

A Retrospective Study of Non-operative Management of Distal Radial Fractures in an Indigenous Black Population

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Authors' contributions

This work was carried out in collaboration among all authors. Author KAM designed the study, author OE performed the statistical analysis, authors KAM and WA wrote the protocol and wrote the first draft of the manuscript. Author OE managed the analyses of the study. Authors KAM and CCO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Operative fixation is increasingly used to treat distal radial fractures. However, non-operative management of these fractures is common, especially in developing countries. Although surgery results in better restoration of anatomy, it is unclear if this translates to a better function.

Aim: The study aims to assess patients' functional outcome after non-operative treatment of distal radius fractures.

Methods: This work was a five-year retrospective study involving 35 subjects treated for a distal radial fracture with non-operative methods. The pre-operative and post-operative distal radius radiographic parameters, DASH scores at 22-month follow-up and the Frykman class of the fractures were documented. The correlation between the Frykman classes and DASH scores and that between the post-operative radiographic parameters and DASH scores was assessed.

Results: All the distal radius parameters except the palmar tilt improved with non-operative treatment in this study. There were no significant differences in the mean DASH scores between those with acceptable and non-acceptable radiographic indices. The most frequent class of fracture in this study was Frykman class 1. The Frykman class showed a strong correlation with the DASH score, with an increasing class of injury having a higher DASH score, $\rho = .651$, $p\text{-value} = .001$.

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Conclusion: Non-operative management of distal radial fractures was associated with favourable DASH scores, even though most of the patients had at least one unacceptable radiographic parameter post-reduction.

Keywords: Distal radius fracture; Frykman; DASH score.

1. INTRODUCTION

Distal radial fractures are commonplace in orthopaedic practice and account for approximately 20% of all fractures treated in the emergency department [1]. These fractures typically afflict the elderly following falls and other forms of mild to moderate trauma. It also affects younger people but will require a more severe force to occur. Traditionally, distal radial fractures have been treated non-operatively with casting (with or without manipulation). This tradition has progressively given way to more aggressive treatment with some form of internal fixation [2]. Over the past few decades, advancements for treating these fractures have been toward stable internal fixation after anatomic reduction. However, conservative management is still relevant in orthopaedic practice, especially in resource-constrained environments.

Studies have established that closed reduction may not restore the anatomical alignment and relationships of the distal radius [3,4]. Other problems have also been noted to be associated with non-operative treatment. These problems include the subsequent redisplacement and collapse of an initially acceptable reduction within the cast, wrist and finger stiffness imposed by casting for periods of 4 to 6 weeks among others. Despite these shortcomings, most distal radial fractures are still treated non-operatively even in developed countries [2]. Contemporary literature does not adduce evidence to support the push toward internal fixation [5]. In the developing world, the current trend is toward internal fixation, especially where factors that lead to subsequent instability are present. However, Chung et al. [2] observed that most fractures are managed non-operatively in the developing world. Factors that contribute to this reason in the developing world, apart from intrinsic factors associated with the fracture characteristics, include lack of expertise, cost of treatment and implant availability.

Some studies, especially in the elderly, comparing operative with non-operative treatment have found no difference in functional status based on the Disabilities of the Arm,

Shoulder and Hand (DASH) score at any follow-up point between both groups. However, radiographic outcome and grip strength were superior in the operative group [6]. Correlation between radiographic parameters and functional outcomes has been a subject of controversy for years. Studies have found that radiographic parameters correlate poorly with patient-reported outcomes following operative treatment of distal radial fractures, while other studies find that there is some correlation [7,8]. Due to the lack of clear-cut evidence of the superiority of operative over non-operative treatment for distal radial fractures in the literature, the authors decided to evaluate the functional outcome after non-operative treatment of such fractures in a tertiary hospital in Nigeria.

2. MATERIALS AND METHODS

This research was a 5-year retrospective study between July 2013 and July 2018 and included all adult patients who received non-operative treatment (manipulation with a moulded below elbow cast) for closed distal radial fractures within this period. The manipulation was done under sedation with total intravenous anaesthetic agents, and the reduction was maintained in a below elbow cast till radiologic evidence of healing (usually between 6 to 8 weeks). The cast was then removed and patients were commenced on active range of motion exercises for the wrist and fingers. A wrist brace is usually prescribed for protection for another six weeks after cast removal. The authors excluded patients with incomplete records, including pre- and post-reduction radiographs, post-treatment DASH scores and other relevant biodata. The DASH evaluation was done at a mean time of 22 months follow up.

A total of 35 patients met the inclusion criteria and participated in the study. The authors extracted the patients' demographic data from the hospital records. The researchers contacted individuals with missing DASH scores and conducted DASH evaluations at the next clinic appointment. Outcome measures included the pre-operative and post-operative radiographic assessment of the fractures and a DASH

assessment of the patients. The research question was if there was any relationship between fracture patterns classified by Frykman and the degree of functional limitation using DASH score averages of the different classes. The researchers also studied the relationship between the radiographic parameters and functional outcomes using the DASH score. Data analysis was done with SPSS version 20.

