doi.org/10.5281/hsd.v21i7.2125>
2. Rev-Marocaine-Chir-Orthop-Traumatologique-2020-86-19-25.pdf [Internet]. [cité 5 févr 2026]. <https://applications.emro.who.int/imemrf/Rev-Marocaine-Chir-Orthop-Traumatologique/Rev-Marocaine-Chir-Orthop-Traumatologique-2020-86-19-25.pdf>. Consulté le 5 févr 2026
3. Infections in primary intramedullary nailing of open tibial fractures: a review article.
4. Mounir DC. Belhadj Amina Bouguetta Chaima.
5. Uchiyama Y, Kobayashi Y, Ebihara G, Hamahashi K, Watanabe M. Retrospective comparison of postoperative infection and bone union between late and immediate intramedullary nailing of Gustilo grades I, II, and IIIA open tibial shaft fractures. Trauma Surg Acute Care Open. 2016;1:e000035. <https://doi.org/10.1136/tsaco-2016-000035>
6. Kone S, Open leg fractures treated by intramedullary nailing, DESCOT thesis 2021

7. Kalmeth PHS, Meys G, v. Horn YY, Evers SMAA, Seelen HAM, Hustinx P, Janzing H, vd Veen A, Jaspars C, Sintenie JB, Blokhuis TJ, Poeze M, Brink PRG. Permissive weight bearing in trauma patients with fracture of the lower extremities: prospective multicenter comparative cohort study. BMC Surg. 2018 2;18.

8. Lillo M, El Ezzo O, Cauteruccio M, Ziranu A, De Santis V, Maccauro G. Infections in primary intramedullary nailing of open tibial fractures: a review article. Eur Rev Med Pharmacol Sci. 2019;23(2 Suppl):195–200.

9. Laigle M, Rony L, Pinet R, Lancigu R, Steiger V, Hubert L. Intramedullary nailing for adult open tibial shaft fracture. An 85-case series. Orthop Traumatol Surg Res. 2019;105:1021–4. <https://doi.org/10.1016/j.otsr.2019.04.020>

10. Traitement des fractures ouvertes de jambe stade III en urgence : enclouage centromédullaire associé à un lambeau de couverture [Internet]. [cité 11 mai 2026]. <https://www.santetropicale.com/Resume/8803.pdf>. Consulté le 11 mai 2026

11. Holbrook JL, Swiontkowski MF, Sanders R. Treatment of open fractures of the tibial shaft: Ender nailing versus external fixation. A randomized, prospective comparison. J Bone Joint Surg Am. 1989 Sep;71(8):1231–8.

12. Court-Brown CM, McQueen MM, Quaba AA, Christie J. Locked intramedullary nailing of open tibial fractures. J Bone Joint Surg Br. 1991 Nov;73(6):959–64.

13. Whittle AP, Russell TA, Taylor JC, Lavelle DG. Treatment of open fractures of the tibial shaft with the use of interlocking nailing without reaming. J Bone Joint Surg Am. 1992 Sep;74(8):1162–71.

14. Tornetta P, Bergman M, Watnik N, Berkowitz G, Steuer J. Treatment of grade-IIIb open tibial fractures. A prospective randomised comparison of external fixation and non-reamed locked nailing. J Bone Joint Surg Br. 1994 Jan;76(1):13–9.

16. Alberts KA, Loochagen G, Einarsdottir H. Open tibial fractures: faster union after unreamed nailing than external fixation. Injury. 1999 Oct;30(8):519–23.

15. Brumback RJ, Jones AL. Interobserver agreement in the classification of open fractures of the tibia. The results of a survey of two hundred and forty-five orthopaedic surgeons. *J Bone Joint Surg Am.* 1994 Aug;76(8):1162–6
16. Adrien Cheyrou-Lagreze. Enclouage secondaire dans les fractures ouvertes de diaphyse tibiale : comparaison d'une conversion en un temps versus deux temps. *Médecine humaine et pathologie.* 2020. dumas-03373689
17. Mauffrey C, Bailey JR, Bowles RJ, Price C, Hasson D, Hak DJ, et al. Acute management of open fractures: proposal of a new multidisciplinary algorithm. *Orthopedics.* 2012 Oct;35(10):877–81.
18. Bhandari M, Guyatt GH, Swiontkowski MF, Tornetta III P, Hanson B, Weaver B, et al. Surgeons' preferences for the operative treatment of fractures of the tibial shaft. An international survey. *J Bone Joint Surg Am.* 2001;83-A(11):1746-52.
19. Joshi D, Ahmed A, Krishna L, Lal Y. Unreamed interlocking nailing in open fractures of tibia. India. *J Orthop Surg Res.* 2004;12(2):216-21.
20. Abdelaal M, Kareem S. Open fracture tibia treated by unreamed interlocking nail. Long experience in El-Bakry General Hospital. *Open Journal of Orthopedics.* 2014;4:60-9.