

Correlation Between Radiological Parameters And Patient's Functional Satisfaction Outcomes Post Treatment Of Distal Radius Fractures

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ABSTRACT

Background: Radial fracture healing can be evaluated radiologically with the Sarmiento score based on Volar Tilt, Radial Shortening and Radial Inclination measurement assessment points. Meanwhile, to assess patient functional satisfaction, the DASH score can be used. This study aims to determine the relationship between radiological parameter components and patient functional outcomes (DASH Score) in radius fracture patients at Dr. Mohammad Hoesin General Hospital Palembang.

Method: A cross-sectional study using secondary data from medical records of radius fracture patients was undertaken at Dr. Mohammad Hoesin General Hospital Palembang from January 2023 to January 2024. There were 43 samples diagnosed with distal radius fractures who met the inclusion criteria. The correlation between the radiological parameter components and the DASH score was analyzed using the Spearman Rho's test and the influence of the radiological parameter components on the DASH score was analyzed using the linear regression test. All data were analyzed with SPSS version 22.0.

Results: In this study, the results showed that there was a weak, non-significant correlation between loss of volar tilt and the DASH score ($r = 0.211$; $p = 0.175$), a moderate positive significant correlation between radial shortening and the DASH score ($r = 0.572$; $p = 0.000$), and a weak positive significant correlation between radial inclination and the DASH score ($r = 0.343$; $p = 0.024$). Based on the linear regression test, it was found that the sequentially significant effects on the DASH score were radial shortening and loss of radial inclination.

Conclusion: Radial Shortening is the most significant radiological predictor in determining the functional function of radial fracture patients.

Keywords: DASH Score, Loss of Radial Inclination, Loss of Volar Tilt, Radial Shortening

INTRODUCTION

Fracture occurs more frequently in the modern era due to increased mobility.¹ One type of fracture is a distal radius fracture.¹⁻³ Distal radius fractures often occur in young men and post-menopausal women. Younger patients with distal radius fractures occur due to high energy trauma. Low energy trauma tends to occur in older patients due to osteopenia/osteoporosis.⁴ Distal radius fractures can be treated surgically, conservatively, or both. The decision to treat a distal radius fracture may depend on many factors, such as fracture condition, comminution, joint involvement, patient needs and others. Data on the outcome of operative treatment is provide good functional satisfaction in 75% of patients.⁵ However, on the other hand, a prospective study conducted by Ranjeet said that they could not see any significant difference between the outcome of operative and non-operative treatment, which resulted in the patient's functional outcome being equally good.⁶

One of the radiological functional evaluations is the Sarmiento score (modification of Lidstrom and Frykman) with assessment points measuring Volar Tilt, Radial Shortening and Radial Inclination. Radiological evaluation can be carried out using radiological Xray Wrist with true AP & Lateral position.⁷

Assessment of patient functional satisfaction can use various validated tests, one of which is DASH SCORE, which is a 30-item questionnaire tool designed to assess patient functional satisfaction and health status during the previous week. The items question the level of difficulty in performing different physical activities for the arms, shoulders and hands, the severity of each pain symptom, activity-related pain, tingling, weakness and stiffness and the impact of the problem on social functioning, work, sleep and self-image.⁸

Considering that in many distal radius fractures different conditions of fracture segment comminution and various complications can be found, it is necessary to determine a main radiological parameter as the main objective of distal radius fracture segment reduction as an effort to obtain results that provide good functional satisfaction of patient.

METHOD

This research is an analytical observational study with a cross-sectional design using secondary medical record data to analyze the strength of the relationship between various components including Volar Tilt, Radial Height, and Radial Inclination in predicting good patient satisfaction outcomes. The research was undertaken at RSUP. Dr. Moh. Hoesin Palembang from January 2023 to January 2024. There were 43 distal radius fracture patients who met the inclusion criteria.

The independent variables in this study are radiological parameter components including Volar Tilt, Radial Shortening and Radial Inclination. Meanwhile, the dependent variable is patient functional satisfaction using the DASH score assessment. The correlation between the radiological parameter components and the DASH score was analyzed using the Spearman Rho's test and the strongest influence of the radiological parameter components on the DASH score was analyzed using the linear regression test. All data were analyzed with SPSS version 22.0.

RESULTS

Characteristics of the Research Sample

In this study, the mean age of distal radius fracture patients was 35.9 years (range 25 to 44 years) with the largest age range being 25 – 43 years (90.7%). The majority of distal radius fracture patients were male (58.1%). The most common type of fracture was the Smith type (55.8%) and the majority of distal radius fracture patients in this study received surgical treatment (88.4%) (Table 1).

