

## “Do Radiographic parameters predict Functional Outcome in Distal end Radius Fracture?”

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### Abstract

**Background:** Lower end radius fractures are among the most common fractures of the upper limb and accounts for 15-20% of orthopedic admissions in hospitals. Management these fractures continues to be a therapeutic problem and challenge. Though there are various treatment options described so far; still there is lacunae in the literature, regarding accurate treatment modality, particularly in case of unstable fractures. Various clinical and biomechanical studies have shown the benefits of restoring anatomical reduction. However other studies have demonstrated that restoring normal anatomy does not offer better functional outcomes. While achieving good fracture alignment may be significant, the actual functional importance of anatomical reduction is controversial. The assumption that functional outcome is better by restoration of anatomy is argued.

Most orthopaedicians accept the fact that anatomical alignment is preferable, but the threshold for acceptable malunion and the long-term outcome of anatomical reduction on functional outcome and patient related satisfaction remain to be evaluated.

The study had been taken up to disclose the correlation between anatomical and functional outcome in these patients with distal radius fracture.

**Objective:** To examine association of radiographic parameters of distal radius fracture and objective (ROM, Grip strength) and subjective (PRWE) functional outcome.

**Study design and setting:** A observational study on management of adult patients with distal radial fractures presenting at Deenanath Mangeshkar Hospital and Research Centre, Pune from October 2013 to December 2015.

**Patients and methods:** This study carried out on the patients with intra-articular and extra-articular fractures of the distal end radius as per selection criteria and after taking a written informed consent. Outcome measures were assessed both objectively and subjectively. Objective assessment included a radiographic score determined by measuring the radial length, radial angle and dorsal angle on wrist radiographs; and the wrist function by measuring the range of motion and hand-grip strength. Subjective assessment was done using wrist pain and disability based on the patient rated wrist evaluation (PRWE) score. Data were analyzed using SPSS v20.

**Results and analysis:** The mean age of our study population (49) was 53 years (20 – 90 years), and 33 patients (67%) were female. Twenty eight fractures (57.1%) were of the dominant hand. Non-operative (14) and operative treatments (35) were used. Majority of patients had a good radiographic score (61%), while 6% had a poor score. Sixty five patients (65%) had a good functional objective score, and 21% had an excellent score. In the subjective assessment of pain and disability, the PRWE score was highest in the 41-60 years age group at 38/100 and least in those at 60 and above years (32/100;  $p=0.004$ ). There was a positive correlation ( $p=0.000$ ) between radiographic assessment and the objective functional assessment in younger age group. There was no correlation between the radiographic score and the subjective assessment ( $p=0.319$ ). Grip strength was a significant predictor of disability (PRWE score).

**Conclusion:** The majority of the patients had a good radiographic score which correlated positively with the objective functional score, especially in the younger patients; however, a good radiographic score does not seem to positively affect the subjective functional outcome. The patient's age is an important factor in the overall patient satisfaction regardless of the radiographic and the objective functional scores, hence to be considered during planning of treatment options.

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### Introduction

Distal end radius fractures are among the most common fractures of the upper extremity and accounts for 15-20% of orthopedic admissions in hospitals and caused by high-energy trauma in young individuals and by low-energy trauma in the old age groups.

Management of these fractures continues to be a problem and challenge for the treating orthopedic surgeon. There are various methods described for the management of these fractures, which includes the Plaster of Paris cast, K-wire and cast, per-cutaneous pinning, open reduction with internal fixation and external fixator. There is still no consistent scientific evidence that would allow secure decision making regarding approximate treatment, particularly in case of unstable fractures<sup>1,2</sup>. A recent study investigating the preferred treatment of distal radial fractures by younger American orthopaedic surgeons, documented a shift in treatment modality towards open reduction and internal fixation, from 42% in 1999 to 81% in 2007( $p<0.0001$ ), despite the fact that no evidence based conclusion so far

can be made that could justify such a shift in treatment modality<sup>3</sup>.

Various clinical<sup>4-10</sup> and biomechanical<sup>11-13</sup> studies have shown the benefits of restoring anatomical reduction. However other studies<sup>14-18</sup> have demonstrated that restoring normal anatomy does not offer better functional outcomes. While achieving good fracture alignment may be significant, the actual functional importance of anatomical reduction is controversial. The assumption that functional outcome is better by restoration of anatomy is argued.

Most orthopaedicians accept the fact that anatomical alignment is preferable, but the threshold for acceptable malunion and the long-term outcome of anatomical reduction on functional outcome and patient related satisfaction remain to be evaluated<sup>19-21</sup>.

