

## OSTEOSYNTHESIS OF FRACTURES OF THE DISTAL END OF RADIUS BONE OF ADULTS

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### ABSTRACT

**Background:** Fracture of the distal end of the radius is a very common pathology in traumatology. Given its instability, the complex nature of the fracture line and the need for an anatomical reduction explains why several modalities of osteosynthesis exist and yet no consensus has been established.

**Objectives:** We therefore aimed to define the different modalities for surgical management of distal radius fractures in adults and evaluate the results.

**Methods:** We report the results of an analytical and prospective study conducted over a period of 3 years 3 months from March 2011 to May 2014 at the Department of Orthopedic and Traumatologic Surgery (ward A) of at the Yaoundé Central Hospital. We consecutively recruited, by means of a data sheet; patients operated for the distal radius fracture and also followed them up clinically and radiologically over a minimal period of 6 months. The variables studied were socio-epidemiological profiles, the clinical forms of these fractures, the surgical techniques used, the post operatory anatomical results and the functional outcomes evaluated according to the Gartland and Werley score. Data analysis was done using Statistical Package for Social Sciences SPSS software.

**Results :** These fractures presented varied facies, with the dominant lesions being type 1 (32.5%), 10 (30%) and 9 (17.5%) in the kapandji classification. Joint fractures accounted for 52.5% of the series, dominated by types 10 and 9 fractures. Fifty seven percent (57%) of these joint fractures were comminutative. Closed surgeries were done in 42.5% of cases. These fractures were treated by pinning (55%), external fixator combined or not with pinning (25%) and by screwed plate (20%). Of these joint fractures, 79% were treated by pins and 21% by screwed plate. Eighty three percent (83%) of complex joint fractures benefited from osteosynthesis by external fixators. Single joint fractures were treated by screwed plate (44.4%) and by pines (53.6%). With a mean follow-up period of 20 months and according to the score of Gartland and Werley, the overall analysis showed 72.5% excellent and good anatomical results; 82.5% excellent and good functional results with a parallelism between the quality of the anatomical and functional results.

**Conclusion:** The therapeutic challenge resides in the placement of the right surgical indication; early rehabilitation being an essential complement for the rapid and satisfactory recovery of wrist function.

**Keywords:** Distal Radius Fracture, Osteosynthesis, Yaoundé

### INTRODUCTION

Fractures of the distal end of the radius are very common and account for about 1/6 of all fractures observed and treated in surgical emergencies [1]. In antiquity, they were all classified as dislocations. However, it was POUTEAU (France, 1783) and COLLES (Scotland, 1814) that classified these fractures into a new entity: fractures of the distal end of the radius [2]. They are defined by the Anglo-Saxon school as a transverse break of continuity located 3 cm the distal epiphyseal end of the radius with or without

articular radiations. Some authors once considered them as fractures that consolidate without a specific treatment and without functional sequelae since it had been proven that there exists a correlation between the anatomical reduction of the fracture and the quality of the restoration of wrist function [3]. Orthopedic treatment has thus shown its limits in restituting the bone anatomy accounting therefore for the wide practice of surgical treatment. The chronic instability of these fractures, the forces and stress to which the wrist is subjected have been the subject of several clinical studies

conducted in the laboratory which have shown the importance of an anatomical reduction of the fracture site. It was admitted that fractures with a displacement of more than 2 mm, a shortening of the radius of more than 5 mm or a dorsal angulation of more than 20 ° are unstable [4]. Given the large therapeutic tools (screws, pins, external fixator, plates, locked plates, resorbable plates, bone grafts and synthetic substrates) made available to practitioners, their surgical management has evolved a lot since 1906, when they were first performed by LAMBOTTE [5]. This multiplicity of proposed treatments proves that until today none has been judged totally satisfactory and the large variety of the works published on the subject according to KAPANDJI [6] testifies to the lack of therapeutic consensus. In Cameroon, no work has been done on the subject. This is why we carried out this work with the aim of determining the surgical management of fractures of the distal end of the radius in adults at Yaoundé Central Hospital and to evaluate the results.

