



Management of humeral shaft fractures : An observational study in adults in N'Djamena (Chad)

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Abstract

Introduction : Humeral shaft fractures (HSF) are common, but limited data are available regarding this condition in Chad. The aim of this study was to describe the epidemiological, clinical, therapeutic, and outcomes aspects of these fractures at the National Reference University Hospital (CHU-RN) of N'Djamena.

Patients and methods : This was a 12-month retrospective observational study (November 2024 to August 2025). All patients aged 18 years and older admitted and treated at the CHU-RN for a recent HSF were included. Functional outcomes were evaluated using the modified Stewart and Hundley score.

Results : Out of 454 admissions for fractures, 43 cases of HSF were recorded, representing a hospital frequency of 9.5% (95% CI : [7.11% - 12.52%]). The median age was 25.1 years with a male predominance (sex ratio of 3.8). Road traffic accidents were the leading etiology (44.2%), mostly involving high-energy trauma (72.1%). The middle third was the most frequent location (53.5%) and complex fracture patterns (AO groups B and C) predominated (58.1%). Initial radial nerve palsy was observed in 7.0% of patients. Treatment was surgical in 60.5% of cases (n = 26), predominantly with open reduction and plate fixation (69.2% of operated patients). At a median follow-up of 10.8 months, the overall union rate was 93.0% with a median healing time of 3.2 months. Functional outcomes were satisfactory (excellent or good) in 81.4% of cases.

Conclusion : Humeral shaft fractures in Chad mainly affect young adult males during high-energy road traffic accidents. Open reduction and plate fixation provides excellent bone union rates and satisfactory functional outcomes.

Keywords: Humeral shaft, fracture, internal fixation, bone plate, Chad

Introduction

Humeral shaft fractures are defined as those where the fracture pattern is located between the insertions of the pectoralis major muscle proximally and the brachialis muscle distally ^[1]. They can occur at any age and primarily affect young individuals following high-energy trauma, as well as elderly osteoporotic individuals following low-energy trauma. Diagnosis is usually straightforward, based on clinical signs and mainly confirmed by radiography ^[2].

These fractures often have an uncomplicated course. Their primary complications include radial nerve palsy (mostly encountered in distal third fractures), nonunion, and elbow joint stiffness ^[3-6]. The management of humeral shaft fractures remains divided between proponents of conservative orthopedic treatment and those of surgical treatment. The proximity of the radial nerve constitutes a major risk that highlights the critical importance of managing these injuries. Orthopedic treatment maintains broad indications, but at the cost of a demanding immobilization for the patient and regular radiographic follow-up ^[7, 8].

They account for 1% to 5% of all long bone fractures ^[9]. They represent approximately 3% of all fractures, resulting from direct or indirect trauma including falls, road traffic accidents, and gunshot wounds, among others ^[10]. They predominantly affect young men in cases of high-energy trauma, unlike female subjects in cases of low-energy trauma related to osteoporosis ^[11].

According to the literature, humeral shaft fractures are frequent, with an incidence of approximately 70,000 cases per year in the United States. In Cameroon, a study conducted in 2025 highlighted a frequency of 4.7% for humeral shaft fractures ^[12]. Another study conducted in 2026 in Mali noted a frequency of 2.33% ^[2]. In Chad, few data exist regarding humeral shaft fractures, which underlines the clinical relevance of the present study.

Patients and Methods

This was a 12-month retrospective observational study (running from November 2024 to August 2025) conducted in the Department of Orthopedic Surgery and Traumatology at the National Reference University Hospital (CHU-RN) of N'Djamena.

The study population consisted of all patients admitted to the department for a humeral fracture.

Inclusion criteria were as follows: All patients aged 18 years and older, admitted to the department for a humeral shaft fracture, who were treated and followed up in the department, and who gave their consent to participate in the study.

Patients admitted for other types of fractures or for non-traumatic injuries were not included. Furthermore, patients with incomplete medical records or those lost to follow-up were excluded from the study.

Data collection was performed using a questionnaire on a pre-designed survey sheet. Data were extracted from medical records, hospitalization logs, operative reports, anesthesia records, and outpatient consultation registers. The variables studied included: sociodemographic, anatomopathological, clinical, paraclinical, therapeutic, and outcomes data.

The AO classification was used to describe fracture patterns, and the Gustilo-Anderson classification was applied in cases of open fractures [13, 14]. Functional and anatomical outcomes were evaluated using the modified Stewart and Hundley score [15], which assesses pain, joint mobility, and post-treatment radiological alignment.