The study had been taken up to assess the correlation between anatomical and functional outcome in these patients with distal radius fracture.

### Aims and Objectives

1. To examine association of radiological parameters of distal radius fracture and functional result (disability).
2. To analyze the correlation between objective physical characteristics of injured wrist (grip strength, ROM) and the subjective functional outcome i.e. Patient Rated Wrist Evaluation (PRWE) for patient's disability evaluation.

### Material and Methods

**Study Area:** Deenanath Mangeshkar Hospital and Research Center, Pune.

**Study Population:** Skeletally matured patients who suffered distal end radius fractures.

**Study Design:** Observational study.

**Sample Size:** 49

**Study Duration:** October 2013- December 2015. In this observational study we considered all skeletally mature patients who suffered distal end radius fracture, irrespective of method of treatment used.

#### Inclusion Criteria:

- Age more than 18 years.
- Distal end radius fractures irrespective of method of treatment received.

#### Exclusion Criteria:

- Additional wrist injury (carpal fracture).
- Open fracture.
- Associated with neurovascular injury.

Every patient was evaluated according to functional (subjective by PRWE score and objective by ROM, grip strength) and radiographic (Radial length, Radial tilt, Dorsal tilt, and Volar tilt) outcomes. All the patients were assessed on follow up visits at 3 weeks, 3 months, 6 month, 1 year.

### Statistical Methods

Descriptive analysis consisting of mean, SD performed on the variables obtained. Statistical correlation for the association between the parameters done with the Spearman correlation with the test SPSS v20 software.

### Observations and Results

49 patients fulfilled the selection criteria and were followed to up to the final assessment. The mean age of our study population (n = 49) was 53 years (range, 20–90 years), and 33 patients (67%) were female. The minimum follow up from fracture treatment was 6 months. Twenty eight fractures (57.1%) were of the dominant hand. All treatment decisions were made according to the clinical judgment of the treating on call surgeon before study enrollment; nonoperative and operative treatments were used. Nonoperative treatment (n = 14) entailed closed reduction and immobilization with below elbow cast. Operative treatment (n = 35) included closed reduction percutaneous pinning (n = 15), open reduction and internal fixation with volar plate (n = 9), and closed reduction and external fixation (n = 11).

### Radiographic assessment

On radiographic assessment, 30 patients (61%) had good radiographic score, 11 patients (23%) had fair, while 5 patients (10%) had an excellent radiographic score and 3 patients (6%) had a poor score.

The mean radial length was about 2mm at the time of injury. It restored to average of 11 mm after the reduction to an average of 8mm at the most recent follow up.

The mean radial tilt was 5<sup>0</sup> at the time of injury which restored to an average of 20<sup>0</sup> after intervention and to an average of 16<sup>0</sup> at the final follow up.

The dorsal tilt (from a neutral of 0 degrees) decreased from an average of 20<sup>0</sup> before the reduction to normal palmar tilt of an average of 1.53<sup>0</sup> after reduction. The mean dorsal tilt was 2.84<sup>0</sup> at the most recent follow up evaluation.

Postoperatively the dorsal tilt could be corrected to the anatomical palmar tilt or atleast a neutral angle in 33 patients (67%) while in 16 patients (33%) the dorsal tilt could not be restored even to a neutral angle.

### Objective Assessment

On objective assessment of the wrist function with respect to ROM, 32 patients (65%) had a good objective functional score, 7 patients (14%) had fair, while 10 (21%) had excellent functional objective score and none of the patients had a poor score.

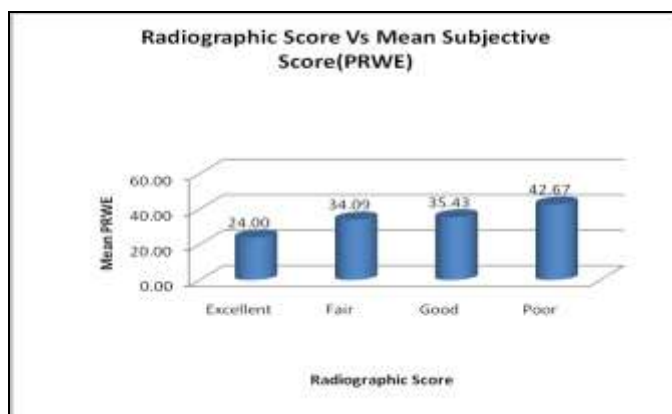
On objective assessment of the wrist function with respect to grip strength, 17 patients (35%) had a good objective functional score, 25 patients (51%) had fair, 5 (10%) had excellent, while 2 patients (4%) had poor score.

