

# Predictive Factors of Functional Outcome of Open Fractures of the Foot at the Bouaké Hospital and University Center

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## Abstract

The study evaluated functional outcomes of foot open fractures, finding satisfactory results in 89.6% of cases. It identified associated lesions, more than two fractures, and lack of rehabilitation as predictors of poor outcomes. Infection rates were low, and overall quality of life scores were good at follow-up.

## Keywords

AOFAS-Open Fracture-Foot-Functional Outcome

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## 1. Introduction

The foot is a complex anatomical structure supporting the weight of the body and putting it in motion while adapting to varied terrain during walking [1]-[7]. The open fracture of the foot is a solution of bone continuity of one or more bone of the foot, which communicates with the outside via a wound [1]-[4]. Their frequency is estimated at 12% [8]. Fractures of the metatarsals (35%) [2]-[6] and calcaneus (40%) [7] [9] are the most common of the foot skeleton. Open fracture of the foot most often occurs in road traffic accidents [1]-[9]. It results from direct injuries by impact or indirect injuries by torsion [1]-[3]. It is of interest to patients aged 21 to 45 years [3] [4] [7] [10]-[12]. Their diagnosis often requires a combination of careful clinical examination and imaging to assess the extent and nature of the lesions. It is a serious medical-surgical emergency because it sometimes causes significant functional consequences [3]-[10] [13]-[15]. The optimal treatment is surgical. This is a challenge for the orthopedic surgeon. It is well codified

and must be early before the sixth hour [12]-[15]. It includes antibiotic therapy, debridement, restraint and coverage of the fracture site [4]-[7] [13]-[16]. Current new surgical techniques have made treatment easy with early treatment of patients [6] [10] [17]-[25]. Infection and gait disturbances associated with residual pain are the major complications [3] [4] [10] [15]-[20]. The functional after-effects are explained by the complexity of the coexisting lesions (tissue, tendon, ligament, bone and vasculaire) [4] [18] [19] [23]-[26]. The lesion mechanism is a determining factor in the therapeutic strategy, particularly for the ideal treatment [27]. The delay in treatment, especially in developing countries, and the under-evaluation of lesions lead to poor functional results which can have consequences, socio-economic and psychological [13] [14]-[19] [20]. In Ivory Coast, little specific work has been devoted to foot trauma [5] [7] [14] [28]. The predominance of open fractures of the metatarsals and calcaneus were noted by these studies but the emphasis is not placed on the evolutionary aspect [5] [7] [14] [28]. The assessment of the functional prognosis is often difficult. Open fracture of the foot involves complex local structural components which make management difficult. Some prognostic factors have been identified in the literature [4] [18] [29]. The presence of associated lesions in addition to the foot lesion, especially in the multiple trauma patient, type III Gustilo-Anderson fractures, the number of metatarsal fractures and damage to the midfoot have been observed as a poor prognosis factor [4] [18] [28]-[32]. The determination of prognostic factors makes it possible to establish functional prognosis scores. Furthermore, in the local literature, there are no specific data on open fracture of the foot, and data highlighting the functional result and the factors which influence the functional prognosis. The main objective of this study was to evaluate the functional results of patients with an open foot fracture. The secondary objectives were to identify the factors influencing the functional outcome.

## 2. Methods

This was a retrospective observational cross-sectional study with a descriptive and analytical aim of the files of patients with an open fracture of the foot according to the SRTOBE [33] model. It was carried out between January 1st, 2012 and December 31st, 2023. This study was carried out in the Traumatology-Orthopaedics department of the Bouaké University Hospital Center. This study concerned patients admitted and treated for an open fracture of the foot in the department. Patients aged over 15 years treated and followed for a recent open fracture (<21 days) of the bones of the foot were included. Patients with incomplete medical records were not included. The diagnosis was made from the history, clinical examination and radiological images with orthogonal incidence of the foot and ankle. The minimum sample size was calculated using the Cochran formula [34]. This size was calculated on the basis of the study carried out in Bouaké in 2022 on foot trauma, which noted a prevalence of open foot fractures of 3.29% [5]. The size  $n = Z(\alpha)^2 \cdot p(1 - p) / \alpha^2$  (n: minimum sample size; p: prevalence;  $\alpha$ : significance threshold (5%);  $Z(\alpha)$ : confidence coefficient at 95% which is equal to 1.96). This was simple random sampling and recruitment was consecutive. The data studied