Regarding ethical considerations, research clearance was obtained from the Dean's Office of the Faculty of Human Health Sciences at the University of N'Djamena, along with an authorization from the management of the National Reference University Hospital. Informed consent was obtained from all patients. Data collection was carried out ensuring patient anonymity by using unique codes to protect the participants' identities. Strict confidentiality was maintained throughout. Survey respondents were contacted by telephone to obtain further information and to perform the functional assessment.

Data entry was performed using Microsoft Word and Excel 2016 software, and then exported to SPSS version 25.0 software for statistical analysis after a double-check process. Qualitative variables were expressed as absolute frequencies and percentages. For injury frequency, the 95% confidence interval (CI) was calculated using the Wilson score method. The normality of the distribution for the variables "age", "time to consultation", and "follow-up period" was previously verified for each group using the Shapiro-Wilk test. For all these variables, the normality hypothesis was rejected ($p < 0.05$), and comparisons between independent groups were performed using the non-parametric Mann-Whitney U test. Due to the non-normal distribution, these variables were expressed as median and interquartile range [Q1; Q3].

Results

Epidemiological and Sociodemographic data

During the study period, we recorded 454 admissions for fractures, including 43 patients admitted for a humeral shaft fracture. The hospital frequency was 9.5% (95% CI according to Wilson: [7.11% - 12.52%]).

The median age of the patients was 25.1 years, with an interquartile range of [19.4 – 34.6] years (IQR = 15.2 years). Male patients accounted for 79.0% ($n = 34$) compared to 21.0% for females ($n = 9$), representing a sex ratio of 3.8.

The distribution of patients according to occupation was as follows: students/pupils ($n = 19$; 44.2%), farmers/herders ($n = 7$; 16.3%), laborers ($n = 6$; 13.9%), housewives ($n = 4$; 9.3%), traders ($n = 3$; 7.0%), civil servants ($n = 2$; 4.6%), and others ($n = 2$; 4.6%).

The educational level of the subjects was distributed as follows: unschooled ($n = 17$; 39.5%), secondary education ($n = 11$; 25.6%), primary education ($n = 9$; 21.0%), and higher education ($n = 6$; 13.9%).

Clinical and Injury Characteristics

The etiologies of the trauma were dominated by road traffic accidents ($n = 19$; 44.2%), followed by sports accidents ($n = 7$; 16.3%), domestic accidents ($n = 5$; 11.6%), and

altercations ($n = 3$; 7.0%), including two cases of gunshot wounds ($n = 2$; 4.7%). The trauma mechanism was direct in 84.0% of cases ($n = 36$) and indirect in 16.0% of cases ($n = 7$). The kinetic energy was high in 72.1% of cases ($n = 31$) and low in 27.9% ($n = 12$) of cases.

The median time to admission was 13.3 hours, with an interquartile range of [5.9 – 20.7] hours (IQR = 14.9 hours). More than half of the patients (60.5%) were admitted between 6 and 24 hours after the trauma. The median time to management was estimated at 3.9 hours, with an interquartile range of [2.0 – 5.9] hours (IQR = 3.9 hours).

Involvement of the right thoracic limb accounted for 67.4% ($n = 29$) of cases versus 32.6% ($n = 14$) for the left. The dominant side was involved in 53.5% of cases ($n = 23$). The distribution of patients according to the fracture site is shown in Table I.

Table 1: Location of the fractures.

Location	N	%
Distal third	15	35
Middle third	23	53.5
Proximal third	5	11.6
Total	43	100

Fractures were closed in 83.7% of cases ($n = 36$) and open in 16.3% ($n = 7$) of cases. Open fractures were classified according to Gustilo and Anderson : type I ($n = 1$; 2.3%), type II ($n = 4$; 9.3%), and type III ($n = 2$; 4.6%). The classification of fracture patterns according to the AO system is shown in Table II.

Table 2: Fracture patterns types classified according to the AO system

Fracture pattern	N	%
A3	7	16,3
A2	3	7,0
A1	8	18,6
B1	3	7
B2	9	20,9
B3	6	14
C1	2	4,7
C2	2	4,7
C3	3	7
Total	43	100

Associated injuries were noted in 60.5% ($n = 26$) of the patients, including 6 (14%) cases of polytrauma. Among these associated injuries (with multiple injuries possible per patient), we observed: limb fractures in 14 (32,5%) patients, with lower limb fracture being the most frequent injury, accounting for 11 (25.6%) cases; traumatic brain injury in 7 (16.3%) patients; and nerve injury in 6 (14%) patients. Peripheral fracture sites were located at the clavicle, radius/ulna, femur, and tibia. Initial nerve involvements affected the radial nerve ($n = 3$; 7.0%), the median nerve ($n = 2$; 4.6%), and the ulnar nerve ($n = 1$; 2.3%).

