Volume 7, Number 3, December 2024

The Journal of Indonesian Orthopaedic & Traumatology

journal homepage: https://journal.indonesia-orthopaedic.org

Clinical Research

Functional Outcomes of Closed Reduction Versus Open Reduction and Internal Fixation for Distal Radius Fractures

Netra Mada Subiyanto[1], Hirman Ari Wibawa[2]

[1]Puskesmas Watumalang, Wonosobo, Indonesia
[2]Orthopaedic and Traumatology Department, RSUD KRT Setjonegoro, Wonosobo, Indonesia

Article History :
Submission: June 10, 2024
Revision: August 8, 2026
Accepted: August 13, 2026

Keywords:
Fracture radius
ORIF
Close Reduction
DASH score
ROM

Corresponding Author:
Netra Mada Subiyanto, MD
netra.mada.s@gmail.com

Abstract

Introduction: Distal radius fractures are common wrist injuries, with treatment ranging from conservative casting to operative fixation. Treatment outcomes can be assessed using objective measures, such as range of motion (ROM), and patient-reported outcome measures, such as the QuickDASH score. This study compared outcomes following open reduction and internal fixation (ORIF) with plates and screws versus closed reduction and casting at 6 months.

Materials and Methods: This cross-sectional comparative study was conducted at KRT Setjonegoro General Hospital and included 30 patients aged 18–50 years with distal radius metaphyseal fractures treated between July 2023 and March 2024. Twenty patients underwent ORIF with plates and screws, while 10 underwent closed reduction and casting. Fractures were classified according to the Frykman classification based on radiographic findings. Functional outcomes were evaluated at 6 months using the QuickDASH score and wrist ROM measurements.

Results: At 6 months, the ORIF group demonstrated significantly better QuickDASH scores and ROM measurements than the closed reduction and casting group ($p<0.001$).

Conclusion: ORIF with plates and screws resulted in significantly better functional outcomes and wrist ROM at 6 months compared with closed reduction and casting in patients with distal radius fractures.

Introduction

A radius distal fracture is one of the common injuries that can be found in orthopedic surgery. This injury forms 8% - 15% of all adult bone injuries.[9] In his book, Solomon et al. (2010) mentioned that bones are fragile in general but they have enough strength and endurance to support the body weight. Fractures can occur due to trauma, repetitive stress, and bones abnormal weakness.[1] According to basic health research in 2013, fracture prevalence reached 5,8%. The highway is the most frequent place for injuries (42,8%). Meanwhile, the most common cause of injury is dominated by motorbike accidents (40,6%) and falls (40,9%).[11]

The fracture treatments can be conservative or surgery. The surgical procedure consists of open reduction, internal fixation, and closed reduction.[13] The treatment of patients with distal radius metaphyseal fractures greatly affects the upper extremity function during recovery. Therefore, the appropriate treatment choice will affect the function of the upper extremity.[2] The basic principle of fracture treatment is to achieve accurate reduction and then use immobilization methods that will maintain and hold that reduction.[10]

To strive for optimal bone healing, it's important to understand the factors that influence it. Four principles of fracture fixation (AO principles) are an integral part of optimal fixation and fracture healing. The first is fracture reduction to restore anatomical relationships. The second principle is fracture fixation to provide absolute or relative stability. The third principle is preserving blood supply to

https://doi.org/10.31282/joti.v7n3.137

the soft tissue and bone. The last principle is early and safe mobilization.[3]

Until now, several scoring methods have been published for clinical assessment of upper extremity function, one of them is the QuickDASH score. DASH is a responsive, valid, and reliable clinical measurement tool for assessing the upper extremity. This questionnaire consists of 30 questions answered by the patients. QuickDASH is a shortened version of the DASH score measurement. from 30 items, QuickDASH uses 11 items to measure function and physical symptoms in individuals with one or several musculoskeletal disorders of the upper extremities. These 11 items are used to measure the level of difficulty in performing various physical activities due to issues with the shoulder, arm, or hand (6 items); the severity of pain and paresthesia (2 items); and the impact of the problem on social activities, work, and sleep (3 items). In this study, the Quick DASH items responses were extracted from the subjects' responses to the complete questionnaire. If at least 10 out of 11 items have been completed, the responses to these items are summed to form a raw score, then converted to a scale from 0 to 100 using the same formula used to calculate the DASH score, with higher scores reflecting greater disability.[8]