**METHODS**

We conducted an analytical and prospective study over a period of 3 years 3 months from March 2011 to May 2014 at the Orthopedic and Traumatologic Surgery unit of the Yaoundé Central Hospital. We consecutively recruited, by means of a data sheet, patients operated for the distal radius fracture and also followed them up clinically and radiologically over a minimal period of 6 months. Surgery was indicated for articular, comminuted, extra-articular, unstable, opened and bilateral fractures, found in the patients with a poly fracture or polytrauma. We included patients aged at least 16 years old, re-evaluated during follow-up visits and assessed after a minimum of 6 month. We excluded patients operated upon for a neglected fracture or malunion and patients who were not followed up/ lost to follow-up. Based on these criteria, 37 patients aged 16 to 75 years, with 40 surgically treated distal radius fractures, participated in this study. The variables studied were social and epidemiological variables, the clinical forms of these fractures, the surgical techniques used, the anatomical results presented and the functional outcomes evaluated according to the Gartland and Werley score. We obtained approval of the Scientific Committee of the Department of Surgery and Specialties as well as that of the National Center of Research and Ethics. Data analysis was done using the Statistical Package for Social Sciences SPSS, software.

**RESULTS**

*Social and Epidemiological characteristics*

Our study population consisted of 20 men and 17 women given a sex ratio of 1.18. The average age of the patients was 43 years old with extremes of 16 to 75 years old. There was a bimodal distribution of the series with a clear predominance among adolescents and young adult of male gender as well as among older women. With respect to their professions, housewives (40.5%) and students (21.6%) were most affected. Etiologies were dominated by domestic accidents in 14 cases (37.8%) followed by road accidents in 11 cases (29.7%) and sports accidents in 6 cases (16.2%); 2 cases of assault were noted. The mechanism of lesion found was indirect for 33 patients (by fall with reception on the palm in 29 cases or the back of the hand in 4 cases). We had a direct mechanism in 04 cases (2 cases of road accidents and 2 cases of assaults). They were high energy trauma.

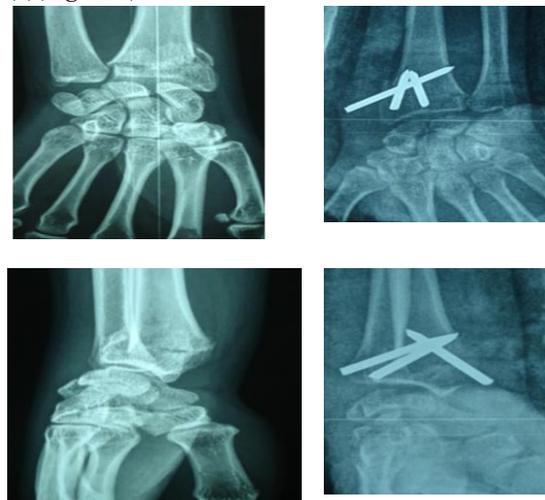
*Clinical forms*

The majority of the patients had been operated for a fracture of the dominant limb (60%). Three patients had bilateral fractures. The lesions were dominated by types 10 and 1 of the Kapandji classification representing respectively 32.5% (13 cases) and 30% (12 cases) of the fractures. Nevertheless, types 9 and 8 accounted for 17.5% (7 cases) and 7.5% (3 cases) respectively, and 52.5% (21 cases) were articular fractures. Of these type 10 kapandji lesions, 42.9% were articular and 23.8% comminutative. Isolated comminuted fractures (type 9) accounted for 33.3% of joint fractures. In general, the fracture of the distal end of the radius was found in the context of a polytrauma in 2 cases and as part of a poly

fracture in 9 cases. At the locoregional level, cutaneous opening was found in 9 cases and a ligamentous wound was present in 4 cases. Other locoregional lesions counted were 2 scaphoid fractures, 2 semilunar fractures and 1 case of semilunar dislocation.

**Therapeutic data**

The average time taken to treat patients was 5 days with extremes ranging from 24 hours to 16 days. According to the approach used, 42.5% (17 cases) of the interventions were closed focus interventions and these included 11 cases of pinning and 6 cases of distraction external fixators combined or not with pinning. Of these 17 cases, 16 were performed under an image intensifier. For open interventions, Henry's approach was the most used accounting for 30% (12) of the cases. In general, throughout the entire series, wiring was the most commonly used surgical technique (55% or 22 cases) followed by screw plate fixation (20% or 8 cases). Concerning articular fractures, osteosynthesis by external fixator associated or not with pinning was indicated only in the so-called complex fractures and performed in 83,3% (10) of the cases . However extra-articular fractures were treated by pinning in 79% of cases (15)(Figure 1)and screw plate fixation in 21% of cases (4)(Figure 2).