3. RESULTS

A total of 35 patients met the inclusion criteria and were recruited for the study, 12 males (34.3%) and 23 females (65.7%). The patients' mean age was 44.03 years (SD = 16.55), and the most affected age group was the 30 to 39-year age group. Table 1 summarizes the distribution of the fracture across different age categories.

Table 1. Frequency of distal radial fractures across the age groups

The age group (years)	N	%
10 – 19	3	8.6
20 - 29	6	17.1
30 – 39	7	20.0
40 – 49	5	14.3
50 – 59	6	17.1
60 - 69	5	14.3
>70	3	8.6

The most frequent class of fracture in this study was Frykman class 1, which occurred in 12 patients, closely followed by class 3 with 11 patients, while class 2 and 6 were the least frequent in 1 patient. Fig. 1 shows the distribution of the fracture patterns.

Table 2. The pre-treatment and post-treatment distal radial parameters

Parameter	Mean pre-treatment value	Mean post-treatment value
Radial height	7.09 mm	8.43 mm
Radial inclination	14.10 ⁰	16.91 ⁰
Palmar tilt	4.49 ⁰	3.63 ⁰
Ulna variance	1.26 mm	0.51 mm
Articular step-off	1.43 mm	0.43 mm

Table 3. The reference values of the distal radial parameters according to the OTA

Parameters	Mean values	Minimum-maximum
Radial height (mm)	12	11 to13
Radial Inclination (°)	23	22 to 24
Palmar tilt (°)	11	10 to 12
Ulna variance (mm)	0	-1 to +1
Articular Step-off (mm)	0	-2 to +2

Five parameters of the distal radius were measured pre-treatment and post-treatment: radial height, radial inclination, palmar tilt, ulna variance and articular step-off. These parameters are summarized in Table 2.

All parameters except the palmar tilt improved with treatment in this study.

According to the Orthopaedic Trauma Association (OTA), the distal radial parameters' typical mean values are given in Table 3 [9].

Studies have shown that an acceptable reduction is present when the parameters are within the following limits; a radial height of 6 to 13mm, a radial inclination of 16 to 24 degrees, a palmar tilt of 0 to 20 degrees, ulnar variance between -1 to 4 millimeters and an articular step-off of not greater than two millimeters [10–12].

In our study, six patients (17.1%) have acceptable parameters in all measured indices, while 29 patients (82.9%) have at least one unacceptable parameter in the measured indices. Table 4 illustrates this information.

There were no significant differences in the mean DASH scores between those with acceptable and non-acceptable radiographic indices. Although those with an acceptable index have a lower mean DASH score in most of the parameters assessed, the differences were not statistically significant. Table 5 outlines the mean DASH scores for each measured variable, categorized as acceptable and unacceptable.

The mean DASH score was 23.04 (SD = 10.46), ranging from 5 to 38.

Table 4. The measured distal radial parameters

Parameters	Acceptable	Unacceptable
Radial height (mm)	31 (88.6%)	4 (11.4%)
Radial Inclination (□)	18 (51.4%)	17 (48.6%)
Palmar tilt (□)	27 (77.1%)	8 (22.9%)
Ulna variance (mm)	13 (37.1%)	22 (62.9%)
Articular Step-off (mm)	34 (97.1%)	1 (2.9%)

The Frykman class showed a strong correlation with the DASH score, with an increasing class of injury having a higher DASH score, $\rho = .651$, p -value = .001. Multiple linear regression was done to predict the DASH score at 22 months post fracture using age, gender, Frykman class and the radiographic indices. Gender alone significantly predicts the DASH score at 22 months. Female gender increased the DASH score by a factor of 8.47, 95% C.I (2.18–14.76), $p < .001$.

4. DISCUSSION

Internal fixation is being increasingly used to treat distal radial fractures; however, closed or non-operative treatment remains a treatment option in most cases. This treatment option was found to be more so for elderly patients [2]. Distal radial fractures are a public health concern in the United States among elderly patients. Approximately 10% of white women above 65 years will sustain a distal radial fracture in their lifetime [13].

Studies involving elderly patients have demonstrated no significant difference in outcome between patients managed non-operatively and those who had internal fixation. Rohit et al. [14] studied 130 patients; 53 of the patients had internal fixation. Their outcome measures included the DASH score, the patient-rated wrist evaluation score (PRWE), the radiographic assessment, among other measures studied. They found no significant difference in DASH, PRWE scores, and the other outcome measures studied, despite a clinically obvious deformity in 77% of the CAST group in their study. They also reported that an acceptable primary reduction was not achieved in 44% of the CAST group, and concluded that unsatisfactory radiographic outcome in older patients does not translate into an unsatisfactory functional outcome.

The age distribution of patients seen in this study is different from that seen in the study by Rohit et al. The mean age of our patients was approximately 44 years with the highest number

of patients in their 30s. The age difference makes extrapolation of their findings to this work challenging. Our study shows that despite the younger age group of our patients, the mean DASH score (23.04) was in the range reported by most respondents to no longer consider their upper limb disorder a problem at 22 months follow-up.