ROM is the extent of movement that occurs at a joint. The starting position for measuring all ROM, except rotation, is the anatomical position. A goniometer is used to measure the active range of motion (ROM) which includes wrist flexion, extension, radial and ulnar deviation, as well as supination and pronation of the injured forearm. Wrist flexion and extension are measured by placing the forearm in a neutral position on a stable surface, and the goniometer is placed on the radial side of the wrist, aligned along the third metacarpal. Wrist radial and ulnar deviation is measured by positioning the forearm in a pronated position on a flat surface with the elbow slightly bent. The goniometer measurement is done along the line of the third metacarpal and the radius bone. The measurement of forearm supination and pronation is done with the elbow bent at 90 degrees, beside the body, and the goniometer reading aligned with an imaginary line between the radial and ulnar styloids.[17]

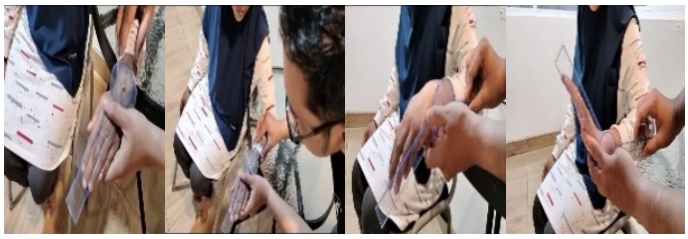
Methods

This study adopts a descriptive cross-sectional methodology and inferential analysis. In this study, the researcher compares the outcomes of surgical treatment with plate & screw fixation and non-surgical treatment involving the application of a cast for distal radius fractures.

The research was conducted at KRT Setjonegoro General Hospital on patients with distal radius metaphyseal fractures who underwent treatment with a plate & screw fixation and the application of a cast from July 2023 to March 2024, who met the inclusion and exclusion criteria. The inclusion criteria are all patients with distal radius metaphyseal fractures who have received treatment with plate and screw fixation or the application of a cast and patients aged between 18-50 years. Classification of distal radius fracture by looking at the result of X-rays and classified using the Frykman Classification, patients residing in Wonosobo, and those willing to participate as respondents. The exclusion criteria include distal radius metaphyseal fractures that are comminuted and open fractures, along with patients who are unwilling to participate as respondents.

In sampling, the Lemeshow formula was used due to the unknown size of the population previously, resulting in a total of 30 samples being obtained. This study used medical record data of patients with distal radius metaphyseal fractures at KRT Setjonegoro General Hospital from July 2023 to March 2024.

A clinical measurement tool to assess the upper extremity using the quick DASH score questionnaire, which contains 11 questions with scores ranging from 1 to 5 for each question, and ROM measurement using a goniometer, which is used for clinical assessment.[16]



(A) (B) (C) (D)

Figure 1. Figure A and B shows the ROM measurement of dorso / plantar flexion and Figure C and D shows the ROM measurement of radial / ulna deviation

Results

Patient Demographics

Among patients with distal radius fractures treated at KRT Setjonegoro General Hospital, 19 (63.33%) were male and 11 (36.67%) were female. Regarding the mechanism of injury, 14 patients (46.67%) sustained fractures in motorcycle accidents, 9 (30.00%) sustained injuries from falls from a height, 5 (16.67%) from slipping and falling, and 2 (6.67%) were struck by a vehicle while walking. Based on fracture location, 14 patients (46.67%) had extra-articular fractures, while 16 (53.33%) had intra-articular fractures.

QuickDASH Score Results for Patients with Distal Radius Metaphyseal Fractures

According to the results presented in Table 2, there was a significant association between treatment type and QuickDASH category. In the plate-and-screw group, 14 patients had normal functional status and 6 had mild disability, with no patients classified as having moderate or severe

disability. In the cast group, 5 patients had normal functional status and 5 had mild disability, with no patients classified as having moderate or severe disability. The difference between the treatment groups was statistically significant ($p<0.001$). These findings indicate that treatment with plates and screws was associated with better functional outcomes than treatment with casting.

According to the results presented in Table 3, there was a significant association between treatment type and wrist range of motion (ROM). The difference between the plate-and-screw and casting groups was statistically significant ($p<0.001$). These findings indicate that patients treated with plate-and-screw fixation had better ROM outcomes than those treated with casting alone.

