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Comparison of X-ray radiology outcomes (Radial inclination, radial length, palmar tilt) and upper extremity function (Quick dash score) in distal radius fracture patients post internal fixation at RSUP Dr. M Djamil Padang (Short term follow-up)

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Abstract
Introduction: Distal radius fracture is one of the most commonly encountered fractures in the emergency room. In the management of distal radius fractures at RSUP M Djamil, it is categorized into two approaches: surgical and non-surgical. This study explores the radiological outcomes (Radial inclination, Radial length, Palmar tilt) and Upper Extremity Function (Quick DASH Score) in patients with Distal Radius Fractures after Internal Fixation (Short-term Follow-up).
Objective: To compare the radiological outcomes of X-ray and upper extremity function between patients with distal radius fractures treated with internal fixation.
Method: This study is a descriptive analytic using a retrospective approach. The sample in this study consists of patients with distal radius fractures who underwent internal fixation procedure at RSUP Dr. M. Djamil Padang. The data were analyzed using univariate analysis to describe the frequency distribution of research variables and bivariate analysis using paired T-test to compare pre-operative X-ray scores with post-operative scores, as well as comparing post-op X-ray scores with Quick Dash scores.
Results: The data analysis results indicate that there are significant result in radiological outcomes after surgery. This suggests that internal fixation surgery is effective in improving patient conditions, and most patients with distal radius fractures managed using internal fixation demonstrate good average upper extremity function outcomes.
Conclusion: The management of distal radius fractures using the internal fixation method is effective in improving patient conditions, especially in terms of radiological outcomes such as Radial Inclination, Radial Length, and Palmar Tilt. Internal fixation procedures can be considered a good choice in the management of distal radius fractures, with the hope of improving the quality of life for patients after surgery.

Keywords: Radiology, distal radius fracture, upper extremity function, internal fixation

Introduction
Distal radius fractures are among the most commonly encountered fractures in emergency departments. They account for 17.5% of all fractures worldwide and 5.2% of patients admitted to emergency departments. The incidence of distal radius fractures is notably high, at 195.2 per 100,000 people per year. In the United States, the reported incidence of distal radius fractures in 2001 was approximately 640,000 cases, with the number increasing annually [1].
A study conducted in Sweden found that over a three-year period (2015-2017), there were 23,394 reported cases of distal radius fractures, predominantly in the elderly. In Indonesia, the prevalence of fractures is 5.5%, with 52.2% of these cases being distal radius fractures. The majority of these fractures occurred in males (59.6%) within the age range of 10-19 years (19.9%), with the most common causes being accidents (85%) and falls (61.6%) [1].
The management of distal radius fractures, according to the Clinical Practice Guidelines at RSUP M Djamil, is categorized into two approaches: surgical and non-surgical. The choice of appropriate diagnostic support and management significantly affects upper extremity function. Evaluating the outcomes based on the Clinical Practice Guidelines for distal radius fractures at RSUP M Djamil requires assessments through roentgen x-rays in two projections, conducted at

6 weeks and 3 months post-treatment. The x-ray assessment involves measuring palmar tilt, radial inclination, radial length, and ulnar variance. Additionally, the evaluation of upper extremity function can be performed through active and passive range of motion (ROM) assessments of the hand, wrist, and elbow [2].

Besides clinical ROM examinations, the Quick DASH Score questionnaire can be utilized to quickly assess the level of disability and sequelae symptoms in patients with distal radius fractures. However, its use is not currently implemented at RSUP M Djamil and is not included in the Clinical Practice Guidelines for distal radius fractures. The Quick DASH Score is an effective method for evaluating the impact of distal radius fractures on patients' function and quality of life. The results from the Quick DASH Score can aid in planning appropriate interventions and developing rehabilitation programs tailored to the individual needs of patients. By integrating clinical examinations with the Quick DASH Score questionnaire, a comprehensive assessment can be conducted, allowing physicians to gain deeper insights into the patient's condition and design optimal treatment plans.

Methods

This is an analytical study utilizing a retrospective cohort design, conducted at Dr. M. Djamil Hospital, Padang, from January to February 2024. The study population comprised all patients with distal radius fractures who underwent internal fixation at RSUP Dr. M. Djamil Padang, totaling 101 individuals. The inclusion criteria were patients with distal radius fractures who had undergone internal fixation at RSUP Dr. M. Djamil Padang, provided that they returned for follow-up at least six months post-procedure and consented to participate in the study. Patients who did not meet the inclusion criteria included those who had undergone non-medical interventions prior to medical treatment, those who did not attend follow-up visits for more than six months post-procedure, or those with invalid medical records.