**Subjective Assessment**

On subjective assessment of the wrist function, 30 patients (61%) had a good PRWE score, 7 patients (14%) had fair, while 12 (25%) had excellent PRWE score and none of the patients had a poor score.

The mean subjective PRWE score in age group (41– 60 years) was the highest 38.17/100 which indicates less satisfaction, while in those above 60 years was the lowest 32.9/100 i.e. more satisfaction. There was a significant negative correlation between age and the mean PRWE subjective score (p= 0.004). This implies that older age groups had a lower (PRWE) score i.e. better subjective score despite lower radiographic and or functional objective score.

Association between radiographic and subjective outcome.



**Fig. 1: Radiographic Score Vs Mean PRWE Score**

The correlation between the radiographic score and the subjective assessment was not statistically significant (p =0.319), which indicate that patient satisfaction was not necessarily related to good radiographs after treatment.

**Association between Radiographic and objective outcome**

The dorsal tilt is more closely related to grip strength and the all of the movements except radial deviation.

**Table 1: Radiological parameters Vs Objective parameters**

	Radial length	P-value	Radial tilt	P-value	Dorsal tilt	P-value	Radiological score	P-value
	Correlation Coefficient		Correlation Coefficient		Correlation Coefficient		Correlation Coefficient	
Flexion	.265	.065	.064	.661	.606	.000*	.565	.000*
Extension	.142	.331	.074	.612	.623	.000*	.588	.000*
Ulnar deviation	.164	.259	.101	.489	.630	.000*	.557	.000*
Radial Deviation	.160	.271	.004	.981	.242	.093	.172	.239
Pronation	.197	.175	.213	.143	.382	.007*	.543	.000*
Supination	.200	.168	.180	.215	.316	.027*	.485	.000*
ROM	.184	.205	.184	.206	.606	.000*	.632	.000*
Grip strength	.292	.042*	.102	.487	.626	.000*	.573	.000*

**Table 2: Radiographic Score Vs ROM outcome in Young and Old age group**

	Correlation coefficient	P value
Young (less than 60 yrs.)	.687	.000
Old (more than 60 yrs.)	.173	.465

**Table 3: Radiographic Score Vs Grip Strength outcome in Young and Old age group**

	Correlation coefficient	P-value
Age upto 60 yr	0.607	.000
Age more than 60 yr	0.081	.735

There was a positive correlation between radiographic outcome and functional objective outcome in younger age group. This shows that, the better the radiographic outcome the better the functional objective outcome in patients under 60 years of age.

However, the correlation between the radiographic score and the objective functional assessment in age group more than 60 years was not statistically significant (ROM  $p=0.465$ , Grip strength  $p=0.735$ ).

**Association of Objective and Subjective outcome**

There was no correlation between the mean subjective PRWE score and the objective ROM functional score ( $p=0.562$ ). This indicates that, better objective functional assessment is not always associated with higher patient satisfaction. However, Grip strength was a significant predictor of disability (PRWE score).

**Table 4: PRWE Score Vs ROM Score**

<b>PRWE Score Vs ROM Score</b>	<b>P= 0.562</b>
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**Table 5: PRWE Score Vs Grip Strength outcome**

<b>PRWE Score Vs Grip Strength</b>	<b>P= 0.001</b>
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**Discussion**

In recent years, wrist injuries evaluation is focused on assessment disability from the patient’s perspective (PRWE). Small stressed the significance of patient’s related satisfaction in the evaluation of outcome<sup>22</sup>.

**Analysis of Radiographic assessment versus Objective outcome:**

It is believed that good radiological reductions produce good functional results. Trumble et al.<sup>7</sup> also determined a close relation of step off, and radial shortening with the functional results in a 52 displaced, intraarticular fractures. A study done by McQueen and Caspers<sup>5</sup> shown the relationship between radiographic displacement and functional outcome in 30 patients with average age 69 years treated conservatively. However, study done by Young and Rayan<sup>23</sup> did not shown a correlation between radiological and functional results in low-demand patients older than 60 years of age. Also Kojii Fujii et al<sup>9</sup> in their study did not find correlation between radiological and functional outcome in elderly population. These studies mainly comprised of elderly individuals.

In this study while correlating radiological results with objective functional outcome in patients more than 60 years of age, also shows no statistical significant correlation. However, in younger age group, there was statistical significant correlation. In other words, in younger age groups better radiographic outcome is associated with better functionality, unlike in elderly patients where this association is absent. We conclude

that the anatomical restoration results in better functional outcome in young groups, but not in older age group patients.