The American Academy of Orthopedic Surgeons (AAOS) [15] clinical practice guidelines for treating distal radial fractures in adults contains systematic reviews for treatment options. These guidelines are not rigid and make allowance for the peculiarities of the fracture and the patient circumstances. The guidelines recommend operative fixation for inadequately reduced unstable fractures, or in whom an adequate reduction and maintenance in a cast may fail. The radiographic indices associated with a particular fracture help determine the expected behavior of each fracture. Operative treatment is widely acknowledged to give better radiographic parameters than non-operative treatment in patients younger than 55. All radiographic indices are reported to be improved by operative treatment with a volar plate.

In this study, all the radiographic indices improved after closed treatment, but some indices did not reach the acceptable range. The most frequent indices found to be unacceptable following closed reduction were the ulnar variance and radial inclination. The other indices, the radial height, palmar tilt, and articular step off, were acceptable in most patients following closed treatment.

However, these findings did not translate to any significant difference in the DASH score evaluation for those patients with unacceptable radiographic indices. Those with an acceptable index have a lower mean DASH score in most of the parameters assessed, but the difference was not statistically significant. This finding is similar to that for elderly patients. A longer follow-up time is needed to assess the long-term difference in the DASH score.

Table 5. The mean DASH score between acceptable and unacceptable parameters. The standard deviations are enclosed within the brackets

Parameters	Mean DASH for the acceptable group	Mean DASH for the unacceptable group	Mean difference	Z- statistics*	p-value
Radial height (mm)	21.64 (10.20)	27.74 (11.75)	6.09	-1.01	.312
Radial Inclination (°)	24.74 (8.05)	19.79 (12.12)	4.95	-1.32	.186
Palmar tilt (°)	21.05 (10.71)	26.69 (8.35)	5.64	-1.38	.169
Ulna variance (mm)	21.64 (9.04)	22.75 (11.29)	1.11	-0.256	.798
Articular Step-off (mm)	22.47 (10.51)	18.00 (0.00)	4.47	-0.595	.552

*= The Z-statistics is for the Man-Whitney U-test for a difference in the means between two independent groups

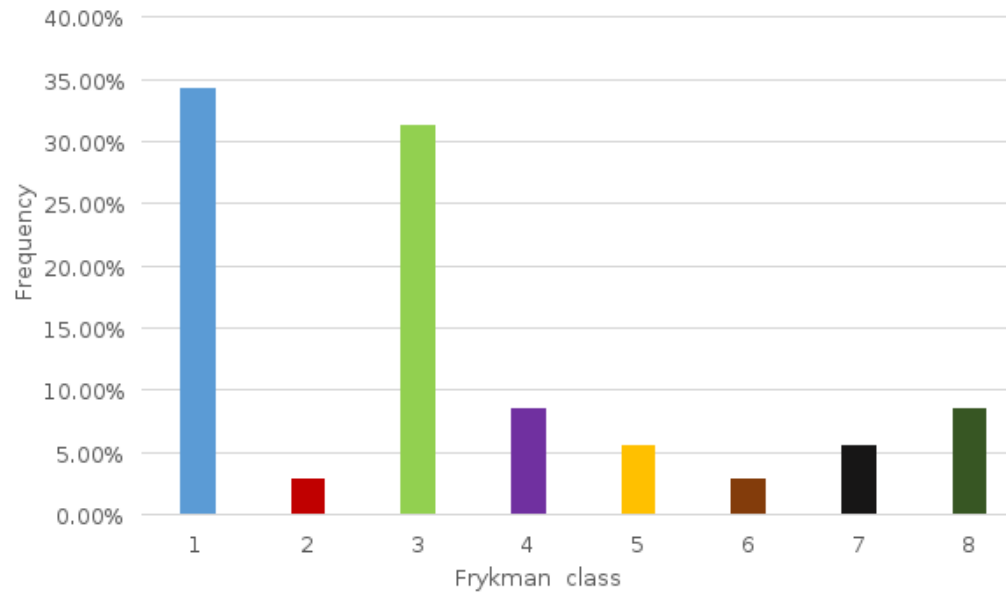


Fig. 1. Distribution of the Frykman class of the fractures in this study population

Radial height, palmar tilt and radial inclination are the most commonly used radiographic parameters to predict the outcome after distal radial fractures. However, controversies exist regarding the relative importance of each of these radiographic parameters. Various authors have found different parameters to correlate with functional outcome studies [16,17]. In this study, different parameters influenced the DASH scores in a varied pattern. Radial height and palmar tilt increased the DASH scores where the radiographic parameter was unacceptable post-reduction, but not enough to increase it beyond the point where the patient still considered the wrist a problem.

5. CONCLUSION

Non-operative management of distal radial fractures was associated with favorable DASH scores in predominantly young and middle-aged patients, even though most of the patients had at least one unacceptable radiographic parameter post-reduction.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline patients consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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