Radiological outcome of distal radius fractures undergoing closed reduction and cast splint

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ABSTRACT

Fractures of the distal radius are the most common fractures. Much has been written about this topic, but still many questions remain, including major controversies regarding outcome and optimal treatment. Closed reduction and plaster cast is the most common treatment for fractures of the distal radius. If an unacceptable re-displacement occurs, re-reduction and surgical fixation may be necessary.

Objective: To determine the radiological outcome of distal radius fractures undergoing closed reduction and cast splint.

Materials and Methods: This descriptive Cross sectional study was conducted in the Department of orthopaedics, Hayatabad medical complex, Peshawar from Nov 2013 to Nov 2014 , a total of 105 patients presenting with distal radius fractures were included in the study through a consecutive sampling technique and were subjected to closed reduction & cast splinting and radiological outcome were recorded.

Results: The mean age was 31.62 ± 7.62 years of which 66.7% were male and 33.3% were females. After closed reduction & cast splinting, radial shortening was observed in 20% of cases, dorsal angulations was observed in 13.3% and radial angulations was observed in 6.7% of cases.

Conclusion: Worse radiological outcomes are not uncommon after closed reduction & cast splinting. More research is required to generate recommendations for the therapy to reduce the burden of these worse radiological outcomes.

Keywords: Closed reduction, cast splint, shortening, angulations.

INTRODUCTION

Fractures of the distal radius are the most common fractures.[1]This fracture is especially frequent in children and the elderly. The metaphyseal widening of the distal radius is a zone predisposed to fractures because of a lower amount of strong cortical bone and higher amount of weaker cancellous bone. The major risk factors are low bone mineral density (BMD) and a tendency to fall.[2] Overall incidence rates about 24-27 per 10,000 person/years have been presented in recent reports[3, 4, 5], female to male ratio is about 3:1.3

Displaced factures that can be reduced to an acceptable anatomical position (approximately, axial shortening <2 mm or <10° dorsal angulation) can be immobilized in a short arm cast for about 5 weeks.[6] Closed reduction and plaster cast is still the most common treatment for fractures of the distal radius. If an unacceptable redisplacement occurs, re-reduction and surgical fixation may be necessary. The risk for redisplacement increases with age over 60 years, dorsal angulation >20°, dorsal communition, an associated ulna fracture and intra-articular involvement.[7]

However, they are complex injuries with a variable prognosis and if they are not treated optimally, they can be associated with various complications.[8]

Traditionally, the outcome after fractures of the distal radius has been assessed by radiological parameters and objective physical variables (grip strength and ROM). The correlation between radiological parameters and objective physical variables is questionable.[9]

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The present study is designed to determine the frequency of different radiological parameters among patients with displaced distal radius fractures subjected to closed reduction and cast splint. This study will provide us with a fresh local evaluation of the fractures managed by closed reduction and cast splint.

METHODOLOGY

This Descriptive study was conducted in Orthopaedics Department, Hayatabad Medical Complex, Peshawar, from November 2013 to November 2014. Inclusion criteria were patient with mean age group of 18 to 50 years, distal radius extra-articular (Fernendous Type 1).

Patients with pathological factures, bilateral radius fractures, congenital deformity of the radius, Intra articular fractures and Open fractures were excluded because these conditions may act as confounders and introduce bias in the study results.

All patients were subjected to detailed history, followed by complete routine examination and baseline investigations. All the patients were subjected to closed reduction under intravenous sedation and analgesia followed by short arm cast splint (as per standard orthopaedic protocols). All the procedures including closed reduction and cast splint were done by senior orthopaedic resident. Once done and patients stabilized, radiograph was taken to measure radial shortening, dorsal and radial angulation. Once done, the patient was labelled as having acceptable radiological reduction (axial shortening <2 mm or <10° dorsal angulation) and discharged on routine medication and home care advise. Patients were followed on 2 weeks and 6 weeks.

All the above mentioned information including name, age and gender was recorded in a pre-designed proforma. Strictly exclusion criteria were followed to control confounders and bias in the study results.

The collected data was stored and analysed in SPSS version 10 for windows. Mean ± SD was calculated for numerical variables like age. Frequencies and percentages were calculated for categorical variables like gender and radiological outcome (Radial shortening, dorsal angulation and radial angulation). Radiological outcome was stratified among age and gender to see the effect modifiers.

RESULTS

The study was conducted on 105 adult patients presenting with distal radius fracture.

The mean age of our sample was 31.62 ± 7.62 years. We divided the patients in 3 different age groups and we found that in the age group up to 25.00 years we had 20%, in the age group 25.01 to 35.00 years we had 53.3% and in the group 35.01 and above we had 26.7% of patients, there were 66.7% males and 33.3% females.

All the patients were subjected to conservative treatment of their distal radius fracture (closed reduction & cast splinting) and it was found that acceptable radiological outcome was observed in 63 (60%) of patients and un acceptable outcome was observed in 42 (40%) of patients.. If we look at the individual breakup of the unacceptable outcome, we observed that of total 40% unacceptable outcome, 20% were of radial shortening, 13.3% were of dorsal angulation and remaining 6.7% were of radial angulation. (Table 1)

We stratified the radiological outcome with regards to gender. We observed that un acceptable outcome was more pronounced in female gender as compared to male gender as on applying chi square test, the difference was statistically significant with a p value of 0.03(Table 2).

We stratified the radiological outcome with regards to different age groups. We observed that un acceptable outcome was more pronounced in older age groups as compared to younger as on applying chi square test, the difference was statistically significant with a p value of 0.00 (Table 2).