were taken from patient hospitalization records. The data were sociodemographic (age, gender, profession, etiology, time to admission). The data concerning the lesions were the site of the fracture, the fractured bone, the type of fracture line, the number of fractured bones, the Gustilo type and the location of the wound. The Gustilo-Anderson classification was used to classify the open fracture [35]. The data concerning the treatment were the type of anesthesia, the therapeutic time, the type of restraint, the type of coverage, the operative duration, and the time of treatment. The variables studied after treatment were hospitalization time, rehabilitation, healing, complications, consolidation, functional outcome, and the patient's quality of life. Treatment was medical and surgical in all patients. Antibiotic therapy instituted parenterally upon admission combined ceftriaxone (100 mg/kg/day) and metronidazole (1500 mg/day). This treatment was relayed orally upon discharge with amoxicillin-clavulanic acid (100 mg/kg/day) over 10 - 15 days. The roofing of the hearth was early and carried out according to the Gustilo type. It was covered by suture for Gustilo types I and II. Directed healing was done for type IIIa and a flap for type IIIb or IIIc. Self-rehabilitation exercises were prescribed to patients to improve functional results. They consisted of active mobilization of free joints, complete support for consolidation of fractures with active mobilization of the ankle. The AOFAS score (American Orthopedic Foot and Ankle Score) was used to evaluate the functional result of the foot rated from 0 to 100 points [36] [37]. The results were excellent for a score between 95 - 100, good for a score between 75 - 94 points, average between 51 - 74 points and poor between 0 - 50 points. Very good, good or average functional results were judged satisfactory, while fair or poor results were judged unsatisfactory [35]-[37]. Patient satisfaction and quality of life were assessed using the SF-36 scale [37] [38]. The SF-36 scale includes 36 questions that assess eight scales (physical function, physical role limitation, pain, general health, vitality, social function, emotional role limitation, and mental health). The eight scales rate health between 0 and 100, and higher values demonstrate better quality of life. Post operative infection was assessed according to the following criteria, at least one of which was required: a wound with signs of infection (pain, swelling, redness, increase in local temperature); presence of purulent discharge from the wound; positive microbiological culture of the fluid at the wound level [39]. Consolidation was defined clinically by the absence of pain upon weight bearing and the absence of mobility of the foci. Radiologically, consolidation was defined as the formation of a callus involving at least three out of four cortices [39].

## 2.1. Statistical Analysis

The SAMPL statistical analysis model was used [40]. Data processing was carried out using SPSS version 25 software. Concerning the quantitative variables, the Wilk-Shapiro normality test was previously carried out with a margin of error of 5% and a confidence interval of 95%. All quantitative variables followed the normal distribution. The distribution was symmetrical, the calculated central tendency parameter was the mean, and the standard deviation was its dispersion

parameter. Furthermore, categorical variables were expressed as percentages. Binary and multivariate explanatory logistic regression analysis was performed to explore the risk factors of a satisfactory functional outcome. The so-called “step by step” analysis with a top-down strategy was adopted [41] [42]. In this study, the dependent variable was functional outcome. The independent variables were age, type of fracture line, number of fractured bones, Gustilo type, associated lesions, treatment time, duration of intervention, type of restraint, rehabilitation, complications. Variables with a  $p \leq 0.2$  in univariate analysis were significantly associated with an unsatisfactory functional result. They were introduced into the multivariate model for control and identification of confounding and interaction factors. Finally, in the multivariate model, variables with a  $p \leq 0.05$  were considered as the determining independent predictive factors of an unsatisfactory functional result. The results were expressed as raw Odd Ratio with its 95% confidence interval in univariate analysis and as adjusted Odd Ratio with its 95% confidence interval in multivariate analysis. Tables and figures were used to describe some results.

## 2.2. Ethical Considerations

This study was guided by ethical standards. We respected the anonymity and confidentiality of information, and the free and informed consent of patients was required.

## 3. Results

### 3.1. General Characteristics of the Study

The size  $n = Z(\alpha)^2 \cdot p(1 - p) / \alpha^2 = [(1.96)^2 \times 0.0329(1 - 0.0329) / (0.05)^2] = 48.8921$ ; (n: minimum sample size; p: prevalence;  $\alpha$ : significance threshold (5%);  $Z(\alpha)$ : 95% confidence coefficient which is equal to 1.96), *i.e.* 49 cases at least. In total, this study included 83 patients during the study period, *i.e.*, an exhaustive sample. The study characteristics are summarized in **Table 1**.

**Table 1.** General characteristics of patients with an open fracture of bone of the foot floating at Bouaké University.

| Variables                                                   | Values             |
|-------------------------------------------------------------|--------------------|
| Average age (years)                                         | 31+/-5.9 (17 - 65) |
| Average admission (hour)                                    | 5+/-3.4 (2 - 54)   |
| <b>Gender</b>                                               |                    |
| Men                                                         | (n = 65; 78.3%)    |
| Female                                                      | (n = 18; 21.7%)    |
| <b>Occupation</b>                                           |                    |
| Direct service staff for individuals. merchants and sellers | (n = 30; 36.1 %)   |
| Pupils and student                                          | n = 21; 25.4%)     |
| Farmers and skilled agricultural workers                    | (n = 12; 14.5%)    |