Characteristics of Sarmiento Radiological Score

In this study, the mean Sarmiento radiological score was 1.326 ± 1.34 (range 0 – 5). The mean loss of volar tilt was 2.116 ± 3.633 (range 0 – 16) with the majority in the good category (95.3%); the mean radial shortening was 1.512 ± 2.186 (range 0 – 11) with the majority in the good category (97.7%); and the mean loss of radial inclination was 3.535 ± 4.239 (range 0 – 16) with the majority in the good category (90.7%) (Table 2).

Characteristics of the Disabilities of the Arm, Shoulder and Hand Score (DASH Score)

In this study, the mean DASH score was 27.53 ± 5.70 (range 20 – 39) and all scores were less than 40/good (100%).

Table 1. Characteristics of the Research Sample

Characteristics	Frequency	Percentage
Age (years old)		
• Mean \pm SD	35.95 \pm 6.37	
• Median (Min-Max)	37 (25 – 44)	
Age Category		
• 25 – 43 years old	39	90.7
• 44 – 50 years old	4	9.3
Gender		
• Male	25	58.1
• Female	18	41.9
Fracture Type		
• Barton	3	7.0
• Colles	16	37.1
• Smith	24	55.8
Management		
• Conservative	5	11.6
• Operative	38	88.4

RSMH Palembang Medical Record Data

Table 2. Characteristics of Sarmiento Radiological Score

Characteristics	Frequency	Percentage
Sarmiento Score		
• Mean \pm SD	1.326 \pm 1.34	
• Median (Min-Max)	1 (0 – 5)	
Loss of Volar Tilt		
• Mean \pm SD	2.116 \pm 3.633	
• Median (Min-Max)	0 (0 – 16)	
Radial Shortening		
• Mean \pm SD	1.512 \pm 2.186	
• Median (Min-Max)	1 (0 – 11)	
Loss of Radial Inclination		
• Mean \pm SD	3.535 \pm 4.239	
• Median (Min-Max)	2 (0 – 16)	
Loss of Volar Tilt		
• Good	41	95.3
• Fair	2	4.7
Radial Shortening		
• Good	42	97.7
• Fair	1	2.3
Loss of Radial Inclination		
• Good	39	90.7
• Fair	4	9.3

RSMH Palembang Medical Record Data

Table 3. DASH Score Characteristics

Characteristics	Frequency	Percentage
DASH Score		
• Mean \pm SD	27.53 \pm 5.70	
• Median (Min-Max)	27 (20 – 39)	
DASH Score		
• Good	43	100.0
• Fair	0	0.0

RSMH Palembang Medical Record Data

Correlation between the Sarmiento Radiological Score Components and the DASH score

With the correlation test, the results showed that there was a weak correlation that was not significant between loss of volar tilt with the DASH score ($r = 0.211$; $p = 0.175$); there was a moderate positive correlation that was significant between radial shortening with the DASH score ($r = 0.572$; $p = 0.000$); and there was a weak-positive correlation that was significant between radial inclination with the DASH score ($r = 0.343$; $p = 0.024$)

Influence of the Sarmiento Radiological Score Components on the DASH score

Based on the linear regression test, it was found that the significant influence sequentially on the DASH score was radial shortening and the loss of radial inclination with the formula:

$$\text{DASH Score} = 24.172 + 1.180 (\text{Radial Shortening}) + 0.393 (\text{Radial Inclination})$$

Table 4. Correlation of Sarmiento Radiological Score Components with DASH scores

Variable	Sarmiento Score Component	r	P value
DASH Score	<i>Loss of Volar Tilt</i>	0.211	0.175
	<i>Radial Shortening</i>	0.572	0.000*
	<i>Loss of Radial Inclination</i>	0.343	0.024*

*Spearman Rho's Test, *p < 0.05*

Table 5. Influence of the Sarmiento Radiological Score Components on the DASH score

Variable	Sarmiento Score Component	R	P value
Constanta		24.172	0.000*
DASH Score	<i>Loss of Volar Tilt</i>	0.090	0.657
	<i>Radial Shortening</i>	1.180	0.003*
	<i>Loss of Radial Inclination</i>	0.393	0.044*

*Linier Reggesion Test, *p < 0.05*

DISCUSSION

Distal radius fractures are one of the most common injuries encountered in orthopedic practice, especially in the western world.⁹ Between the ages of 18 and 50, the distribution of distal radius fractures is low and similar in women and men. However, after the age of 50 years, there is a marked increase in the number of fractures in women, while the frequency of distal radius fractures in men remains almost the same.⁴ In this study, the mean age of distal radius fracture patients was 35.9 years with an age range of 25 to 44 years old. Younger patients with distal radius fractures occur due to high energy trauma. Sports and car accidents are known to be one of the most common causes of distal radius fractures in young adults.⁴²

