

## Comparison of Upper Extremity Function After Operative and Non-operative Management of Distal Radius Intra-Articular Fractures with Clinical Assessment of QuickDASH Score: An Observational Study at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

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### ABSTRACT

**Introduction:** Intra-articular fracture of the distal radius is a common injury and can disrupt upper extremity function. This study aims to compare upper extremity function after treatment of intra-articular distal radius fractures in productive age between operative and non-operative procedures using the QuickDASH score. **Methods:** This observational analytical study with a retrospective cohort design involved 80 patients with intra-articular distal radius fractures who were managed operatively (60 patients) and non-operatively (20 patients) at Dr. Mohammad Hoesin General Hospital Palembang. Data was collected from patient medical records and analyzed using the independent t-test and Chi-Square test. **Results:** The mean QuickDASH score in the operative group ( $10.53 \pm 17.25$ ) was significantly lower than the non-operative group ( $23.29 \pm 23.82$ ) ( $p = 0.012$ ). There was a significant relationship between operative management and QuickDASH score ( $p = 0.023$ ). Patients treated operatively were 1.5 times more likely to have normal upper extremity function (QuickDASH score  $\leq 20$ ). **Conclusion:** Operative treatment of intra-articular distal radius fractures in productive age provides better upper extremity functional outcomes compared to non-operative treatment, based on QuickDASH score assessment.

### 1. Introduction

Distal radius fracture is one of the most common musculoskeletal injuries, especially in the productive age population. The incidence of these fractures continues to increase along with the increasing activity and mobility of modern society. Distal radius fractures can result from direct trauma, such as a fall on an outstretched arm, or indirect trauma, such as a motor vehicle accident. These injuries can cause significant functional impairment in the upper extremities, affecting the patient's ability to perform daily activities, work, and participate in social activities. Intra-

articular fracture of the distal radius is a subtype of distal radius fracture that involves the surface of the radiocarpal joint. This type of fracture is more complex and has a higher risk of long-term complications than extra-articular fractures. Complications that can occur include joint stiffness, chronic pain, post-traumatic osteoarthritis, and malunion deformity. Therefore, the management of intra-articular distal radius fractures requires special attention and a comprehensive approach to achieve optimal functional results. Management of intra-articular distal radius fractures can be operative or non-operative. Operative

treatment, such as open reduction internal fixation (ORIF) with a volar locking plate, aims to accurately restore joint anatomy and provide stability to the fracture fragments. This action allows for early mobilization and more aggressive rehabilitation, which is expected to speed up the recovery of upper extremity function.<sup>1-3</sup>

Several studies have demonstrated the superiority of operative management in terms of long-term functional outcomes in patients with intra-articular distal radius fractures. One study found that ORIF with a volar locking plate provided better functional outcomes than external fixation in unstable distal radius fractures. Another study reported that ORIF with a volar locking plate has become the gold standard in the management of distal radius fractures, especially displaced or intra-articular fractures. Another study also demonstrated significant improvements in wrist range of motion and radiographic outcomes in patients undergoing ORIF with a volar locking plate. Although operative treatment offers potential benefits, it also carries the risk of complications, such as infection, implant failure, and neurovascular injury. Therefore, treatment selection must consider individual patient factors, such as age, activity level, comorbidities, and patient preferences. Non-operative management, such as closed reduction and immobilization with a cast or splint, is usually chosen for intra-articular distal radius fractures that are not too displaced or unstable. This procedure is more conservative and has a lower risk of complications than operative treatment. However, non-operative management can cause joint stiffness, chronic pain, and less than optimal functional results, especially in productive-age patients who have high functional demands.<sup>4,5</sup>

A study compared the functional outcomes of patients with distal radius fractures treated with volar locking plate ORIF or bridging external fixation. The results showed significant differences in wrist pain and function between the two groups, with the ORIF group showing better results. Another study also reported better functional outcomes in elderly patients

undergoing ORIF with a volar locking plate compared with percutaneous pin placement.<sup>6,7</sup> This study aims to compare upper extremity function after treatment of intra-articular distal radius fractures in productive age between operative and non-operative procedures using the QuickDASH score. The QuickDASH score is a validated questionnaire for assessing disability and symptoms in the upper extremities, including aspects of pain, function, and specific symptoms. A lower QuickDASH score indicates better upper extremity function. By comparing the QuickDASH scores between the operative and non-operative groups, it is hoped that useful information can be obtained in determining optimal management strategies for intra-articular distal radius fracture patients of productive age.