This study employed univariate analysis to describe the frequency distribution of variables in tabular form and to compare diagnostic results. Bivariate analysis was conducted using paired T-tests to compare X-ray scores before and after surgery, and post-operative X-ray scores with Quick DASH scores. Data were analyzed using computer software to determine if there were significant differences between pre- and post-operative X-ray scores and to assess the relationship between post-operative X-ray scores and Quick DASH scores.

Results

In this study, 40 samples met the inclusion criteria. The majority of patients (35%) with distal radius fractures were aged between 10 and 18 years, followed by patients over 60 years old (27.5%). Patients aged 19-44 years and 45-59 years had lower proportions, at 17.5% and 20% respectively. Males had a higher proportion of distal radius fracture cases compared to females, comprising 60% of the total cases.

Regarding the type of fracture, it can be concluded that Closed Fracture Left Distal Radius is the most common diagnosis, accounting for 47.5% of total cases. Closed Fracture Right Distal Radius and Open Fracture Left Distal Radius had almost equal proportions, at 30% and 20% respectively. Open Fracture Right Distal Radius was the least common, occurring in only 2.5% of total cases.

Grouping characteristics based on the Frykman Fracture Classification yielded the following results: Frykman type I was the most common, covering half of the cases (50%), followed by Frykman type II as the second most common, with a proportion of 20%. Frykman types III, V, and VII had lower proportions, at 5%, 12.5%, and 7.5% respectively, while Frykman types VI - VIII were the rarest, occurring in only 2.5% of total cases.

Table 1: Characteristic of patient with Radius Distal Fracture in Dr. M. Djamil General Hospital Padang

Karakteristik	n	F (%)
Age (Years)		
10-18	14	35
19-44	7	17.5
45-59	8	20
≥ 60	11	27.5
Gender		
Male	24	60
Female	16	40
Diagnose		
Closed Fraktur Left Distal Radius	19	47.5
Closed Fraktur Right Distal Radius	12	30
Open Fraktur Left Distal Radius	8	20
Open Fraktur Right Distal Radius	1	2.5
Classification		
Frykman type I	20	50
Frykman type II	8	20
Frykman type III	2	5
Frykman type V	5	12.5
Frykman type VI	1	2.5
Frykman type VII	3	7.5
Frykman type VIII	1	2.5

In the preoperative radiological outcome analysis, which includes three main variables: Radial Inclination, Radial Length, and Palmar Tilt, the following observations were made. Firstly, concerning radial inclination, data indicate that the majority of patients had an inclination within the range of 5-14 degrees, with the highest number falling within the 10-14 degree range (35%). Secondly, regarding radial length, most patients had a preoperative radial length within the range of 3-6 mm, with half of the patients falling within this range (50%), and no patients had a preoperative radial length above or equal to 12 mm. Thirdly, regarding palmar tilt, the majority of patients showed an acceptable tilt within the range of 1-10 degrees, with the highest number falling within this range (70%). However, about a quarter of the patients exhibited palmar tilt outside of this range (≥ 11 degrees).

As for the postoperative radiological outcome analysis, concerning the radial inclination, the majority (52.5%) of patients had a radial inclination within the range of 0-4 degrees, followed by 47.5% with inclinations ranging from 5-9 degrees. Regarding postoperative Radial Length, the majority (67.5%) of subjects had a radial length of less than 3 mm, with 32.5% having a radial length within the range of 3-6 mm. For Palmar Tilt, 67.5% had a range of 1-10 degrees, followed by 22.5% of subjects with a neutral palmar tilt, and 10% of subjects with a palmar tilt range of 11-14 degrees.

Table 2: Radiological Outcome

Variable	Pre-Op		Post-Op	
	n	F (%)	n	F (%)
Radial Inclination				
0-4	6	15	21	52.5
5-9	13	32.5	19	47.5
10-14	14	35	0	0
≥ 15	7	17.5	0	0
Radial Length				
< 3	8	20	27	67.5
3-6	20	50	13	32.5
7-11	12	30	0	0
≥ 12	0	0	0	0
Palmar Tilt				
Neutral	2	5	9	22.5
1-10	28	70	27	67.5
11-14	6	15	4	10
≥ 15	4	10	0	0

Table 3: The result of the Pair t-Test Analysis for the variables X-Ray Score Loss of Radial Inclination, Radial Length, and Palmar Tilt Loss

Variable	Standard Error	95%CI	P-Value
Loss Radial Inclination Pre Op - Loss Radial Inclination Post Op	0.921	(3.61 – 7.33)	0.000
Loss Radial Lenght Pre Op - Loss Radial Lenght Post Op	0.421	(1.64 – 3.35)	0.000
Loss Palmar Tilit Pre Op - Loss Palmar Tilt Post Op	1.21	(1.44 – 6.34)	0.003

Based on the results of the pair t-test analysis conducted, it can be seen that the p-value for each research variable has a value of $p< 0.05$, meaning there is a difference in the mean between Loss Radial Inclination, Loss Radial Length, and Loss Palmar Tilt both before and after internal fixation intervention. Therefore, it can be concluded that the internal fixation process has a significant effect on the observed parameters in this study.