**Continued**

|                                           |                 |
|-------------------------------------------|-----------------|
| Elementary professions (masons, laborers) | (n = 8; 9.6%)   |
| Teaching speciality (teachers)            | (n = 5; 6%)     |
| Healthcare                                | (n = 4; 4.8%)   |
| Military profession                       | (n = 3; 3.6%)   |
| <b>Etiologies</b>                         |                 |
| Road traffic accident                     | (n = 68; 81.9%) |
| Ballistic accident                        | (n = 6; 7.3%)   |
| Domestic accident                         | (n = 5; 6%)     |
| Work Accident                             | (n = 4; 4.8%)   |
| <b>Gustilo-Anderson classification</b>    |                 |
| Type I                                    | (n = 21; 25.4%) |
| Type II                                   | (n = 35; 42.1%) |
| Type IIIa                                 | (n = 17; 20.4%) |
| Type IIIb                                 | (n = 8; 9.6%)   |
| Type IIIc                                 | (n = 2; 2.5%)   |
| <b>Fracture site</b>                      |                 |
| Fore foot                                 | (n = 51; 61.4%) |
| Midfoot                                   | (n = 15; 18.1%) |
| Rearfoot                                  | (n = 17; 20.5%) |
| <b>Number of broken bones</b>             |                 |
| 1                                         | (n = 47; 56.6%) |
| 2                                         | (n = 19; 19.3%) |
| >2                                        | (n = 20; 24.1%) |
| <b>Broken bone</b>                        |                 |
| Métatarsal                                | (n = 48; 57.8%) |
| Phalanges                                 | (n = 15; 18.1%) |
| Calcaneus                                 | (n = 11; 13.3%) |
| Cuboid                                    | (n = 3; 3.6%)   |
| Navicular                                 | (n = 2; 2.4%)   |
| Cunéiform                                 | (n = 2; 2.4%)   |
| Talus                                     | (n = 2; 2.4%)   |
| <b>Type of fracture line</b>              |                 |
| <b>Simple</b>                             |                 |
| Transverse                                | (n = 13; 15.6%) |
| Oblique                                   | (n = 41; 49.4%) |
| Spiral                                    | (n = 5; 6%)     |

## Continued

| Complex                                    |                    |
|--------------------------------------------|--------------------|
| 3 <sup>rd</sup> fragment                   | (n = 9; 10.9%)     |
| Bifocal                                    | (n = 4; 4.8%)      |
| Comminutive                                | (n = 11; 13.3%)    |
| Associated lesion                          |                    |
| Removal                                    | (n = 19; 22.8%)    |
| Dislocations                               | (n = 5; 6%)        |
| Tendon section                             | (n = 22; 26.5%)    |
| Fractures (femur. leg. malléolus. humérus) | (n = 11; 13.3%)    |
| Others (face. skull. abdomen. urogenital)  | (n = 10; 12.1%)    |
| Average therapeutic time (hours)           |                    |
| <48 h                                      | (n = 21; 25.3%)    |
| >48h                                       | (n = 62; 74.4%)    |
| Average duration of intervention (hours)   |                    |
|                                            | 2.4+/- 1.6 (1 - 4) |

Tetanus vaccination was up to date in 42 (50.6%) patients. The wound was located on the dorsal (n = 48; 57.8%) and plantar aspect of the foot (n = 35; 42.2%). The fractures were displaced (n = 61; 73.5%) and non-displaced (n = 22; 26.5%). Concerning the metatarsals, the first (n = 8; 9.6%), the central ones (n = 29; 35%) and the fifth (n = 11; 13.2%) were affected. Associated lesions were observed in 67 patients (80.7%). The Lisfranc joint was affected in 7 cases (8.4%). Surgical treatment was carried out in the operating room under locoregional (n = 77; 92.7%) or general (n = 6; 7.3%) anesthesia. Trimming was carried out before osteosynthesis. The type of restraint is summarized in **Table 2**. Coverage was achieved by suture (n = 59; 71.1%), directed healing (n = 19; 22.9%) and a flap (n = 5; 6%).

**Table 2.** Methods of contention of fractures of patients with an open fractures of bone of the foot at the Bouaké University Hospital.

| Type de Gustilo | Métatarsal         | Phalange           | Calcaneus          | Cuboïd     | Cunéiform  | Naviculaire | Talus      | Mixed              |
|-----------------|--------------------|--------------------|--------------------|------------|------------|-------------|------------|--------------------|
| I (n = 21)      | Br + BP<br>(n = 4) | Br + AT<br>(n = 4) | Br + BP<br>(n = 1) | Br (n = 0) | Br (n = 0) | Br (n = 0)  | Br (n = 0) | Br + BP<br>(n = 1) |
|                 | BP (n = 2)         | BP (n = 0)         | BP (n = 1)         | BP (n = 0) | BP (n = 1) | BP (n = 0)  | BP (n = 0) | BP (n = 3)         |
|                 | Br + AT<br>(n = 2) | S (n = 2)          |                    |            |            |             |            |                    |
| II (n = 35)     | Br + BP<br>(n = 6) | Br + AT<br>(n = 5) | Br + BP<br>(n = 2) | Br (n = 0) | Br (n = 0) | Br (n = 0)  | Br (n = 0) | Br + BP<br>(n = 2) |
|                 | BP (n = 5)         | BP (n = 1)         | BP (n = 3)         | BP (n = 0) | BP (n = 0) | BP (n = 0)  | BP (n = 1) | BP (n = 6)         |
|                 | Br + AT<br>(n = 2) | AT (n = 2)         |                    |            |            |             |            |                    |