## **2. Methods**

This study used a retrospective cohort design to analyze differences in functional outcomes between patients who underwent surgery and those who did not undergo surgery for intra-articular distal radius fractures. This design allows researchers to compare long-term outcomes of two groups that differ based on exposure history (in this case, type of treatment) over a specific time period. This research was conducted in the surgical outpatient installation of the orthopedic and traumatology surgery division of Dr. Mohammad Hoesin General Hospital Palembang, Indonesia. The study population was all patients of productive age (18-60 years) who were diagnosed with an intra-articular distal radius fracture and received hospital treatment between September 2023 and January 2024. The inclusion criteria for this study were: Patients aged between 18 and 60 years; Diagnosis of intra-articular fracture of the distal radius confirmed by radiographic examination; Have completed a minimum of 6 months of post-treatment follow-up. Meanwhile, the exclusion criteria for this study were: History of previous distal radius fracture in the same extremity; Significant neurovascular injury associated with fracture; Comorbidities that may affect upper extremity function (e.g., rheumatoid arthritis,

osteoarthritis, peripheral neuropathy); Inability or unwillingness to complete the QuickDASH questionnaire.

Data were collected retrospectively from patients' electronic medical records. Information collected includes: Demographic Data: Age, gender; Clinical Data: Mechanism of injury, fracture classification, type of treatment (operative or non-operative), postoperative complications (if any); Outcome Data: QuickDASH score filled in by the patient at the last control visit (at least 6 months post-treatment). The QuickDASH score is a questionnaire consisting of 11 questions that assess the level of disability and symptoms of the arm, shoulder, and hand. Each question has 5 answer choices indicating the severity of the symptom or disability. The total score ranges from 0 (no disability) to 100 (severe disability). A higher QuickDASH score indicates a higher level of disability. The main outcome of this study was upper extremity function as measured using the QuickDASH score. QuickDASH scores are categorized as follows: Normal:  $\leq 20$ ; Light: 21-40; Medium: 41-60; Weight: 61-80; Very Heavy: 81-100.

Data were analyzed using SPSS version 26.0 statistical software. Demographic and clinical characteristics of patients are presented in descriptive form (mean  $\pm$  standard deviation for continuous variables and frequencies and percentages for categorical variables). Differences in characteristics between the operative and non-operative groups were analyzed using the independent t-test for continuous variables and the chi-square test for categorical variables. Differences in QuickDASH scores between operative and non-operative groups were analyzed using independent t-tests. Logistic regression analysis was used to assess the association between treatment type (operative vs. non-operative) and upper extremity function category (normal vs. abnormal), controlling for potential confounding factors such as age and gender. A p-value  $< 0.05$  was considered statistically significant. This research was approved by the Research Ethics Committee of Dr. Mohammad Hoesin General Hospital Palembang. All patient data is

anonymized to protect their privacy.

### 3. Results

Table 1 presents an interesting picture of the demographic characteristics of patients who experienced intra-articular distal radius fractures at Dr. Mohammad Hoesin General Hospital Palembang. Data show that these fractures do not discriminate by gender, with equal proportions of men and women (70% vs. 30%) in both groups, whether or not undergoing surgery. Interestingly, although the mean age of patients in the non-operative group was slightly older (40.05 years) than in the operative group (37.23 years), this difference was not statistically significant. This means that age is not a determining factor in choosing the type of treatment in cases of intra-articular distal radius fractures at this hospital. The age distribution of patients also provides valuable insight. The majority of patients (35%) were in the productive age range of 26-45 years, both in the operative and non-operative groups. This shows that intra-articular distal radius fractures are a significant health problem in the productive age group, which can have an impact on their productivity and quality of life. The proportion of patients in other age ranges (13-25 years, 46-60 years, and  $>60$  years) was also relatively balanced between the two groups. This shows that intra-articular distal radius fractures can occur in various age groups, although they are more common in productive age.