In this study, it was found that the majority of distal radius fracture patients were male (58.1%). These results are in line with research by Kong et al., 2020 which reported that the majority of distal radius fracture patients were male (59.4%).¹¹ Another study conducted by Ihza et al., 2022 also reported that the majority of distal radius fracture patients were male (59.6%).⁴³ The overall incidence of fracture is higher in men than in women up to the age of 48, but over the age of 48 women have a higher incidence of fracture.⁴³

In this study, the scoring for assessing radiological outcomes was assessed using Sarmiento et al which is a modification of the Lidstrom scoring system consisting of the Loss of Volar Tilt, Radial Shortening and the Loss of Radial Inclination. Based on this score, patients are categorized as Excellent: 0, Good: 1-3, Fair: 4-6 or Poor 7-12.¹⁷ Meanwhile, clinical assessment of functional distal radius fractures is assessed using the DASH score. In this study, the mean DASH score of all patients was good (< 40) with a mean DASH score of 27.53

In this study, the mean loss of volar tilt for distal radius fracture patients was 2.116⁰ (range 0 to 160) with the majority of loss of volar tilt being good (95.3%). The Loss of Volar Tilt had no significant correlation with DASH score. Several studies are still being debated to determine the relationship between the radiological Loss of Volar Tilt and patient function, whereas several studies state that there is no significant relationship between radiological Volar Tilt and patient functional satisfaction.^{37,39} In contrast, a cadaveric study linked the mechanical effect in the cases of mal-reduction from volar tilt, wherein

the force distribution on the radius and ulna will change and be more concentrated on the volar/dorsal side depending on the direction of the deformity.³⁸

In this study, the mean results of radial shortening were 1.512 mm. Radial shortening has a significant correlation with the DASH score. Radial shortening after distal radius fracture is one of the main factors affecting wrist joint function. A study that reviewed 269 distal radius fractures by Solgaard in adults concluded that radial shortening is the most significant radiological predictor in determining patient function and is the most recommended for restoration/reposition if the deformity occurs after a distal radius fracture, as well as the primary goal in surgery.²⁶ Macqueen et al showed that the radial shortening which is more than 3 mm will cause declining power of grasping. Long-term post-fracture effects result in when the radius shortens, the load on the ulnar increases, which can significantly change the contact position and stress level, leading to traumatic arthritis (caused by increased stress in the contact area) and also causing changes in conduction load, which results in degenerative changes in the articular cartilage and affects wrist stability.⁴⁰

The next component of the Sarmiento score that is correlated with the DASH score is loss of radial inclination. Radial inclination is the slope of the articular surface of the radius in the frontal plane.³⁶ In this study, the mean loss of radial inclination was 3.535°. Loss of radial inclination has a significant correlation with the DASH score. Radial inclination represents the angle between one line connecting the tip of the radial styloid and the ulnar aspect of the distal radius and a second line perpendicular to the longitudinal axis of the radius. Radial inclination averages between 21 and 25 degrees and ranges from 15-35 degrees. Loss of radial inclination will increase the load and cause radial deviation of the wrist⁴¹. Radial Inclination has a close correlation with radial height, and both are indicators of the Axial compression mechanism.⁴² Jenkins and Mintowt-czyz show that there is a correlation between the loss of radial height resulting in a decrease in grip function. Long-term axial compression results in degenerative changes in the radiocarpal joint and DRUJ.⁴² Wilcke et al studied the existence of a significant relationship between the loss of radial height of >10 degrees which resulted in worsening of the DASH Score in cases of distal radius fractures.⁴³

Using the bivariate test, it was found that the radiological outcomes which had a significant correlation with the DASH score were loss of radial inclination and radial shortening. Based on the multivariate test with linear regression, it can be concluded that an increase of 1 point in radial shortening results in an increase in the DASH score of 25.352; an increase of 1 point in radial inclination results in an increase in the DASH score of 24.565 and an increase in 1 point in radial shortening and 1 point in radial inclination results in an increase in the DASH score of 25.745.

CONCLUSION

Radial Shortening and Radial Inclination are significant radiological predictors in determining functional patients and Radial Shortening is the strongest radiological predictor in determining functional radial fracture patients. These two parameters are recommended to be prioritized for restored/repositioned if deformity occurs after a distal radius fracture, as well as the primary goal in surgery.

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