Table 4: The pre-postoperative X-ray results and Quick DASH scores

Pasien	Pre-Op	Post-Op	QUICK Dash Score
1.	4	1	4,5
2.	3	1	11,4
3.	10	2	2,3
4.	3	3	0
5.	4	3	4,5
6.	1	2	13,6
7.	2	2	4,5
8.	7	2	9,1
9.	2	0	13,6
10.	5	0	4,5
11.	3	1	2,3
12.	5	2	6,8
13.	2	2	2,3
14.	7	1	2,3
15.	2	3	11,4
16.	4	1	9,1
17.	1	2	4,5
18.	2	1	2,3
19.	4	3	0
20.	3	2	4,5
21.	3	3	4,5
22.	10	1	0
23.	2	2	9,1
24.	3	2	6,8
25.	4	2	2,3
26.	5	1	2,3
27.	7	1	2,3
28.	6	3	4,5
29.	4	2	4,5
30.	4	2	4,5
31.	4	3	2,3
32.	7	2	2,3
33.	3	2	4,5
34.	5	2	2,3

35.	10	1	2,3
36.	3	2	2,3
37.	4	1	2,3
38.	5	3	2,3
39.	6	3	4,5
40.	4	1	4,5
Mean	4	2	5

Table 4 provides data on X-ray scores before surgery (Pre-Op), after surgery (Post-Op), and Quick DASH scores. In this table, the X-ray scores provide information about the physical condition of the bones before and after intervention, while the Quick DASH score gives an indication of the patient's level of function and disability after surgery. For example, a patient with an X-ray score of 10 before surgery decreased to 2 after surgery, indicating an improvement in their physical condition based on the X-ray score. This aligns with the Quick DASH score of the patient, which also shows an improvement in the patient's overall function and quality of life after the surgical procedure.

Table 5: The results of the pair t-test analysis between the variable X-Ray Score Post Op and Quick DASH Score

Variable	Standard Error	95%CI	P-Value
X-Ray Score Post Op – Quick DASH Score	0.581	(-3.94 – -1.59)	0.000

Based on the pair t-test analysis results, it can be seen that the p-value is < 0.05 (0.000), indicating a significant relationship between the X-ray score post-op and the Quick DASH Score post-surgical intervention. These results confirm that the increase in X-ray scores post-surgery correlates strongly with the improvement in Quick DASH Score after the surgical procedure, indicating the effectiveness of the surgical procedure in reducing upper limb functional impairments.

Tabel 6: The pre and post-operative radiological outcomes

Result	X-Ray Score Pre Op	X-Ray Score Post Op
Excellent	0	2
Good	16	38
Fair	17	0
Poor	7	0

Table 6 displays the radiological outcomes before (Pre-Op) and after surgery (Post-Op), divided into four categories: Excellent, Good, Fair, and Poor. From the presented data, it is evident that the majority of patients show improvement in radiological condition after surgery.

Table 7: The results of the pair t-test analysis between the variable X-Ray Score Pre-Op and X-Ray Score Post-Op.

Variable	Standard Error	95%CI	P-Value
X-Ray Score Pre Op - X-Ray Score Post Op	0.400	(1.69 – 3.30)	0.000

Based on the pair t-test analysis results above, it can be observed that the p-value is < 0.05 (0.000), indicating a significant difference in the mean between the X-ray score pre-op and the X-ray score post-op. This result indicates that there is a significant change between the X-ray scores before surgery (pre-op) and after surgery (post-op), demonstrating the effectiveness of the surgical intervention in improving the observed condition through a significant increase in post-operative X-ray results.

Table 8: Functional Outcome Scores

Result	Quick DASH Score
No Functional Limitations	40
Mild Functional Impairment	0
Moderate Functional Impairment	0
Severe Functional Impairment	0

Table 8 shows the analysis results of functional outcomes based on the Quick DASH scores, which describe the level of functional limitations in patients. The results indicate that the majority of patients (40) had no functional limitations after the intervention, reflecting the overall success of the procedure. No patients experienced mild, moderate, or severe functional impairment following the intervention.