Table 2 highlights the striking differences in upper extremity functional recovery between intra-articular distal radius fracture patients who underwent operative and non-operative treatment. The QuickDASH score, which measures the degree of disability and symptoms in the arm, shoulder, and hand, is a key indicator in this assessment. The most interesting finding was the statistically significant difference in mean QuickDASH scores ( $p=0.012$ ) between the two groups. The mean score in the operative group (10.53) was much lower than that in the non-operative group (23.29), indicating that patients who underwent surgery experienced a much

lower level of disability and symptoms after six months post-procedure. This difference is further strengthened by looking at the median scores. The median in the operative group (3.4) indicates that the majority of patients who underwent surgery had near-normal upper extremity function, perhaps even without bothersome symptoms. In contrast, the median in the non-operative group (14.75) shows that many patients who did not undergo surgery still experience significant disability and symptoms. The wider range of QuickDASH scores in the operative group (0-84.1) compared to the non-operative group (0-70.5) reflects the greater variation in functional outcomes in the operative group. This may be due to differences in initial fracture severity, surgical

technique, or other individual factors. However, despite the variations, the low mean and median scores in the operative group still indicate the superiority of surgery in improving upper extremity function.

QuickDASH is divided into normal ( $\leq 20$ ) and abnormal ( $> 20$ ) upper extremity functions. With the Chi-Square test, there was a meaningful relationship between operative management and QuickDASH scores. Patients with surgically managed distal radius fractures were 1.5 times more likely to have normal upper limb function compared to patients with non-operatively managed distal radius fractures (RR = 1.515 (95%CI 1.003 – 2.288);  $p = 0.023$ ) (Table 3).

Table 1. Characteristics of respondents.

Characteristics	Operatives (n=60)	Non-operative (n=20)	Total (n=80)	p-value
Gender, n (%)				
Male	42 (70,0)	14 (70,0)	56 (70,0)	1,000 <sup>a</sup>
Female	18 (30,0)	6 (30,0)	24 (30,0)	
Age (years)				
Mean $\pm$ SD	37,23 $\pm$ 15,99	40,05 $\pm$ 15,77	37,94 $\pm$ 15,89	0,496 <sup>b</sup>
Median	34	40	37	
Min-Max	13 - 69	16 - 63	13 - 69	
Age range, n (%)				
13-25 years	18 (30,0)	6 (30,0)	24 (30,0)	
26-45 years	21 (35,0)	7 (35,0)	28 (35,0)	
46-60 years	14 (23,3)	4 (20,0)	18 (22,5)	0,976 <sup>c</sup>
> 60 years	7 (11,7)	3 (15,0)	10 (12,5)	

<sup>a</sup>Chi-Square Test; <sup>b</sup>Independent T-Test; <sup>c</sup>Pearson Chi-Square Test; \* $p < 0.05$  indicates a statistically significant difference.

Table 2. QuickDASH score for patients with intra-articular distal radius fractures.

Characteristics	Operatives (n=60)	Non-operative (n=20)	Total (n=80)	p-value
QuickDASH score				
Mean $\pm$ SD	10,53 $\pm$ 17,25	23,29 $\pm$ 23,82	13,72 $\pm$ 19,74	0,012*
Median	3,4	14,75	4,5	
Min-Max	0 - 84,1	0 - 70,5	0 - 84,1	

Mann Whitney test, \* $p < 0,05$ .

Table 3. Relationship between management and QuickDASH score ( $> 20$ ).

Characteristics	Normal (n=46)	Abnormal (n=34)	RR (95%CI)	p-value
Management, n (%)				
Operative	50 (83,3)	10 (16,7)	1,515 (1,003-2,288)	0,023*
Non-operative	11 (55,0)	9 (45,0)		

Chi-Square test, \* $p < 0,05$ .