**Continued**

|               |                    |                    |                    |                    |            |            |               |                    |
|---------------|--------------------|--------------------|--------------------|--------------------|------------|------------|---------------|--------------------|
| IIIa (n = 17) | Br + AT<br>(n = 5) | Br + AT<br>(n = 2) | Br + AT<br>(n = 3) | Br (n = 0)         | Br (n = 0) | Br (n = 0) | Br/BP (n = 1) | Br + AT<br>(n = 3) |
|               | BP (n = 1)         | BP (n = 0)         | BP (n = 0)         | BP (n = 0)         | BP (n = 0) | BP (n = 0) | BP (n = 0)    | BP (n = 1)         |
| AT (n = 1)    |                    |                    |                    |                    |            |            |               |                    |
| IIIb (n = 8)  | Br + AT<br>(n = 2) | Br + AT<br>(n = 2) | Br + AT<br>(n = 1) | Br + AT<br>(n = 1) | Br (n = 0) | Br (n = 0) | Br (n = 0)    | Br + AT<br>(n = 2) |
|               | BP (n = 0)         | BP (n = 0)         | BP (n = 0)         | BP (n = 0)         | BP (n = 0) | BP (n = 0) | BP (n = 0)    | BP (n = 0)         |
| IIIc (n = 2)  | Br + BP<br>(n = 1) | Br (n = 0)         | Br (n = 0)         | Br (n = 0)         | Br (n = 0) | Br (n = 0) | Br (n = 0)    | Br + AT<br>(n = 1) |
|               | BP (n = 0)         | BP (n = 0)         | BP (n = 0)         | BP (n = 0)         | BP (n = 0) | BP (n = 0) | BP (n = 0)    | BP (n = 0)         |

\*Br: pin; BP: cast boot; S: syndactyly; AT: cast splint; Br + BP: pin + cast boot; Br + AT: pin + cast splint; \*Mixed: >2 different fractured bones.

**3.2. Results after Treatment**

The post-therapeutic results are summarized in **Table 3**. The bacteriological samples taken during the infections noted as germs *Staphylococcus aureus* (n = 7), and *Enterobacter* sp (n = 2) sensitive to usual antibiotics. The consolidation (**Figure 1**) concerned 81 patients because two patients were amputated following complications. The functional result concerned 58 patients.



**Figure 1.** Profile X-ray of the foot of a type III open fracture of the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> metatarsals with interphalangeal dislocation of the 5<sup>th</sup> toe treated by pinning.

**3.3. Logistic Regression Analysis**

**Table 4** summarizes the binary (p < 0.2) then multivariate (p < 0.05) logistic regression analysis of the predictive factors of an unsatisfactory functional result. In the univariate analysis, complex fracture line, more than two fractured bones, Gustilo type III, associated lesions, a pre-therapeutic delay > 48 hours, an intervention

**Table 3.** Post therapeutic characteristics of patients with an open fracture of bone of the foot at Bouaké University Hospital.

| Variables                                  | Values                   |
|--------------------------------------------|--------------------------|
| Average duration of hospitalization (days) | 16 ± 5.9 (2 - 32)        |
| Average healing time (days)                | 19 ± 9.1 (3 - 59)        |
| Rehabilitation                             | (n = 17; 20.4%)          |
| Average number of sessions                 | 6/-5.3 (4 - 12)          |
| Complications                              |                          |
| Infections (suppuration)                   | (n = 9; 10.9%)           |
| Skin necrosis                              | (n = 4; 4.8%)            |
| Acute forefoot ischemia                    | (n = 2; 2.4%)            |
| Secondary movement                         | (n = 2; 2.4%)            |
| Vicious callus                             | (n = 2; 2.4%)            |
| Osteitis                                   | (n = 5; 6%)              |
| Complex regional pain syndrome             | (n = 5; 6%)              |
| Consolidation (months)                     | 3 ± 3.3 mois (2 - 7)     |
| Average follow-up (months)                 | 87 ± 6.8 mois (62 - 125) |
| Functional result (AOFAS)                  |                          |
| Very good                                  | (n = 29; 50%)            |
| Good                                       | (n = 17; 29.3%)          |
| Average                                    | (n = 6; 10.3%)           |
| Bad                                        | (n = 6; 10.3%)           |
| Average SF-36 score                        | 67 ± 69.4 (49 - 76)      |

duration > 2 hours, a restraint orthopedic condition, lack of rehabilitation, and the presence of complications were factors associated with a poor outcome. In the multivariate analysis, Associated lesions, more than two fractured bones, lack of rehabilitation as predictors of poor outcomes.

**Table 4.** Results of the logistic regression of the predictive factors of unsatisfactory functional result of the open fracture of foot at the Bouake Hospital.

| Indépendant variables    | Univariate analysis  |             | Multivariate analysis |             |
|--------------------------|----------------------|-------------|-----------------------|-------------|
|                          | ORb (IC 95%)         | p-value     | ORa (IC 95%)          | p-value     |
| Age (>30 ans)            | 1.14 (0.14 - 13.81)  | 0.97        |                       |             |
| Line type (complex)      | 1.82 (0.18 - 93.22)  | <b>0.17</b> |                       | 0.64        |
| Number of fracture (>2)  | 4.78 (0.61 - 58.08)  | <b>0.08</b> | 2.81 (0.00 - 13.47)   | <b>0.04</b> |
| Gustilo type (type III)  | 2.26 (0.46 - 58.28)  | <b>0.05</b> |                       | 0.09        |
| Associated lesions (yes) | 1.02 (0.13 - 26.16)  | <b>0.04</b> | 4.11 (1.28 - 65.04)   | <b>0.01</b> |
| Processing time (>48 h)  | 2.19 (0.21 - 111.51) | <b>0.16</b> |                       | 0.32        |

**Continued**

|                                 |                     |             |                     |             |
|---------------------------------|---------------------|-------------|---------------------|-------------|
| Duration of intervention (>2 h) | 0.92 (0.11 - 7.58)  | 0.25        |                     | 0.87        |
| Type of fixation (orthopaedic)  | 1.14 (0.01 - 1.22)  | <b>0.03</b> |                     | 0.17        |
| Rehabilitation (no)             | 5.33 (0.03 - 14.44) | <b>0.00</b> | 6.06 (4.53 - 86.11) | <b>0.04</b> |
| Complications (yes)             | 1.51 (0.16 - 13.45) | <b>0.05</b> |                     | 0.70        |

IC: Intervalle de confiance; OR: Odds ratio (b = brut; a = ajusté).

