

Floating Elbow: Anatomical, Clinical, Therapeutic and Outcome Aspects in 11 Cases at Bouake University Hospital

Bada Justin Léopold Niaoré Sery*, Achié Jean-Regis Akobe, Kouamé Innocent M'Bra, Loukou Blaise Yao, Kouamé Jean-Eric Kouassi, Yao Guy Serge N'Guessan, Ibrahim Soumahoro, Michel Kodo

Department of Orthopaedic and Trauma Surgery, Bouaké University Hospital Centre, Bouaké, Ivory Coast
Email: *leosery@yahoo.fr

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Abstract

Introduction: Floating elbows are rare but serious conditions. They are treated surgically. The aim of this study was to describe the anatomical, clinical, therapeutic and prognostic aspects of floating elbows at Bouaké University Hospital. **Materials and Methods:** This was a retrospective, descriptive study covering a 10-year period. It included all patients aged over 15 years presenting with a floating elbow who were treated and followed up for at least 3 months in the department. **Results:** The hospital prevalence was 0.17 percent. The mean age of patients was 19.8 years. Men were predominantly affected. Road traffic accidents were the main cause (n = 9; 81%). The fractures were open in 8 cases. According to the Rogers classification, Group Ia fractures were the most common. The mean time to treatment was 5.4 days. Treatment was most often surgical (10 cases). Fixation using a screw-fixed plate was the most commonly used method. The mean time to union was 4 months. Elbow stiffness (n = 10) was the most common complication. Functional outcomes were good in 6 out of 8 cases. **Conclusion:** Floating elbows are rare injuries. The injuries most commonly involved the diaphysis of the humerus and both forearm bones. Surgical treatment yielded good functional outcomes. Elbow stiffness remains the main complication of these injuries.

Keywords

Floating Elbows, Surgical Treatment, Screw-Fixed Plate, Elbow Stiffness

1. Summary

This retrospective descriptive study reports the epidemiology, injury patterns,

management, complications, and functional outcomes of 11 adult patients with floating elbow treated at Bouake University Hospital. Most injuries followed road traffic accidents, were open fractures, and received surgical fixation. Elbow stiffness was frequent, while functional outcomes among patients available for assessment were generally favourable.

2. Introduction

This segmental injury of the upper limb was initially described in children [1]. Rogers *et al.* [2] were the ones who proposed the term “floating elbow” in adults. These are rare but serious injuries [1] [3] [4]. It involves a fracture of the humeral shaft or distal humerus associated with a fracture of the olecranon, of the diaphysis, or of the apophyseal portion of one or both forearm bones. The diagnosis is most often clinical and radiographic. Plain radiography is sufficient to establish the diagnosis. Surgical treatment is the best option for these injuries. However, their course may be marked by numerous complications such as elbow stiffness. Few studies in literature have addressed them. In Africa, a study conducted in Tunisia reported 14 cases over a 10-year period [5]. In Ivory Coast, the literature is sparse [6]. In our department, floating elbows were treated. This study aimed to describe the anatomical and clinical features, treatment and outcomes of floating elbows at the CHU de Bouaké.

3. Materials and Methods

This was a retrospective, descriptive study from 1st January 2013 to 31 December 2023. This study concerned the records of patients admitted for floating elbow. The floating elbow was defined, according to Rogers, as the association, on the same upper limb, of a fracture of the humerus (diaphysis or distal humerus) and an ipsilateral fracture of one or both forearm bones (olecranon, diaphysis or proximal end), resulting in a “floating” elbow disconnected from the proximal and distal segments. Each included case met this definition, confirmed by standard anteroposterior and lateral radiographs of the upper limb. Cases were identified from the department hospitalisation register, the operating theatre register and the corresponding archived medical records. Patients of both sexes, aged over 15 years, presenting a floating elbow of any aetiology, treated in the department and followed for a minimum of 3 months were included in this study. During the study period, thirteen records of floating elbow were identified and reviewed. Two records were excluded: one for age under 15 years and one for incomplete data and follow-up of less than 3 months. Eleven patients were ultimately retained for analysis. The parameters studied were prevalence, sociodemographic aspects: notably age, sex, the patient’s occupations and the aetiologies. The anatomoclinical aspects concerned the delay to admission, the side affected, the type of injuries according to Rogers’ classification, presence or absence of skin opening, and associated injuries. The therapeutic aspects: the mean time to management, the type of orthopaedic or surgical treatment. And the outcome aspects by investigating complica-

tions, the mean time to union and the functional outcome. Functional evaluation was performed according to the Stewart and Handley scale modified by Diémé *et al.* [7] based on union, limb mobility and pain (**Table 1**). The result was considered satisfactory when it was very good, good or fairly good.