Table 1. Respondent Demographics

Characteristics	Respondents	Percentage
Gender		
• Male	19	63.33%
• Female	11	36.67%
Injury Mechanism		
• Motorcycle accident	14	46,67%
• Fall from height	9	30 %
• Slip and fall	5	16,67%
• Struck while walking	2	6,67%
Fracture Type		
• Extra-articular	14	46,67%
• Intra-articular	16	53,33%

Table 2. QuickDASH score results for patients with distal radius metaphyseal fractures

No	Quick DASH	Treatment		Total	P-value
		Plate & Screw	Cast		
1	Normal	14	5	19	<0.05
2	Mild	6	5	11	
3	Moderate	0	0	0	
4	Severe	0	0	0	
	Total	20	10	30	

Table 3. ROM measurement results for patients with distal radius metaphyseal fractures

No	ROM	Treatment		Total	P-value
		Plate & Screw	Cast		
1	Normal	16	3	19	<0.05
2	Abnormal	4	7	11	
	Total	20	10	30	

Discussion

Distal radius fractures are a common type of fracture, accounting for 17% of emergency room cases.[4] According to the gender distribution in this research, males are more prevalent than females, comprising 63,33% of cases. Dwi Krisna, Putu Prabhawati, et al. (2020) in their research also found similar results, where males outnumbered females.[5] This is due to the higher level of mobility in males compared to females.

Based on the etiology of this research, the most common cause of distal radius metaphyseal fractures was motorcycle accidents, accounting for 46,67%, followed by other causes including falls from a height at 30%, slipping falls at 16,67%, and being struck while walking at 6,67%. According to the Basic Health Research results in 2013, highways rank number one as the most frequent location for injuries, accounting for 42,8%, with the majority of injuries equally dominated by motorcycle accidents.11 Research conducted by Fares, et al. (2021) also stated that the most frequent cause of distal radius fractures is due to falls or motorcycle accidents.7 This can be caused by the very high level of motorcycle usage as well as the low compliance and caution among motorcycle riders.

In this study, the most common type of fracture was the intra-articular type, accounting for 53,33%, and the most frequently used therapy in this study was ORIF with the installation of plate & screw, involving 16 patients. The type of fractures observed may be caused by the differences in hand position at the time of falling, and the treatment of fractures depends on the type of fracture and the consideration of the professional who will perform the therapy. In the research conducted by Johanna Rundgren (2020), it is mentioned that fractures were classified as AO-23-A extra-articular, 12% as AO-23-B intra-articular partial, and 23% as AO-23-C intra-articular. The primary treatment was non-surgical for 74% and surgical for 26% of all fractures. Only 18% of AO-23-A fractures were treated surgically, compared with 48% of AO-23-C fractures. The most frequently used surgical method was plate fixation (82%), followed by pin/wire fixation (8,2%), external fixation (4,8%), and other methods (4,0%).[14]

The statistical result in this study is showing result that there is a significant difference between the functional outcomes of closed reduction therapy and ORIF in patients with distal radius fractures, where the functional outcome is clinically assessed through ROM measurement and based on the patient's perspective with the QuickDASH score. The ROM values and QuickDASH scores in distal radius fracture patients treated with plate & screw fixation have a p-value of 0,00, which is less than the significance level of 5% (0,05). By seeing this value, it can be determined that treatments involving plate & screw fixation gives better results compared to treatments involving the application of a cast in patients with distal radius fractures.

The selection of therapy between closed reduction or open reduction is based on considerations of the patient's age, fracture type, and the degree of displacement and angulation. In the research conducted by Edi Burhan, et al. (2014), it is also stated that there is a significant difference between young patients with intra-articular distal radius metaphyseal fractures who received surgical treatment in the ORIF form and those who received non-surgical treatment in the form of cast.[2] Another study conducted by Jian Song, Ai-Xi Yu, and Zong-Huan Li (2015) also mentions that surgical therapy appears to be more effective for distal radius fractures compared to conservative treatment based on the radiographic analysis. A similar study is done by Cenk Ermutlu, et al. (2020) which states that the choice of surgical therapy using VPL, EF, and K-wires provides adequate fixation, good radiological results, and favorable functional outcomes for distal radius fracture therapy.[6,15] Meanwhile, there is a difference in the research conducted by Mulders, et al. (2017), which states that non-surgical treatment in patients with distal radius fractures with adequate closed reduction and radiographic outcomes provides acceptable functional results after 12 months, measured by the DASH score.[12] The difference in research outcomes can be influenced by many factors, such as the factors of age in sampling, factors that can impede fracture healing, factors of post-treatment care, and the facts that the healing process varies from person to person.