#### 4. Discussion

The main objective of this study was to evaluate the functional results of patients with an open foot fracture. The secondary objectives were to identify the factors influencing the functional outcome. The functional result was satisfactory in 89.6% of cases. Associated lesions, more than two fractured bones, lack of rehabilitation as predictors of poor outcomes following a multivariate logistic regression analysis. This study is the first to specifically study open foot fracture in the local context and their functional prognosis. Here is no general study on open fractures of all bones of the foot but rather specific studies for each bone. Functional assessment simultaneously with that of quality of life in patients with an open foot fracture is uncommon in the literature [4] [5] [7] [37]. Thanks to this double assessment, it is possible to assess the physical functional sequelae and to evaluate the patient overall [37] [38]. The outcome functional is evaluated according to AOFAS by the majority of authors for this type of fracture [12] [15] [23] [36]. The results are discordant because the fractures are varied [2]-[4] [10] [43]. The rate of satisfactory result obtained was consistent with those of Yao *et al.* (65%) [7], Sangaré *et al.* [20] (73%) and Zangh *et al.* [25] (75%). The functional outcome, according to AOFAS of the present study, corroborated those of the African and non-African literature [7] [20] [25] [27] [44]. The quality of life of patients after treatment was assessed by the SF-36 quality of life scale [37] [38]. It specifies the overall state of health of the patient which would be linked to a satisfactory functional result most often [29] [30] [38]. The high number of type II fractures, mostly isolated metatarsal fractures, the consolidation and normal healing in this study could explain this [10] [22] [23] [27]. Fractures without joint involvement as observed in this study have a good functional prognosis, due to a low complication rate and a short union time. Consolidation was achieved within normal time frames. It was consistent with those in the literature [3]-[7] [11]-[14] [18]-[28]. It would be related to the predominance of non-articular fractures, and in particular of the central metatarsals in this present study [20] [23]-[28] [32] [44]. Metatarsal fractures have a propensity for consolidation, even open ones [11]-[14] [18]-[28]. The rate of infectious complications (13%) observed was consistent with literature data [7] [10] [13] [14] [17] [18] [26] [45] [46]. Sloan *et al.* [16] (3%) and Yin *et al.* [45] (3.9%) observed lower rates. This rate could be explained by the long trimming time (>48 hours) observed. Skin opening during a fracture and delay in treatment are negative factors for infection in the literature

[16]-[18] [46]. Several patients did not undergo physiotherapy as in most African studies [7] [13] [14] [20] [28]. Open fractures of the foot have a predisposition to a delay in full weight bearing [4] [18] [28]-[32]. The severity of soft tissue lesions may be the cause of chronic pain leading to a complex regional pain syndrome [30] [44].

Associated lesions ( $p = 0.01$ ; OR = 4.11) was predictor of poor outcome observed in this study as in the literature [4] [30]-[32] [47]. Court-Brow *et al.* [14], Turchin *et al.* [30], Tran *et al.* [47] concluded that foot fracture associated with other lesions affected functional outcome and general health status. This is a function of lesions of other devices which could be the cause of a delay in treatment or a late rise. These associated lesions may be more urgent to treat, and/or sometimes mask the open fracture of the foot [38] [39] [47].

More than 2 fractured bones ( $p = 0.04$ ; OR = 2.81) was predictor of poor outcome observed in other studies [4] [6] [27] [44]. Metatarsal fractures were the most common more observed. The association of metatarsal and calcaneus fractures is often found [3] [5] [8] [18] [26]. Metatarsal fractures are diverse, ranging from a single metatarsal fracture to a combined metatarsal fracture. These combined or mixed fractures sometimes occur during violent or crushing mechanisms [44] [48] [49]. Central metatarsal fractures were the most common in the present study. They are sources of significant functional after-effects such as metatarsalgia most often but consolidate well [27] [32] [44]. The predominance of displaced fractures, complex features, and the association of other fractures could justify this [4] [27] [44] [47] [48]. Fractures with an articular component result in an unsatisfactory functional result [10] [18] [23].

Most fractures in this study were non-articular. Lack of rehabilitation ( $p = 0.04$ ; OR = 6.06) was predictor of poor outcome for open fracture of the bones of the foot. This observation has been made by other authors [4] [7] [32] [44] [49] [50]. The reasons are diverse. The capacity to provide physiotherapy care is low. Physiotherapists are insufficient. This study has limitations. It is retrospective and monocentric. This series is homogeneous because all patients were operated on. However, the type of restraint performed could make the functional assessment difficult. This study represents the first specific to open fracture of the bones of the foot. She is also the first to determine the factors of functional prognosis and the quality of life of patients after treatment in the local literature. These determined independent variables lead to the establishment of so-called predictive scores for better care of foot trauma patients. Understanding the specificities of each foot bone fracture remains fundamental.