Table 1. Evaluation criteria according to Stewart and Hundley, modified [7].

Very good	Absence of pain
	Normal elbow and shoulder mobility
	Good radiological alignment
Good	No pain or weather-related pain
	Shoulder and elbow stiffness less than 20°
	Malunion less than 20°
Fairly good	Mild pain
	Shoulder and elbow stiffness between 20° and 40°
	Malunion greater than 20°
Poor	Persistent pain
	Shoulder stiffness greater than 40°
	Nonunion

4. Results

During this study period, 6594 patients were hospitalised, among whom there were 11 cases of floating elbow. The hospital prevalence was 0.17%. The mean age of the patients was 20 years (16 - 35) with a sex ratio of 4.5. Road traffic accident was the principal aetiology (n = 9; 81%). Fractures were open in 8 cases (arm n = 1, forearm n = 2, arm and forearm n = 5). According to Rogers' classification, group Ia was the most frequent (**Figure 1**). The remaining sociodemographic and anatomoclinical characteristics are summarised in **Table 2**.



Figure 1. Type 1a floating elbow according to Rogers' classification.

Table 2. Sociodemographic and anatomico-clinical characteristics.

Parameters	Characteristics	Number
Sex	Male	9
	Female	2
Occupation	Shopkeeper	6
	Housewife	2
	Trainee driver	1
	School pupil	1
	Farmer	1
Aetiology	Road traffic accident	9
	Sports accident	1
	Ballistic injury	1
Time to admission	Less than 6 hours	1
	More than 6 hours	10
Gustilo-Anderson classification	I	1
	II	5
	IIIc	1
Rogers classification	Group Ia	5
	Group Ib	2
	Group IIa	1
	Group IIb	1
	Group IId	1
Affected side	Dominant	8
	Non-dominant	3
Associated injuries	Bimalleolar fracture	1
	Contralateral elbow dislocation	1
	Ulnar nerve injury	1

The mean time to treatment was 5.4 days (2 - 13). Treatment was non-operative in 1 case and surgical in 10 cases. The therapeutic choice was based on clinical and radiographic criteria: skin opening, displacement and instability of the fracture sites, articular involvement of the lesions and the energy of the trauma favoured osteosynthesis. The surgical indication was therefore selected in ten patients presenting with open and/or displaced and unstable fractures. The only patient treated non-operatively (Roger's type Ia) had closed, minimally displaced and stable fractures, reducible and contained by immobilisation, in the absence of cutaneous or neurovascular complications. Debridement was performed in all open fractures. Stabilisation was achieved with implants (**Table 3** and **Figure 2**).

Table 3. Distribution of patients by implant type.

Implant type	Humerus	Radius	Ulna
Plate	9	3	4
Wire	1	7	6
Total	10	10	10

**Figure 2.** Screw-fixed plate osteosynthesis for a Type Ia fracture according to the Rogers classification.

The mean time to bony union was 4 months (2 - 6). Postoperatively, the elbow was immobilized with a brachio-antebrachial splint with the elbow at 90° for a mean duration of 3 weeks. Active and active-assisted mobilization of the elbow was initiated as soon as a stable construct, on average between the 3rd and the 4th week. Rehabilitation was most often self-managed by the patient at home after instruction, access to supervised physiotherapy being limited and inconsistent because of a lack of facilities and for financial reasons; this lack of early specialized rehabilitation should be considered when interpreting the high frequency of elbow stiffness. **Table 4** summarizes the complications during follow-up.

Table 4. Distribution of complications among patients.

Complications	Number
Infection	3
Malunion	1
Nonunion	2
Volkman syndrome	1
Elbow stiffness	5

At a mean follow-up of 49.5 months (17 - 85), six of the eleven treated patients

could be contacted again and evaluated. The five others were lost to follow-up (contact details unobtainable or no response to invitations to attend, two of them residing outside the region). Functional outcomes therefore apply only to these six evaluable patients and are not necessarily representative of all eleven treated patients. Overall functional outcome was evaluated according to the criteria of Stewart and Handley modified by Diémé *et al.* [7] (**Table 5**).