We also stratified individual radiological outcome with regards to gender. While doing so, we observed that the difference was statistically significant as female tend to suffer more from dorsal angulation followed by radial shortening and males tend to suffer more from radial shortening followed by radial angulations. The difference on applying chi square test was having a p value of 0.000.

We also stratified individual radiological outcome with regards to different age groups. While doing so, we observed that the difference was statistically significant as radial shortening was solely observed in young age group, dorsal angulation was equally observed as radial shortening in age group 25.01 to

35.00 years and the entire three radiological outcomes were observed equally in age groups above 35.01 years. The difference on applying chi square test was having a p value of 0.004.

TABLE 1: TYPE OF RADIOLOGICAL OUTCOME AFTER CONSERVATIVE TREATMENT (n = 105)

	Frequency	Percentage
Acceptable reduction	63%	60.0%
Radial shortening	21%	20.0%
Dorsal Angulations	14%	13.3%
Radial Angulations	7%	6.7%
Total	105%	100.0%

TABLE 2: GENDER WISE STRATIFICATION OF RADIOLOGICAL OUTCOME AFTER CONSERVATIVE TREATMENT (n = 105)

Count

Parameter		Radiological Outcome		p Value
		Acceptable	Un Acceptable	
Gender of the patient	Male	49(77.8%)	21(50%)	0.03 .
	Female	14(22.2%)	21(50%)	
	Total	63(100%)	42(100%)	
Age group	Up to 25.00 years	14(22.2%)	7(16.67%)	.000
	25.01 to 35.00 years	42(66.67%)	14(33.33%)	
	35.01 years & higher	7 (11.11%)	21(50%)	

DISCUSSION

Because of the high incidence, fractures of the distal radius are an important public health issue. It is essential to manage this common injury correctly and cost effectively, there is still insufficient evidence and lack of consensus with regard to the management of this frequent fracture. In our series, we observed acceptable and unacceptable radiological outcome in terms of radial shortening, radial angulations and dorsal angulations. These finding has been supported by several other investigations.[10-17]

In a prospective study of 216 patients, Grewal and MacDermid [10] demonstrated a strong link between poor outcome (based on PRWE and DASH scores) and the presence of a poor radiological outcome of the distal radius in patients <65 years. In a recent study, Brogrenet al.[11] reported that dorsal angulation over 10° and positive ulnar variance was associated with higher patient-reported disability (DASH). Karneziset al.[12] and Kumar et al.[13] also reported positive correlations between radiological and patient-rated results (DASH and PRWE score, respectively).

To date, there is no consensus regarding which radiological parameter that best predicts the outcome[15-17]. We recorded that all three radiological parameters in a good number of patients (40%). Reasonably, all three parameters have a bearing because they are coherent and reflect the effect of the forces (axial load and dorsal extension) on the distal radius at the time of the injury. The result is an axial shortening of the distal radius, a dorsal angulation of the articular surface and a radial compression that “shortens” the radius styloid. Experimental studies have explained how malunion gives symptoms by causing a carpal malalignment that alters the dynamics and loading patterns of the wrist joint1[17-20]. Pogue et al.[17] found that normal wrist mechanics were maintained if axial shortening was <2 mm, volar tilt changed by <20°, and radial inclination was maintained at >10°.

The potential measurement error in the radiological assessment awakes the question of whether it is meaningful to relate the degree

of radiological deformity to the outcome. Despite a confirmed high-rate agreement, the intra-observer tolerance limits (the expected margin of error) have been estimated to ±5 mm for radial shortening and ±10° for dorsal angulation[21]. Rather than dismissing the existing scientific evidence that involves radiological measurements, we suggest that one should be careful to set rigorous thresholds or postulate conclusions on precise radiological measurements. However, it would be imprudent to conclude that 2 mm is the crucial limit of allowed axial shortening. However, it is not unlikely that the radiological measurement error partially can explain the discrepancy in the literature, at least regarding intra-articular fractures in which, the low rate agreement for measuring size of steps and gaps in healed fractures renders difficulties for valid comparisons of results.[22]

Evaluating the predictors of the functional outcomes after DRF is difficult because of the variability in the treatment methods, differences in the surgeons' expertise, the lack of a well-defined study protocol to collect all the relevant data, and the inconsistency in the follow-up times. The purpose of this study was to add further knowledge to the existing literature, to collect comprehensive outcome data radiologically, and to further recommend defining predictors to assist the future treatments. The outcome parameters have been used in other studies.[23]

In a series by Bentohami A et al [24], the quality of radiographic reduction was judged to be adequate by radiological parameters, which included dorsal tilt, radial inclination, and radial shortening. In 22% of patients the quality of radiographic alignment was judged to be inadequate. We observed no effect of radiographic parameters on the functional outcome. Female sex and longer duration of follow-up (>35 months) were the only independent prognostic factors significantly associated with a worse QuickDASH score.

Fractures of the distal radius form a heterogeneous group of patients that is treated with numerous techniques and assessed with a variety of outcome measurements. The diversity makes it difficult to come to consensus, which in part explains the lack of medical evidence. Randomized comparisons provide the highest level of medical evidence and are optimal for comparisons of specific interventions in defined patient groups but are probably not sufficient to form consensus on how to optimally treat fractures of the distal radius. Even a large number of well-powered, scientifically optimally designed studies are unlikely to give us all the answers. It is also important to realize that with large enough samples statistically significant differences probably can be demonstrated between any methods. However, the difference might not be clinically relevant and thus the study has little clinical relevance.

CONCLUSION

Worse radiological outcome are not uncommon after conservative treatment for distal radius fractures with closed reduction & cast splinting. More research is required to generate recommendations for the therapy to reduce the burden of this worse radiological outcome.

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