Conclusion

Open reduction and internal fixation (ORIF) with plates and screws resulted in better upper-extremity functional outcomes than closed reduction and casting in patients with distal radius fractures, as assessed using the QuickDASH score and wrist range of motion (ROM). These findings may support the consideration of ORIF as an appropriate treatment option for distal radius fractures and may contribute to reducing post-traumatic functional impairment and complications.

References

1. Apley AG, Solomon L, Graham A. Buku ajar orthopedi dan fraktur sistem Apley. Nugraha E, translator. Jakarta: Widya Medika; 2010.
2. Burhan E, Manjas M, Riza A, Erkadius. Perbandingan fungsi extremitas atas pada fraktur metafise distal radius intraartikuler usia muda antara tindakan operatif dan non operatif dengan penilaian klinis QuickDASH score. J Kesehat Andalas. 2014;3(1):32-36.
3. Cunningham BP, Brazina S, Morshed S, Miclau T. Fracture healing: a review of clinical, imaging and laboratory diagnostic options. Injury. 2017;48 Suppl 1.
4. de Bruijn MAN, van Ginkel LA, Boersma EZ, van Silfhout L, Tromp TN, van de Krol E, et al. The past, present and future of the conservative treatment of distal radius fractures. Injury. 2023;54 Suppl 5:110930.
5. DwiKrisna PP, Subawa IW, Wiguna IGLNA. Perbandingan outcome penanganan pembedahan dan tanpa pembedahan pada fraktur radius distal di RSUP Sanglah periode April 2016-Agustus 2017. 2020;11(3):1081-1084.
6. Ermutlu C, Mert M, Kovalak E, Kanay E, Obut A, Ozturkmen Y. Management of distal radius fractures: comparison of three methods. Cureus. 2020;12(8).
7. Fares AB, Childs BR, Polmear MM, Clark DM, Nesti LJ, Dunn JC. Dorsal bridge plate for distal radius fractures: a systematic review. J Hand Surg Am. 2021;46(7):627.e1-627.e7.
8. Franchignoni F, Vercelli S, Giordano A, Sartorio F, Bravini E, Ferriero G. Minimal clinically important difference of the Disabilities of the Arm, Shoulder and Hand outcome measure (DASH) and its shortened version (QuickDASH). J Orthop Sports Phys Ther. 2014;44(1):30-39.
9. Kellam JF, Meinberg EG, Agel J, Karam MD, Roberts CS. Fracture and dislocation classification compendium-2018. J Orthop Trauma. 2018;32 Suppl 1.
10. Meena S, Sharma P, Sambharia AK, Dawar A. Fractures of distal radius: an overview. J Family Med Prim Care. 2014;3(4):325-332.
11. Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Republik Indonesia Nomor HK.01.07/MENKES/270/2019 tentang Pedoman Nasional Pelayanan Kedokteran Penatalaksanaan Fraktur. Jakarta: Kementerian Kesehatan Republik Indonesia; 2019.
12. Mulders MAM, van Eerten PV, Goslings JC, Schep NWL. Non-operative treatment of displaced distal radius fractures leads to acceptable functional outcomes, however at the expense of 40% subsequent surgeries. Orthop Traumatol Surg Res. 2017;103(6):905-909.
13. Pramana MRB, Karna MB, Wiguna IGLNAA. Gambaran karakteristik fraktur ekstremitas atas di Instalasi Gawat Darurat RSUP Sanglah Denpasar periode Januari 2019-Juni 2019. J Med Udayana. 2021;10(12):75-88.
14. Rundgren J, Bojan A, Mellstrand Navarro C, Enocson A. Epidemiology, classification, treatment and mortality of distal radius fractures in adults: an observational study of 23,394 fractures from the national Swedish fracture register. BMC Musculoskelet Disord. 2020;21(1):88.
15. Song J, Yu AX, Li ZH. Comparison of conservative and operative treatment for distal radius fracture: a meta-analysis of randomized controlled trials. Int J Clin Exp Med. 2015;8(10):17023-17035.
16. Institute for Work & Health. The DASH outcome measure: QuickDASH scoring. Toronto: Institute for Work & Health; 2006 [cited 2024 Jan 2]. Available from: https://dash.iwh.on.ca/sites/dash/files/downloads/QuickDASH_Scoring_2010.xls
17. Yang Z, Lim PPH, Teo SH, Chen H, Qiu H, Pua YH. Association of wrist and forearm range of motion measures with self-reported functional scores amongst patients with distal radius fractures: a longitudinal study. BMC Musculoskelet Disord. 2018;19:142.