Table 5. Distribution of patients according to functional outcomes by the criteria of Stewart and Handley as modified by Diémé *et al.* [7].

Functional outcome	Number
Very good	1
Good	3
Fairly good	0
Poor	2
Total	6

5. Discussion

This study aimed to describe the anatomico-clinical and therapeutic aspects of floating elbows. Floating elbows were rare with a prevalence of 0.17%. The sex ratio was 4.5. According to Rogers' classification, group Ia were the most frequent lesions and most open. Treatment was surgical in most cases. Complications were dominated by elbow stiffness. Functional outcomes, according to the criteria of Stewart and Handley modified by Diémé *et al.* were satisfactory in 4 cases out of 6 (66.7%). Our results corroborate those in the literature [8]-[10]. The floating elbow [11], which defines a fracture of the humerus and an ipsilateral fracture of one or both forearm bones, is a rare injury. It was initially described in children [1] [10] [12] then in adults [8] [13]-[15]. This injury shows anatomico-clinical variation reflected by various classifications in the series in the literature [8] [12] [15]. In this series, the mean age of the patients was 20 years. The most frequent anatomico-clinical variety was type Ia according to Rogers' classification, which describes isolated diaphyseal fractures of the humerus and both forearm bones. Our results are comparable to several African series. In the series of Lamah *et al.* [3] in Guinea, the patients were young and diaphyseal fractures were the most frequent. In Benin, Chigblo *et al.* [16] also found in a series of 20 cases a mean age of 36.65 years with a predominance of diaphyseal fractures of the humerus and of one or both forearm bones. This is the most active age group and the one most often exposed to road traffic accidents. These injuries are variously classified by numerous classifications in the literature [2] [6] [13] [17]. In this study, the floating elbow was associated with an elbow dislocation in one case and an ulnar nerve injury in one case. In the literature, several associated injuries have been reported [2] [5] [7] [10] [12] [16]. In this series, one patient (Ia according to Rogers' classification) was treated non-operatively and the others surgically. Several reasons may justify

the surgical choice: the complexity of the lesions due to the velocity of the trauma, the skin opening of the lesions and the displacement of the fractures. In the study by Lamah *et al.* [3], five patients were treated non-operatively based on selection criteria. Non-operative treatment is found in the literature; it is performed under well-defined conditions [1] [9]. The complications in this series were dominated by elbow stiffness. This could be explained by the complexity of the joint lesions of the elbow and the insufficiency of functional rehabilitation of the elbow. These results were comparable to those in the literature [2] [11] [18]. The functional outcomes according to the Stewart and Hundley score modified by Diemé [7] in this study were satisfactory in 4 cases out of 6 (66.7%). There are several scores or classifications allowing the evaluation of functional outcome in the literature [8] [9] [15] [19]. Whatever the score, it takes into account flexion-extension and pronation-supination and pain. The outcome may be influenced by the type of treatment, associated injuries and the effectiveness of rehabilitation. This study has limitations. It is retrospective and non-comparative. The sample size is small.

6. Conclusion

The floating elbow is a rare injury. Associated lesions are most often an open skin wound. Diaphyseal fractures of the humerus and of both forearm bones are the most frequent. In this series, management, most often surgical, was associated with satisfactory functional outcomes in the majority of evaluable patients. Given the small sample size, the retrospective, non-comparative nature of the study, and the number of patients lost to follow-up, these data alone do not permit establishing the efficacy of surgical treatment and should be interpreted with caution. However, stiffness remains a complication of these injuries. This study has limitations. It is retrospective and non-comparative. The sample size is small.

Author Contributions

Sery Bada Justin Leopold N: Conceptualization, study design, patient management, data collection, literature review, manuscript drafting, and final approval of the manuscript. Akobe Achie Jean Regis: critical revision of the manuscript, and final approval. Soumahoro Ibrahim: Patient management, data collection. N'Guessan Yao Guy Serge: Patient management, data collection. M'Bra Kouame Innocent: Clinical supervision, critical revision of the manuscript, and final approval. Yao Loukou Blaise: Clinical supervision, critical revision of the manuscript, and final approval. Kouassi Kouame Jean Eric: Clinical supervision, critical revision of the manuscript, and final approval. Michel Kodo: Study supervision, critical revision of the manuscript, and final approval.

Conflicts of Interest

The authors declare no conflict of interest.

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