Discussion

The majority of distal radius fracture patients are aged between 10 and 18 years, accounting for 35% of cases, followed by patients over 60 years old at 27.5%. The age groups 19-44 years and 45-59 years have lower percentages, at 17.5% and 20%, respectively. Males experience distal radius fractures more frequently than females, comprising 60% of total cases. This finding aligns with the study by Ihza *et al*. (2021) at Abdul Wahab Sjahranie Hospital, Samarinda, where the highest number of distal radius fracture patients were aged 10-19 years, totaling 29 individuals (19.9%), while the fewest cases were among those under 10 years old, with only 11 individuals (7.5%). The data indicate that males dominate with 87 cases (59.6%), while females account for 59 cases (40.4%) [3].

Based on the presented data, it can be concluded that the majority of distal radius fracture patients fall into different age ranges depending on the population studied. The 10-18 years and over 60 years age groups have the highest proportions, while the 19-44 years and 45-59 years age groups have lower percentages. Overall, males tend to have a higher incidence of distal radius fractures compared to females. This finding is consistent with previous studies showing a predominance of distal radius fractures in males. However, there is variation in the distribution of distal radius fractures by gender within each age group. For instance, among children, distal radius fractures are more common in males, whereas in adults, the distribution is more even between males and females.

Regarding fracture types, this study found that Closed Fracture Left Distal Radius is the most common diagnosis, with a proportion of 47.5% of total cases. Closed Fracture Right Distal Radius and Open Fracture Left Distal Radius have similar proportions, at 30% and 20% respectively. Open Fracture Right Distal Radius is the least common, occurring in only 2.5% of cases. According to the study by Ihza *et al*. (2021), the majority of distal radius fracture patients had closed fractures, totaling 137 individuals (93.8%), while open fractures accounted for 9 individuals (6.2%). In the study by Patidar *et al*. (2020), distal radius fractures were more commonly found on the left side,

with 28 cases (58.3%), compared to 20 cases (41.7%) on the right side [4].

Classification of fracture characteristics according to the Frykman classification in this study showed that Frykman type I was the most common, accounting for half of the cases (50%). Frykman type II was the second most common, with a proportion of 20%, while Frykman types III, V, and VII had lower proportions of 5%, 12.5%, and 7.5%, respectively. Frykman types VI-VIII were the least common, occurring in only 2.5% of cases. This differs somewhat from the findings of Patidar *et al*. (2020), where among 48 patients, the most common classification was Frykman type IV (30 cases, 62.5%), followed by type VI (8 cases, 16.7%), type V (7 cases, 14.6%), type VII (2 cases, 4.2%), and type III (1 case, 2.1%).

Most patients showed improvement in radiological conditions after surgery, particularly in the excellent and good categories. Initially, no subjects met the criteria for Excellent before surgery (number of Excellent X-ray Scores Pre-Op = 0), but there were 2 subjects who reached the Excellent criteria after surgery. Similarly, the number of subjects meeting the Good criteria increased from 16 before surgery to 38 after surgery. This indicates a significant improvement in surgical outcomes, according to the Lindstrom criteria. This demonstrates that surgery has successfully enhanced bone reduction success, as evidenced by the radiological changes in X-ray scores from fair and poor categories to good and excellent after internal fixation. Thus, this analysis provides an optimistic view of the effectiveness of internal fixation surgery in improving patients' conditions based on radiological X-ray scores.

This finding is consistent with the study by Schupp A, *et al*. (2003), where researchers used a 2.4 mm Locking Compression Plate (LC) for internal fixation, resulting in 15 patients with excellent outcomes, 13 with good outcomes, 4 with fair outcomes, and 1 with poor outcomes among 33 patients with an average age of 76 years. The study concluded that more than 80% of distal radius fractures with osteoporosis achieved excellent and good radiological outcomes [5].

However, the study by Niraj *et al*. reported that out of 80 patients, 68 patients achieved acceptable reduction (excellent-good), while 12 patients had unacceptable reduction (fair-poor). Nevertheless, all radiological parameters improved from pre-surgery to three months post-surgery. Most patients showed improvement in radiological outcomes after surgery, especially in the "Good" and “Excellent” categories. Similarly, the final functional assessment of the extremities 6 months or more post-surgery showed good results for all patients. In the study by Phadnis J, *et al*. (2012), the median DASH Score for functional assessment was 2.3. Overall, 133 patients (74%) had good or excellent DASH scores. Statistical analysis showed that no specific variables, including gender, age, fracture type, or postoperative immobilization, significantly affected the outcomes [6].

Conclusion

The demographics of distal radius fractures can vary based on the focus and population studied, including factors such as age, gender, fracture location, and classification. Research indicates significant improvements in radiological outcomes post-surgery in patients who undergo internal fixation, demonstrating that internal fixation surgery is effective in enhancing patient conditions. Additionally, there is a significant positive correlation between radiological outcomes and good extremity function in patients with distal radius fractures treated with internal fixation.

Conflict of Interest
Not available

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