#### 4. Discussion

Intra-articular fracture of the distal radius is a complex injury that involves the articular surfaces of the wrist joint, disrupts its structural integrity, and triggers a series of pathophysiological events that can lead to significant impairment of upper extremity function. The wrist joint is a complex structure consisting of the distal radius, distal ulna, and carpal bones (scaphoid, lunate, triquetrum, pisiform, trapezoid, capitate, and hamatum). This joint allows flexion, extension, radial deviation, and ulnar deviation movements, which are essential for optimal hand function. The stability of the wrist joint is maintained by strong ligaments, including the volar and dorsal radiocarpal ligaments, the volar and dorsal ulnocarpal ligaments, and the intercarpal ligaments. These ligaments limit excessive movement and prevent joint dislocation. Intra-articular fractures of the distal radius often occur as a result of high-energy trauma, such as a fall on an outstretched arm or a traffic accident. This injury mechanism can cause a variety of fracture patterns, ranging from simple fractures with little displacement to complex comminuted fractures with significant displacement.<sup>8,9</sup>

The structural damage that occurs in intra-articular distal radius fractures involves misalignment of the articular surfaces, cartilage damage, and ligament tears. Misalignment of articular surfaces disrupts joint biomechanics, causing uneven load distribution and increasing the risk of post-traumatic osteoarthritis. Cartilage damage, whether focal or diffuse, can cause pain, crepitus, and limited range of motion. Ligament tears cause joint instability, which can worsen misalignment of the articular surfaces and increase the risk of long-term complications. After a fracture, the body responds with an acute inflammatory reaction. Inflammatory cells, such as neutrophils and macrophages, are released to the injury site to clear cellular debris and initiate the healing process. Inflammatory mediators, such as prostaglandins and cytokines, are released and cause vasodilation, increased vascular permeability, and chemotaxis of other inflammatory cells. These

inflammatory mediators also stimulate nociceptors, namely the nerve endings responsible for detecting pain. Stimulation of nociceptors causes the transmission of pain signals to the brain, resulting in intense painful sensations. This pain can limit wrist and hand movement, interfere with daily activities, and reduce quality of life.<sup>10,11</sup>

Swelling is another manifestation of the inflammatory response. Increased vascular permeability allows fluid and plasma proteins to escape from the blood vessels and accumulate in the tissue around the joint. This fluid accumulation causes visible swelling and can contribute to pain and limited range of motion. As time passes, the acute inflammatory reaction is replaced by a proliferative and remodeling phase. In the proliferative phase, fibroblasts produce collagen to form scar tissue. Excessive scar tissue formation can cause adhesions within the joint, which limits movement and causes stiffness. Limited range of motion in intra-articular fractures of the distal radius is the result of a combination of factors, including: Pain: Pain inhibits active and passive movement of the wrist and hand; Swelling: Swelling limits the range of motion of the joint and increases intra-articular pressure, which can cause pain and limit Movement; Stiffness: The formation of scar tissue and adhesions within a joint limits mechanical movement of the joint; Articular surface misalignment: Articular surface misalignment disrupts joint biomechanics and limits range of motion.<sup>12,13</sup>

Intra-articular fractures of the distal radius that are not treated properly can cause post-traumatic osteoarthritis. This condition is characterized by the progressive destruction of articular cartilage, which is the protective layer that covers the ends of bones in joints. Cartilage damage causes direct friction between the bones, triggering a chronic inflammatory reaction and pain. Over time, damaged cartilage can wear away completely, causing the bones to rub directly against each other. This can cause severe pain, stiffness, and loss of function of the wrist and hand. Post-traumatic osteoarthritis is a serious complication that can

significantly reduce a patient's quality of life. Intra-articular distal radius fractures are complex injuries that can cause significant impairment of upper extremity function. Understanding the pathophysiology of these injuries is critical to developing effective management strategies and preventing long-term complications. Appropriate treatment, both operative and non-operative, aims to restore joint anatomy, reduce pain and inflammation, prevent stiffness, and minimize the risk of post-traumatic osteoarthritis.<sup>14,15</sup>