**Figure 1:** Pinning fixation of distal radius fracture.



**Figure 2:** Plating fixation of distal radius fracture.

*Results after bone fixation*

*Anatomical evaluation*

An anatomical or functional reduction of the fracture site was obtained in 65% (26) of the fracture cases. According to the criteria

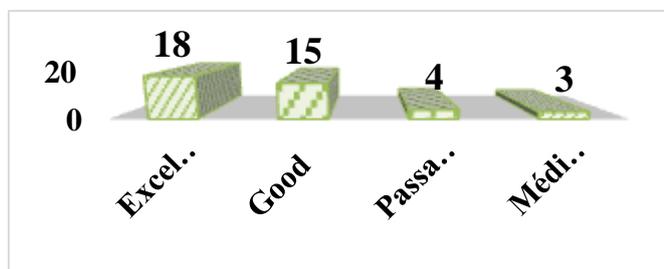
of VAN DER LINDEN and ERICSON [7], the radiological evaluation was considered excellent and good in 72.5% (29) of cases. It was fair and mediocre in 27.5% (11) of the cases. With respect to the wrist involvement, the anatomical results were excellent and good in 84.2% (16) of the cases when the fracture was extra-articular. They were fair and poor in 8 cases (38.1%) when the fracture was articular. Depending on the type of osteosynthesis used, pinning showed excellent radiological results of 77.3% (17 cases); fair and poor results in 22.7% (5) of the cases. For external fixation, the anatomical result was excellent and good in 50% of cases (Table I).

**Table I:** Joint and extra-articular fractures according to the type of osteosynthesis

Kapandji	Pinning	Screw plates	External fixation +pinning	External fixation
Type 1	10	2	-	-
Type 2	1	-	-	-
Type 4	1	1	-	-
Type 5	5	-	-	-
Type 7	-	1	-	-
Type 8	2	1	-	-
Type 9	1	-	4	2
Type 10	3	1	-	-

#### Functional evaluation

The average decline was 20 months with extremes ranging from 6 to 36 months. According to the Gartland and Werley score, the functional results were excellent and good in 82.5% (33) of the cases. They were rated as fair and poor in 17.5% (7) of the cases. Extra-articular fractures had 94.7% (18 cases) of excellent and good results and joint fractures had 28.6% (6 cases) of fair and poor results. Fixation by pinning showed excellent and good results in 81.8% (18) of cases and average and poor results in 18.2% (4) of the cases. Concerning external fixation, the functional result was excellent and good in 70% of the cases while the screwed plates gave excellent and good results in all (100%) of the cases (Figure 3)



**Figure 3:** Functional Evaluation of the Wrists by Gartland and Werley Score

#### DISCUSSION

In our series, the average age of patients was 43 years with a predominance of male gender in 54% of cases and of the dominant side at 60%. These results are similar to those of

Praveen M. Anvekar et al [8] who found a male predominance at 55%, an average age of 40 years and the dominant wrist was majorly involved in 60% of cases. Kyriakedes James C. et al [9] found a female predominance (45.5%) with an average age of 50 years. In contrast, Bitega.JP et al [10] found an average age of 39 years and only 18.6% of fractures on the dominant limb. The main etiologies were domestic accidents in 14 cases (37.8%) followed by road accidents 11 cases (29.7%). This high frequency of domestic accidents was also reported by Bitega [10] at 50%. In contrast, Frakha et al [11] reported road traffic accidents (58%) followed by home accidents (32%) as predominant etiologies.

The classification of KAPANDJI [6] is based on the analysis of X-rays films taken, if necessary, under traction. In our series, lesions were dominated by types 10, 1 and 9, of which 52.5% were articular fractures. Fractures associated with lesions of the styloid process of the ulnar bone (Kapandji type 10 fractures) are reported with different frequencies in the literature [12,13,14]. BITEGA [10] had 18.7% of styloid involvement. KURUP [15] reports that ulnar involvement is a factor in the poor prognosis of radiological findings. This predominance of types 10 and 9 could be explained by the high frequency of high energy fractures in our series (61%).