## 5. Conclusion

This study on the results of open fracture of the bones of the foot noted a satisfactory overall functional result in 89.6%. Union was achieved in all patients. Infection was the major complication but with a low rate. Associated lesions, more than two fractured bones, lack of rehabilitation as predictors of poor outcomes

following a multivariate logistic regression analysis. The patients' quality of life according to the SF-36 scale was satisfactory at last follow-up.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

### References

- [1] Beerekamp, M.S.H., de Muinck Keizer, R.J.O., Schep, N.W.L., Ubbink, D.T., Panne-man, M.J.M. and Goslings, J.C. (2017) Epidemiology of Extremity Fractures in the Netherlands. *Injury*, **48**, 1355-1362. <https://doi.org/10.1016/j.injury.2017.04.047>
- [2] Cakir, H., Van Vliet-Koppert, S.T., Van Lieshout, E.M.M., De Vries, M.R., Van Der Elst, M. and Schepers, T. (2010) Demographics and Outcome of Metatarsal Fractures. *Archives of Orthopaedic and Trauma Surgery*, **131**, 241-245. <https://doi.org/10.1007/s00402-010-1164-6>
- [3] Balaji, G., Nema, S. and Kumar, A. (2020) A Study on Epidemiology of Foot Injuries in South Indian Population at a Tertiary Care Centre. *International Journal of Research in Orthopaedics*, **6**, 1063-1069. <https://doi.org/10.18203/issn.2455-4510.intjresorthop20203732>
- [4] Court-Brown, C., Honeyman, C., Bugler, K. and McQueen, M. (2013) The Spectrum of Open Fractures of the Foot in Adults. *Foot & Ankle International*, **34**, 323-328. <https://doi.org/10.1177/1071100712466232>
- [5] Akobe, A.J.R., Sery, B.J.L.N., Yagra, A., et al. (2022) Traumatismes du pied: Aspects épidémiologiques, anatomopathologiques et thérapeutiques au service d'Orthopédie-Traumatologie du Centre Hospitalier Universitaire de Bouaké (Côte d'Ivoire). *Médecine d'Afrique Noire*, **69**, 48-54.
- [6] Petrisor, B.A., Ekrol, I. and Court-Brown, C. (2006) The Epidemiology of Metatarsal Fractures. *Foot & Ankle International*, **27**, 172-174. <https://doi.org/10.1177/107110070602700303>
- [7] Yao, L.B., Krah, K.L., M'bra, K.I., Akobe, A.J.R., Kouassi, A.N.A. and Kodo, M. (2021) Traumatismes du pied des usagers de motocycles à Bouaké. *Revue Internationale des Sciences Médicales*, **23**, 229-235.
- [8] Buchholz, R.W., Court-Brown, C.M., Heckman, J.D. and Tornetta, P. (2010) Rockwood and Green's Fractures in Adults. *Lippincott Williams & Wilkins*, **7**, 53-84.
- [9] Leite, C.B.G., Macedo, R.S., Saito, G.H., Sakaki, M.H., Kojima, K.E. and Fernandes, T.D. (2018) Epidemiological Study on Calcaneus Fractures in a Tertiary Hospital. *Revista Brasileira de Ortopedia (English Edition)*, **53**, 472-476. <https://doi.org/10.1016/j.rboe.2018.05.014>
- [10] Hoxie, S., Turner, N.S., Strickland, J. and Jacofsky, D. (2007) Évolution clinique des fractures métatarsiennes ouvertes. *Orthopédie*, **30**, 662-665.
- [11] Wood, A.M., Robertson, G.A., Rennie, L., Caesar, B.C. and Court-Brown, C.M. (2010) The Epidemiology of Sports-Related Fractures in Adolescents. *Injury*, **41**, 834-838. <https://doi.org/10.1016/j.injury.2010.04.008>
- [12] Holbrook, T.L., Hoyt, D.B. and Anderson, a.J.P. (2001) The Importance of Gender on Outcome after Major Trauma: Functional and Psychologic Outcomes in Women versus Men. *The Journal of Trauma: Injury, Infection, and Critical Care*, **50**, 270-273. <https://doi.org/10.1097/00005373-200102000-00012>
- [13] Ibrahima, F., Fokam, P., Douala, M.S., et al. (2011) Traumatismes de l'appareil