Therapeutic and Outcomes Aspects

Treatment was orthopedic in 39.5% ($n = 17$) of patients and surgical in 60.5% ($n = 26$) of cases. Table III shows the distribution of patients according to the type of stabilization used.

Table 3: Distribution of all patients according to the type of stabilization

	Treatment / Stabilization	N	%
Orthopedic treatment	"U" splint (AO)	7	16,2
	Shoulder immobilizer	10	23,3
Surgical treatment	Plate fixation	18	41,9
	External fixator	5	11,6
	K-wire	3	7
	Total	43	100

Functional rehabilitation was systematic. It was initiated early (from 48 hours postoperatively) and consisted of elbow mobilization and pronosupination exercises in cases of surgical treatment. In cases of orthopedic treatment, rehabilitation began upon removal of the immobilization device.

The median follow-up of patients was 10.8 months (IQR : [7.7 - 14.2]) with extremes of 3 and 18 months. Bone union was achieved in 40 (93%) patients. The median time to union was 3.2 months (IQR : [2.4 - 3.8] months) with extremes of 1.8 to 4.6 months. We recorded 3 (7%) cases of nonunion. Overall functional outcomes, evaluated using the Stewart and Hundley score, are detailed in Table IV.

Table 4: Distribution of patients according to the Stewart and Hundley

Score	N	%
Very good	32	74,4
Good	3	7
Fair	1	2,3
Poor	7	16,3
Total	43	100

Discussion

This retrospective observational study was conducted at the National Reference University Hospital (CHU-RN) of N'Djamena. It lasted 12 months and provides the first quantified data on humeral shaft fractures (HSF) in adults in Chad. The hospital frequency of HSF among all fractures was 9.5% (95% CI: [7.11% - 12.52%]). The patients were predominantly male (79.1%; n = 34) and young, with a median age of 25.1 years. The injuries were most frequently high-energy (72.1%) and occurred secondary to road traffic accidents (RTAs: 44.2%). The middle third of the shaft was the predominant location for these fractures (53.5%; n = 23). These results show that complex fracture patterns (AO classification groups B and C) represent the majority, accounting for 58.1% (n = 25) of the series (Fig 1AB,2AB,3AB).

Associated injuries were observed in 60.5% (n = 26) of patients, including 7% (n = 3) with primary radial nerve involvement. Surgical treatment was performed in 60.5% of cases (n = 26). At a median follow-up of 10.8 months, the overall union rate was 93% (n = 40) with a median healing time of 3.2 months, yielding 81.4% (n = 35) of satisfactory functional outcomes (excellent and good) according to the modified Stewart and Hundley score.

The 9.5% hospital rate recorded in our series appears higher than the hospital prevalences published in the sub-Saharan region, where documented figures typically range from 1% to 5% [1, 9, 16-18]. This difference is explained by the CHU-

RN's status as a tertiary referral center, but also by the scarcity of orthopedic surgeons in secondary-level hospitals outside the capital. Our center receives the bulk of complex trauma emergencies and severe injuries from N'Djamena and the surrounding provinces. Conversely, a study conducted on children in the same region noted a frequency close to ours, reaching 9.8% [19].

In our series, the injuries primarily affect young male subjects, reflecting the major exposure of the active population to environmental and road risk factors. These data are consistent with other African studies where the mean age hovers around 30 years with a clear male predominance [1, 16, 20, 21]. In contrast, in high-income countries, the epidemiological distribution is bimodal with a major peak in elderly osteoporotic women following falls from standing height [22]. The study by Dalatou *et al.*, conducted in France, thus mentioned a predominance of injuries in patients with a mean age of 77 years [20]. Chad has a predominantly young population, which explains the rarity of fractures on osteoporotic bone in our sample.

RTAs were the leading etiology of fractures in this study, directly related to the increasing density of motorized two-wheeler traffic and non-compliance with road safety regulations. This predominance of RTAs is constant in African urban areas (ranging from 47% to 70% depending on the series) [1, 21]. Conversely, a predominance of mechanical falls unrelated to road traffic remains typical of Western countries [20].

The predominant topography in the middle third (53.5%) is explained by intrinsic mechanical stresses and the relative thinness of the humeral shaft in its central zone, which precisely aligns with classic literature data reporting rates between 50% and 58% [9].