The average time lapse before management of patients was 5 days with extremes ranging from 24 hours to 16 days. This delay is relatively long compared to those reported in the literature [10,11]. BITEGA et al [10] found an average delay of 12 hours with extremes of 3 to 48 hours. This long delay reported in our series is explained on the one hand by the low income of our population (students, students, housewives) who were often uplarded to wait for financial support from other relatives. On the other hand, given that the Yaoundé Central Hospital did not have an image intensifier, we were often uplarded to go to other hospitals (Yaoundé General Hospital and Yaoundé University Teaching Hospital) to carry out closed interventions. This referral could cause delays of 2 to 3 additional days. Fixation by external fixators, with or without pinning, was performed only for type 9 and type 10 articular fractures of the Kapandji classification which represented 62.5% of these fractures. The external fixator is increasingly used in the treatment of extra-articular and non-comminuted fractures of distal radius because, it enables the restoration of the length and inclination of the glenoid process of the radius by ligamentotaxis, but does not actually enable a recovery of the palmar inclination [16]. Also, high rates of complications, sometimes as high as 60%, have been reported after the use of the external fixators. These include cardiac infections, dystrophies of the sympathetic reflex, lesions of the sensory branch of the radial nerve, and vicious calluses. In our series, the external fixator has been used only for the treatment of complex joint fractures. Although recent series show the exclusive use of pins for the fixation of

articular and sometimes comminutive fractures of distal end of the radius [10], the results remain compromising, depending on the experience of the surgeon and the patient and the quality of the technical platform. Open fixation with screws and plates is recommended invasive technique for simple or complex joint fractures of the radius and is not contraindicated in extra-articular fractures even though percutaneous pinning has been described as a simple and non-invasive technique. However, some authors report poor results in this technique; describing complications such as shortening of the radius, wrist stiffness and sympathetic reflex dystrophy [17,18]. The wrist stiffness and dystrophy of the sympathetic reflex are due to the fact that after pinning, the wrist is immobilised palmar flexion. Prolonged immobilization of the wrist in this position for more than 3 weeks would increase the magnitude of the problem. This is why in our series, immobilization by placement of cast after reduction and pinning was not systematic for all the patients. The choice depended on the number of pins used and the stability of the mounting as judged by the surgeon. When the immobilisation was effective, a circular plaster cuff was placed with the wrist in neutral position; the cuff was kept in place for a length 18 and 25 days with an average of 22 days. For all our patients, an active mobilization of the finger was initiated 24 hours after the surgery but only 24 patients (64.9%) had to resort to a physiotherapist for rehabilitation (10 sessions).

The goal of the surgical treatment of fractures of the distal end of the radius is to allow for early mobility of the forearm, preserve wrist function and avoid complications. Good functional results are always accompanied by good anatomical results. In our series, the best anatomical and functional results were found in the group of patients with extra-articular fractures and the group of patients operated by screwed plate and pinning. However, the group of patients with articular fracture, commutative fracture and / or operated by external fixators had poorer anatomical and functional outcomes. We would therefore deduce that articular nature of the fracture would be a factor of poor prognosis. This conclusion has also been made by several authors [8,13]. However, as in our series, external fixation was the method of choice for commutative fractures of the distal end of the radius but despite a well-conducted treatment, the frequency of poor outcomes remained high. In addition, all our patients who had excellent and good anatomical results also had excellent and good functional results. The high rate of functional results in relation to anatomical results would be the result of the observance of the rehabilitation sessions; BITEGA [10] reported better functional results in patients who performed more than 10 physiotherapy sessions (43.75%) compared to those who had

less (31.25%). Unfortunately, this factor was not evaluated in our study.

## CONCLUSION

This study through our series enables us, after descriptions of the different operative techniques to establish the social and epidemiological profile of the population, to identify the clinical forms, to define the indications of the surgical methods, and to analyze the results. It shows that fractures of the distal end of the radius are the common in young male subject victims of a road accident or sports accident and the elderly osteoporotic woman victim of a domestic accident. The clinical forms are dominated by types 1,10 and 9 of Kapandji's modified Castaing classification. Just over half of these fractures are articular. Pinning is the most used surgical procedure, indicated in first intention in extra-articular fractures but also in some cases of simple articular fractures. Bone fixation by external fixation in distraction associated or not with pinning is reference in the management of complex joint fractures. The screw plate treatment is performed for simple joint fractures and offers an alternative for extra-articular fractures of the distal radius. The overall analysis shows excellent and good anatomical and functional results in almost the entire series with a parallelism between the quality of the two results. The therapeutic challenge boils resides in selecting the best surgical indication. However, early rehabilitation is an essential complement for the rapid recovery of wrist and hand function.

## CONFLICTS OF INTEREST

The author(s) declare(s) that there is no conflict of interest regarding the publication of this article

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