**Fig. 2: AP and Lateral x-ray of malunited fracture showing radiological parameters of 61 year old patient**



**Fig. 3: Wrist ROM for the similar patient showing good ROM score of 22 out of 26**

Also we found dorsal tilt has great impact on functional objective outcome and should be restored adequately, the similar results were shown by the study conducted by Forward et al<sup>18</sup>; but there is no relation with radial inclination.

**Analysis of Radiographic results versus subjective assessment**

One study by Jaremko et al<sup>17</sup> evaluated 74 non operatively treated fractures in patients aged 50 or older and concluded no statistical significance between radiographic outcome and patient satisfaction (using DASH and SF-12 surveys).

Another similar study done by Ring and Jupiter<sup>15</sup> shown that PRWE scores have no relation with radiographic outcomes in 20 patients aged 60 or older.

On assessing disability using PRWE score, the findings in the current study were similar to these studies where there was no correlation between the radiographic assessment and the patient reported satisfaction, meaning, that patient satisfaction was not necessarily related to good radiographs after treatment. This leads to the conclusion that fracture healing and rehabilitation after a distal radial fracture should not be assessed only with a radiographic follow-up. A patient-rated disability evaluation should be mandatory.

### Analysis of objective outcome versus subjective assessment

The present study demonstrated that grip strength was significant predictor of disability (PRWE score) and not the ROM. This observation is supported by other studies<sup>24,25</sup>.

Age was an important factor particularly on subjective assessment of the outcome and overall patient satisfaction. Comparing the mean subjective score per each age group, there was a negative correlation between age and the mean (PRWE) subjective score ( $p = 0.004$ ). This implies that older patients tend to have lower (PRWE) score i.e. better subjective score despite lower radiographic and or functional objective scores, probably, due to lower functional demands. These findings are in keeping with the findings of some other studies<sup>17,23,26-29</sup>. On the other hand younger age groups were less satisfied with their functional results regardless of the radiographic score, which is similar to the findings of study by Gilatis<sup>30</sup>, involving young population.

### Conclusion

The majority of the patients had a good to excellent radiographic score which correlated positively with the objective functional score, especially in the younger patients; among older population, functional outcomes were good irrespective of radiographic outcomes.

However, a radiographic score does not seem to affect the subjective functional outcome. The mean subjective PRWE score in age group (41– 60 years) was the highest 38.17/100 which indicates less satisfaction, while in those above 60 years was the lowest 32.9/100 i.e. more satisfaction. There was a significant negative correlation between age and the mean PRWE subjective score ( $p = 0.004$ ). This implies that older age groups had a lower (PRWE) score i.e. better subjective score despite lower radiographic and or functional objective score.

The positive correlation between radiological and objective functional outcome in younger patients suggests that regular follow-up radiographs are required to assess that reduction of the fragments is maintained till fracture union is achieved.

The patient's age is an important factor in the overall patient satisfaction regardless of the radiographic and the objective functional scores, hence to be considered during planning of treatment options.

Further prospective randomized studies with longer follow up periods should be done aiming to compare outcomes of different treatment modalities in different fracture types to be able to come up with a standard protocol for managing these fractures.