The predominance of unstable patterns observed in this study reflects the severity of high-velocity trauma and its direct mechanism, mostly linked to traffic accidents. Bending and crushing forces explain the high proportion of wedge fractures (B2: 20.9%). This result corroborates that of Abiome *et al.*, who found 54.1% of complex patterns [23]. However, it does not match the data from other authors who reported a majority of simple fracture patterns [1].

Initial radial nerve involvement is related to its close anatomical relationship with the radial nerve groove at the middle and distal thirds of the humerus. Our primary involvement rate (7%) aligns with international literature data, which report initial radial nerve palsy rates ranging from 3% to 10.1% [1, 21, 24].

Our therapeutic choice was preferentially oriented toward surgery, specifically open reduction and internal fixation using a plate and screws, which allowed for good bone healing (69.2% of operated patients; Fig. 1, 2). This approach is in line with the recommendations of AO Trauma and the literature demonstrating the superiority of plate fixation [25, 26]. In young adults, rigid plate fixation allows for perfect anatomical reduction (Fig 1 C, D) and enables early rehabilitation of the shoulder and elbow, thereby limiting the risk of secondary joint stiffness [25]. Furthermore, conservative orthopedic treatment achieves a satisfactory overall alignment of the fragments in the absence of neurological complications, while preserving the advantage of the fracture hematoma (Fig. 3).

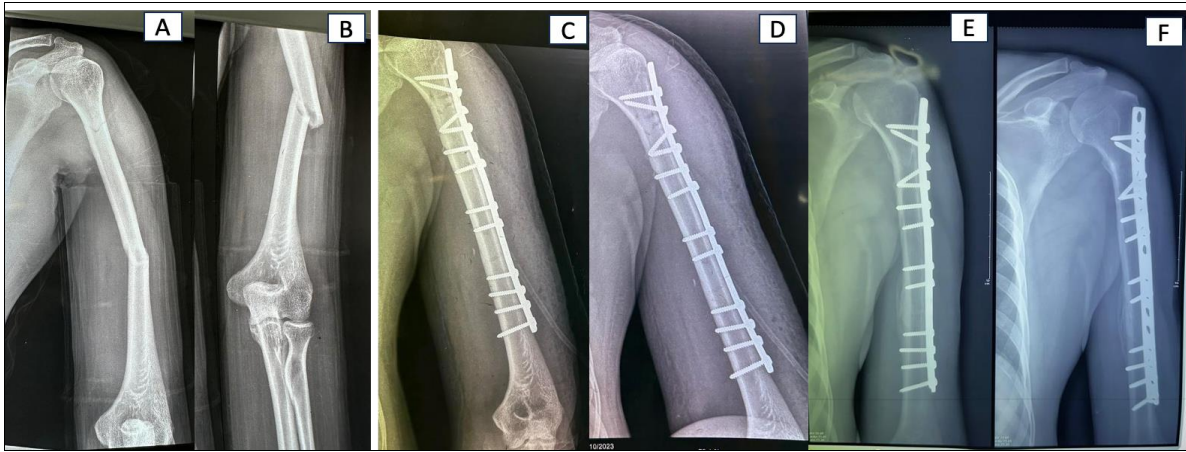


Fig 1 : Initial radiographs showing a segmentary (bifocal) fracture of the left humerus (classified as AO 12-C2) in a 47-year-old patient (A, B); immediate postoperative control radiographs after reduction and internal fixation with a dynamic compression plate (DCP) (C, D); follow-up radiographs at 4 months showing good bone healing (E, F)