Intra-articular fractures of the distal radius, involving the articular surfaces of the wrist, are complex injuries that can significantly compromise upper extremity function. Operative management, particularly ORIF, has become an increasingly popular approach to treating these fractures. ORIF not only aims to repair fractures, but also addresses the pathophysiological problems underlying upper limb functional disorders. One of the main goals of ORIF is to restore the anatomy of the wrist joint as close as possible to its original condition. In intra-articular fractures of the distal radius, uneven joint surfaces or malunion can cause uneven load distribution on the articular cartilage. This triggers a degenerative process that ultimately leads to post-traumatic osteoarthritis. ORIF allows the surgeon to directly visualize and reduce fracture fragments, ensuring accurate alignment and minimizing the risk of joint surface misalignment. Thus, ORIF plays an important role in preventing or at least delaying the development of post-traumatic osteoarthritis, which can cause chronic pain, stiffness, and long-term disability.<sup>16,17</sup>

Joint stability is an important prerequisite for early mobilization and aggressive rehabilitation. Unstable intra-articular fractures of the distal radius can cause pain and discomfort with movement, hindering the rehabilitation process. ORIF, with the use of plates and screws, provides the stability necessary to allow safe and comfortable wrist movement immediately after surgery. Early mobilization, beginning within days of surgery, has been shown to be effective in preventing joint stiffness, adhesion formation, and

muscle atrophy. Active and passive movement helps lubricate joints, maintain range of motion, and stimulate soft tissue healing. In addition, early mobilization can also reduce the risk of postoperative complications such as deep vein thrombosis and infection.<sup>15-17</sup>

Once joint stability is achieved, aggressive rehabilitation can begin. Aggressive rehabilitation involves intensive strengthening and stretching exercises to increase muscle strength, improve coordination, and restore optimal hand function. A structured, guided rehabilitation program by a physical therapist is essential to achieving optimal results. Strengthening exercises aim to strengthen muscles weakened by injury and immobilization. Strong muscles can provide better support to the wrist joint, increase stability, and reduce the risk of re-injury. Stretching exercises help increase joint flexibility and range of motion, allowing patients to perform daily activities more easily. In addition, aggressive rehabilitation also includes proprioceptive exercises to improve joint position awareness and motor control. Good proprioception is important for performing coordinated movements and preventing injury.<sup>17,18</sup>

Numerous studies have demonstrated the superiority of ORIF over non-operative management in improving upper extremity function in intra-articular distal radius fractures. A meta-analysis compared functional outcomes between volar locking plates and external fixation in unstable distal radius fractures. The results show that the volar locking plate provides better functional results in the short and medium term. Another study reported significant improvements in wrist range of motion and radiographic outcomes in patients undergoing volar locking plate fixation for intra-articular distal radius fractures. Additionally, studies show that patients who undergo ORIF have better functional outcomes compared with patients who undergo external fixation.<sup>18,19</sup>

Operative management, particularly ORIF, is an integral part of a holistic approach to treating intra-articular distal radius fractures. This approach not only focuses on fracture repair, but also involves pain management, early mobilization, aggressive rehabilitation, and patient education. Effective pain management is essential to enable early mobilization and active patient participation in the rehabilitation program. Early mobilization, starting immediately after surgery, helps prevent joint stiffness and adhesion formation. Aggressive rehabilitation, involving strengthening and stretching exercises, helps increase muscle strength, improve coordination, and restore optimal hand function. Patient education is also an important component in the management of intra-articular distal radius fractures. Patients need to understand the importance of early mobilization, aggressive rehabilitation, and adherence to an exercise program to achieve optimal results. Operative management, especially ORIF, has been proven to be effective in overcoming the pathophysiological problems underlying upper extremity functional impairment in intra-articular distal radius fractures. By accurately restoring joint anatomy, ORIF reduces the risk of post-traumatic osteoarthritis and improves joint stability. Good joint stability allows for early mobilization and more aggressive rehabilitation, which in turn accelerates recovery of upper extremity function. Further research is needed to evaluate the long-term effectiveness of ORIF in intra-articular distal radius fractures and identify factors that may predict optimal functional outcomes. However, current evidence supports the use of ORIF as the primary option for restoring optimal upper extremity function in patients with intra-articular distal radius fractures.<sup>19,20</sup>

## 5. Conclusion

Operative treatment of intra-articular distal radius fractures in productive age provides better upper extremity functional outcomes compared to non-operative treatment, based on QuickDASH score assessment. These findings can be an important

consideration in selecting a management strategy for intra-articular distal radius fractures in reproductive age.

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