- locomoteur au Cameroun. A propos de 456 cas observés pendant 5 ans à l'hôpital général de Douala. *Health Sciences and Diseases*, **12**, 1-7.
- [14] Kouassi, K.J.E., Yao, L.B., Sery, B.N.J.L., et al. (2018) Plaies du tendon calcanéen par rayons de roue arrière de moto. *African Journal of Orthopedics and Traumatologic Surgery*, **3**, 2-6.
- [15] Rozell, J.C., Connolly, K.P. and Mehta, S. (2017) Timing of Operative Debridement in Open Fractures. *Orthopedic Clinics of North America*, **48**, 25-34. <https://doi.org/10.1016/j.ocl.2016.08.006>
- [16] Sloan, J.P., Dove, A.F., Maheson, M., Cope, A.N. and Welsh, K.R. (1987) Antibiotics in Open Fractures of the Distal Phalanx? *Journal of Hand Surgery*, **12**, 123-124. [https://doi.org/10.1016/0266-7681\(87\)90076-3](https://doi.org/10.1016/0266-7681(87)90076-3)
- [17] Gustilo, R.B., Merkow, R.L. and Templeman, D. (1990) The Management of Open Fractures. *The Journal of Bone & Joint Surgery*, **72**, 299-304. <https://doi.org/10.2106/00004623-199072020-00023>
- [18] Prakash, C., Ravindra, P., Mandeep, S.D. and Shivender, S.G. (2006) Prise en charge des fractures ouvertes complexes du médio-pied avec fixation externe. *Le Journal de la chirurgie du pied et de la cheville*, **45**, 308-315.
- [19] van der Vliet, Q.M.J., Lucas, R.C., Velmahos, G., Houwert, R.M., Leenen, L.P.H., Hietbrink, F., et al. (2018) Foot Fractures in Polytrauma Patients: Injury Characteristics and Timing of Diagnosis. *Injury*, **49**, 1233-1237. <https://doi.org/10.1016/j.injury.2018.04.009>
- [20] Sangaré, A., Alwata, I., Koné, I., Sidibé, S. and Touré, A.A. (2008) Etude des fractures du pied dans le service d'orthopédie et de traumatologie de l'hôpital Gabriel Toure sur dix ans. *Mali Medical*, **23**, 21-24.
- [21] Hedström, E.M., Bergström, U. and Michno, P. (2012) Injuries in Children and Adolescents—Analysis of 41, 330 Injury Related Visits to an Emergency Department in Northern Sweden. *Injury*, **43**, 1403-1408. <https://doi.org/10.1016/j.injury.2011.01.027>
- [22] Jeffers, R.F., Tan, H.B., Nicolopoulos, C., Kamath, R. and Giannoudis, P.V. (2004) Prevalence and Patterns of Foot Injuries Following Motorcycle Trauma. *Journal of Orthopaedic Trauma*, **18**, 87-91. <https://doi.org/10.1097/00005131-200402000-00005>
- [23] Maxwell, J. (1983) Open or Closed Treatment of Metatarsal Fractures. Indications and Techniques. *Journal of the American Podiatric Medical Association*, **73**, 100-106. <https://doi.org/10.7547/87507315-73-2-100>
- [24] Miki, N., Martimbianco, A.L.C., Hira, L.T., Lahoz, G.L., Fernandes, H.J.A. and Reis, F.B.d. (2014) Profile of Trauma Victims of Motorcycle Accidents Treated at Hospital São Paulo. *Acta Ortopédica Brasileira*, **22**, 219-222. <https://doi.org/10.1590/1413-78522014220400642>
- [25] Zhang, T., Yan, Y., Xie, X. and Mu, W. (2016) Minimally Invasive Sinus Tarsi Approach with Cannulated Screw Fixation Combined with Vacuum-Assisted Closure for Treatment of Severe Open Calcaneal Fractures with Medial Wounds. *The Journal of Foot and Ankle Surgery*, **55**, 112-116. <https://doi.org/10.1053/j.jfas.2015.07.023>
- [26] Gao, X., Fan, H., Huang, R., Sui, Y., Li, F. and Yin, H. (2021) Management of Open Calcaneal Fractures with Medial Wounds by One-stage Sequential Reduction and Frame Structure Fixation Using Percutaneous Kirschner Wires. *Orthopaedic Surgery*, **13**, 225-236. <https://doi.org/10.1111/os.12902>
- [27] Ancelin, D. (2024) Fractures des métatarsiens sans atteinte du Lisfranc. *Revue de*