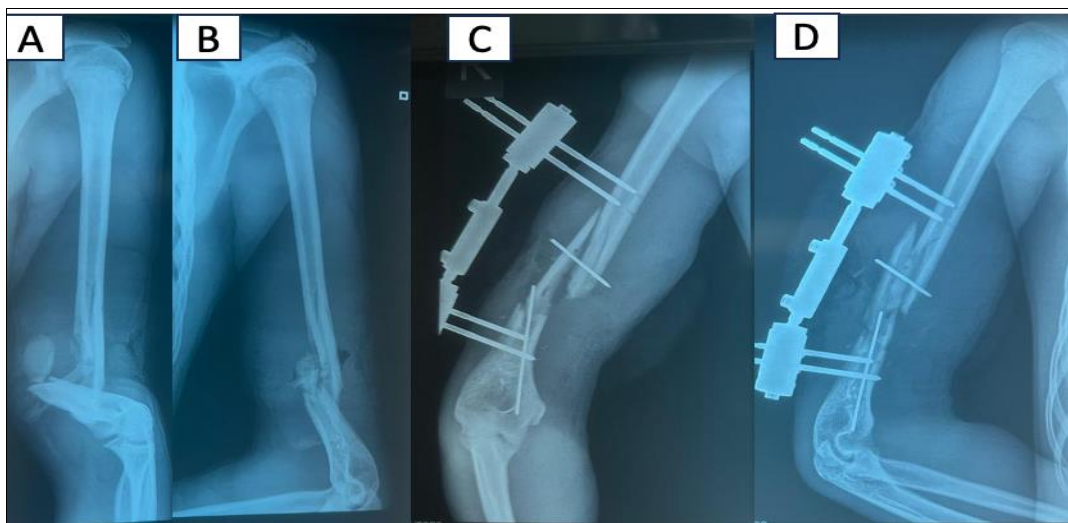


Fig 2 : Initial radiographs of a complex open fracture, classified as Gustilo-Anderson type IIIA, of the left humerus (classified as AO 12-C3) in a 26-year-old patient (A, B); immediate postoperative control radiographs after reduction and stabilization with an external fixator and K-wires (C, D)

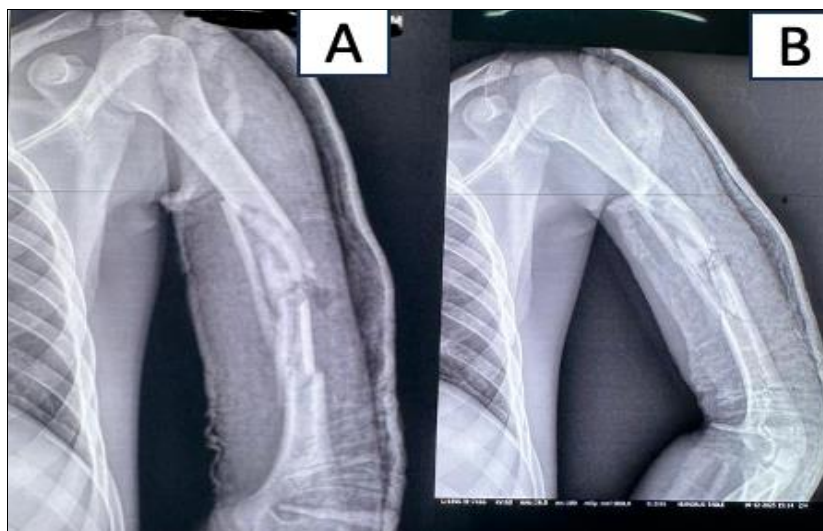


Fig 3 : Initial radiographs showing a complex closed fracture of the left humerus (classified as AO 12-C3) in a 29-year-old patient, managed with conservative orthopedic treatment (A, B)

Our union rate of 93% and our median healing time of 3.2 months are fully comparable to international data mentioning between 91% and 96% bone union after internal fixation [1,25,26]. The 3 cases of nonunion (7%) occurred in

comminuted or open fractures, exposing patients to a high risk of initial mechanical instability or periosteal devitalization. Some authors have reported a higher nonunion rate (15.3%) for humeral shaft fractures treated

surgically ^[28]. However, literature data appear disparate on this subject, with figures ranging from 0% to 27% for orthopedic treatment and from 0% to 19% for surgery ^[29]. Another African study reported an even higher nonunion rate (31%, n = 5/16) in open fractures, but this result remains biased by the small sample size ^[27].

The 81.4% rate of excellent or good functional outcomes according to the modified Stewart and Hundley score is superimposable on the rates observed by other authors ^[1,21,23]. The poor results (16.3%) were mainly secondary to elbow or shoulder joint stiffness, directly linked to a delayed initiation of functional physical therapy in non-compliant patients or those who consulted late.

Despite the original data provided by this study, it remains subject to several limitations due to its retrospective, single-center nature and small sample size. Larger multicenter prospective studies, including controlled comparative trials between orthopedic and surgical treatment, would help better refine therapeutic indications in our resource-limited practice context.

Conclusion

Humeral shaft fractures at the CHU-RN of N'Djamena predominantly affect young adult males following high-energy road traffic accidents. They are characterized by a high proportion of complex and unstable fracture patterns. Therapeutic management, which is preferentially surgical and dominated by plate and screw fixation, yields high union rates as well as satisfactory functional and anatomical outcomes in the vast majority of cases. Earlier and more rigorous initiation of functional rehabilitation is essential to reduce the rate of secondary joint stiffness.

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