### References

1. Brogren E, Petranek M, Atroshi I. Incidence and characteristics of distal radius fractures in a southern Swedish region. *BMC Musculoskelet Disord*.2007;8:48.
2. Egol K, Walsh M, Tejwani N, McLaurin T, Wynn C, Pakisma N. Bridging external fixation and supplementary K-wire fixation versus volar locked locked plating for unstable fractures of the distal radius: a randomized, prospective trail. *J Bone Joint Surg Br*.2008;90(9):1214-21.
3. Koval KJ, Harrast JJ, Anglen JO, Weinstein JN. Fractures of the distal part of the radius. The evolution of practice over time. Where's the evidence? *J Bone Joint Surg Am* 2008 Sep;90(9):1855-61.
4. Knirk JL, Jupiter JB. Intra-articular fractures of the distal end of the radius in young adults. *J Bone Joint Surg [Am]*1986;68-A:647-59.
5. McQueen M, Caspers J. Colle's fracture: does the anatomic results affect the final function? *J Bone Joint Surg [Br]*1988;70-B:649-51.
6. Aro HT, Koivunen T: Minor axial shortening of the radius affects outcome of Colle's fracture treatment. *J Hand Surg[Am]*1991; 16:392-398.
7. Trumble TE, Schmit SR, Vedder NB. Factors affecting functional outcome of displaced intra-articular distal radius fractures. *J Hand Surg[Am]*1994;19:325-40.
8. Tang JB, Ryu J, Kish V, Wearden S. Effect of radial shortening on muscle length and moment arms of the wrist flexors and extensors. *J Orthop Res*.1997;15(3):324-30.
9. Fujiii K, Henmi T, Kanematsu Y, et al: Fractures of the distal end of radius in elderly patients: a comparative study of anatomical and functional results. *J Orthop Surg (Hong Kong)*2002;10:9-15.
10. Wilcke MK, Abbeszadegan H, Adolphson PY. Patients perceived outcome after displaced distal radius fractures: a comparison between radiological parameters, objective physical variables, and the DASH score. *J Hand Ther*2007;20:290-8.
11. Pogue DJ, Viegas SF, Patterson RM, et al. Effects of distal radius fracture malunion on wrist joint mechanics. *J Hand Surg[Am]*1990;15:721-7.
12. Kazuki K, Kusunoki M, Yamada J, Yasuda M, Shimazu A. Cineradiographic study of wrist motion after fracture of the distal radius. *J Hand Surg[Am]*1993;18:41-6.
13. Short WH, Palmer AK, Werner FW, Murphy DJ. A biomechanical study of the distal radial fractures. *J Hand Surg[Am]*1987;12:529-34.
14. Young CF, Nanu AM, Checketts RG. Seven years outcome following Colle's type distal radial fracture. A comparison of two treatment methods. *J Hand Surg*.2003;28B:422-26.
15. Ring D, Jupiter JB. Treatment of osteoporotic distal radius fractures. *Osteoporos. Int*.2005;16 suppl 2:S80-4.
16. Goldfarb CA, Rudzki JR, Catalano LW, Hughes M, Borrelli JJ. Fifteen-year outcome of displaced intra-

- articular fractures of distal radius. *J Bone Joint Surg.*2006;31A:633-39.
17. Jaremko JL, Lambert RG, Rowe BH, Johnson JA, Majumdar SR. Do radiographic indices of distal radius fracture reduction predict outcomes in older adults receiving conservative treatment? *Clin Radiol.*2007;61(1):65-72.
  18. Forward DP, Davis TR, Sithole JS. Do young patients with malunited fractures of the distal radius inevitably develop symptomatic posttraumatic osteoarthritis? *J Bone Joint Surg.*2008;90B:629-37.
  19. Garcia-Elias M, Folgar MA. The management of wrist injuries: an international perspective. *Injury* 2006 Nov;37(11):1049-56.
  20. Downing ND, Karantana A. A revolution in the management of fractures of the distal radius? *J Bone Joint Surg Br* 2008 Oct;90(10):1271-5.
  21. Synn AJ, Makhni EC, Makhni MC, Rozental TD, Day CS. Distal Radius Fractures in Older Patients: Is Anatomic Reduction Necessary? *Clin Orthop Relat Res* 2008 Dec 12.
  22. Smaill BG (1965) Long-term follow-up of Colles's fracture. *J Bone Joint Surg Br* 47(1):80-85.
  23. Young BT, Rayan GM. Outcome following nonoperative treatment of displaced distal radius fractures in low demand patients older than 60 years. *J Hand Surg* 2000;25-B:749-751.
  24. Karnezis IA, Fragkiadakis EG. Association between objective clinical variables and patient-rated disability of the wrist. *J Bone Joint Surg [Br]* 2002;84:967-70.
  25. Swart E, Nellans K, Rosenwasser M. The effects of pain, supination, and grip strength on patient-rated disability after operatively treated distal radius fractures. *J Hand Surg (Am)* 2012;37(5):957-62.
  26. Ranjeet N, Estrella EP. Distal radius fractures: does a radiologically acceptable reduction really change the result? *J Clin Diagn Res* 2012;6(8):1388-1392.
  27. A.J. Kelly, D. Warwick. Is manipulation of moderately displaced Colles' fracture worthwhile? A prospective randomized trial. *Injury.* 1997;28(4):283-287.
  28. Alexander Anzarut, Jeffrey A. Johnson, Brian H. Rowe, et al. Radiologic and patient-reported functional outcomes in an elderly cohort with conservatively treated distal radius fractures. *J Hand Surg.* 2004;29(6):1121-1127.
  29. Andrew J. Synn, Eric C. Makhni, Melvin C. et al: Distal Radius Fractures in Older Patients: Is Anatomic Reduction Necessary? *Clin Orthop Relat Res.* 2009;467(6):1612-1620.
  30. Gliatis JD, Plessas J, Davis TRC. Outcome of distal radius fractures in young adults. *J Hand Surg* 2000;25-B:535-543.