- Chirurgie Orthopédique et Traumatologique*, **110**, 811-822.  
<https://doi.org/10.1016/j.rcot.2024.06.019>
- [28] Akobé, A.J.R., Kouassi, A.A.N., Yao, L.B., et al. (2022) Lésions traumatiques du membre pelvien par les rayons de roues de motocycle. *African Journal of Biomedical Research*, **27**, 10-14.
- [29] Ware, J.E. and Sherbourne, C.D. (1992) The MOS 36-Item Short-Form Health Survey (SF-36): Conceptual Framework and Item Selection. *Medical Care*, **30**, 473-483.  
<https://doi.org/10.1097/00005650-199206000-00002>
- [30] Turchin, D.C., Schemitsch, E.H., McKee, M.D. and Waddell, J.P. (1999) Do Foot Injuries Significantly Affect the Functional Outcome of Multiply Injured Patients? *Journal of Orthopaedic Trauma*, **13**, 1-4.  
<https://doi.org/10.1097/00005131-199901000-00001>
- [31] Richter, M., Thermann, H., Wippermann, B., Otte, D., Schrott, H. and Tscherne, H. (2001) Foot Fractures in Restrained Front Seat Car Occupants: A Long-Term Study over Twenty-Three Years. *Journal of Orthopaedic Trauma*, **15**, 287-293.  
<https://doi.org/10.1097/00005131-200105000-00009>
- [32] Sánchez, L.E., Carsi, V.V., Alcántara, P. and Llabrés, A.J. (1996) Fractures du métatarsien central. *Pied et Cheville International*, **17**, 193-194.
- [33] Gedda, M. (2015) Traduction française des lignes directrices STROBE pour l'écriture et la lecture des études observationnelles. *Kinésithérapie, la Revue*, **15**, 34-38.  
<https://doi.org/10.1016/j.kine.2014.11.003>
- [34] Serhier, Z., Bendahhou, K., Ben Abdelaziz, A., et al. (2020) Fiche Méthodologique n°1: Comment calculer la taille d'un échantillon pour une étude observationnelle? *La Tunisie Médicale*, **98**, 1-7.
- [35] Gustilo, R. and Anderson, J. (1976) Prevention of Infection in the Treatment of One Thousand and Twenty-Five Open Fractures of Long Bones: Retrospective and Prospective Analysis. *The Journal of Bone & Joint Surgery*, **58**, 453-458.  
<https://doi.org/10.2106/00004623-197658040-00004>
- [36] Kitaoka, H.B., Alexander, I.J., Adelaar, R.S., Nunley, J.A., Myerson, M.S. and Sanders, M. (1994) Clinical Rating Systems for the Ankle-Hindfoot, Midfoot, Hallux, and Lesser Toes. *Foot & Ankle International*, **15**, 349-353.  
<https://doi.org/10.1177/107110079401500701>
- [37] SooHoo, N.F., Vyas, R. and Samini, D. (2006) Responsiveness of the Foot Function Index, AOFAS Clinical Rating Systems, and SF-36 after Foot and Ankle Surgery. *Foot & Ankle International*, **27**, 930-934. <https://doi.org/10.1177/107110070602701111>
- [38] Duparc, R., Mendoza, R.M. and William, J.N. (1984) Problems in the Management of Type Three (Severe) Open Fractures: A New Classification of Type Three Open Fractures. *Journal of Trauma*, **24**, 742-746.  
<https://doi.org/10.1097/00005373-198408000-00009>
- [39] Kouassi, K.J.E., Kouassi, A.N.A., Berete, P.I.J., et al. (2021) Clou de Küntscher: Une entité oubliée mais une modalité fiable dans le traitement des fractures diaphysaires du fémur en milieu à ressources limitées. *Revue Internationale des Sciences Médicales*, **23**, 155-161.
- [40] Gedda, M. and Riche, B. (2015) Traduction française des lignes directrices SAMPL pour l'écriture et la lecture des méthodes et analyses statistiques. *Kinésithérapie, la Revue*, **15**, 69-74. <https://doi.org/10.1016/j.kine.2014.11.010>
- [41] Aminot, I. and Damon, M. (2002) Régression logistique: Intérêt dans l'analyse de données relatives aux pratiques médicales. *Revue Médicale de l'Assurance Maladie*,

33, 137-143.

- [42] Mion, G., Herault, S., Libert, N. and Journois, D. (2010) Eléments indispensables de statistiques médicales Opus 5—Analyses multivariées-régression multiple-régression logistique-ACP. *Urgence Pratique*, **102**, 29-37.
- [43] Zayyed, H.S.H., Mohammad, H.E., Mohammad, T.P., Farshid, B.J.H., Sogol, G. and Ali, B. (2019) Injury Patterns among Motorcyclist Trauma Patients: A Cross Sectional Study on 4200 Patients. *The Archives of Bone and Joint Surgery*, **7**, 367-372.
- [44] Egrise, F., Bernard, E., Galliot, F., Pidhorz, L. and Mainard, D. (2024) Prise en charge des fractures d'au moins deux métatarsiens. *Revue de Chirurgie Orthopédique et Traumatologique*, **110**, 300-311. <https://doi.org/10.1016/j.rcot.2022.04.004>
- [45] Li, Y., Bao, R., Jiang, Z. and Wu, H. (2016) Management and Associated Factors of Complications in Operative Fixation of Calcaneal Fractures. *Pakistan Journal of Medical Sciences*, **32**, 857-862. <https://doi.org/10.12669/pjms.324.10225>
- [46] Patzakis, M.J. and Wilkins, J. (1989) Factors Influencing Infection Rate in Open Fracture Wounds. *Clinical Orthopaedics and Related Research*, **243**, 36-40. <https://doi.org/10.1097/00003086-198906000-00006>
- [47] Tran, T. and Thordarson, D. (2002) Functional Outcome of Multiply Injured Patients with Associated Foot Injury. *Foot & Ankle International*, **23**, 340-343. <https://doi.org/10.1177/107110070202300409>
- [48] Fan, M., Li, X., Jiang, X., Shen, J., Tong, P. and Huang, J. (2019) The Surgical Outcome of Lisfranc Injuries Accompanied by Multiple Metatarsal Fractures: A Multi-center Retrospective Study. *Injury*, **50**, 571-578. <https://doi.org/10.1016/j.injury.2018.12.023>
- [49] Ellington, J.K., Bosse, M.J., Castillo, R.C. and MacKenzie, E.J. (2013) The Mangled Foot and Ankle: Results from a 2-Year Prospective Study. *Journal of Orthopaedic Trauma*, **27**, 43-48. <https://doi.org/10.1097/bot.0b013e31825121b6>
- [50] Hetherington, H., Earlam, R.J. and Kirk, C.J.C. (1995) The Disability Status of Injured Patients Measured by the Functional Independence Measure (FIM) and Their Use of Rehabilitation Services. *Injury*, **26**, 97-101. [https://doi.org/10.1016/0020-1383\(95\)92185-d](https://doi.org/10.1016/0020-1383(95)92185-d)