

**The Patient-Rated Wrist Evaluation (PRWE) User Manual**

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## **Introduction**

The Patient-rated Wrist Evaluation (PRWE) was developed to assess pain in the wrist joint and functional difficulties in activities of daily living resulting from injuries affecting wrist joint area (MacDermid, Turgeon, Richards, Beadle, & Roth, 1998). The objectives of this User Manual are:

1. To describe the development of the PRWE and the domains of measurement;
2. To describe the purpose of modifying the PRWE to the patient-rated wrist/hand evaluation (PRWHE)
3. To elaborate steps in administering the PRWHE, scoring instructions, and common issues arising while scoring the PRWHE;
4. To synthesize the literature describing the psychometric properties of the PRWHE, proposed application of the PRWHE across different clinical conditions, alternate language versions of the PRWHE, and provide normative and comparative data for the PRWHE.

## **What is the PRWE?**

The PRWE is a 15 item patient-reported questionnaire. It has two subscales:

- 1) Pain subscale - 5 items (responses ranging from 0 = no pain to 10 = worst ever)
- 2) Function subscale - 10 items, which is further divided into:

Specific activities - 6 items } (responses ranging from 0 = no difficulty to 10 = unable to do)  
Usual activities - 4 items }

A composite score for the PRWE as well as individual scores for the two subscales can be obtained as per the instructions outlined on page 7. in the “Scoring Instructions” section.

The objectives of the PRWE are to:

- 1) To determine the degree of wrist-related musculoskeletal disability (MSKD);
- 2) To design patient-relevant treatment goals;
- 3) To predict prognosis of a patient with wrist injury considering his/her baseline score;
- 4) To determine whether a clinically important change has occurred; and
- 5) To communicate the pain and MSKD associated with the wrist injury in a meaningful way to the patients, other healthcare professionals, and insurance companies.

## Development of the PRWE

### **Rationale for the Development**

Wrist joint range of motion (ROM), muscle strength, and radiographs were considered as key outcomes measures in patients with wrist fractures prior to the development of the PRWE. On the other hand, patient-reported outcomes that examine the impact of a disease on quality of life (QOL), functional status, and overall health status rather than focusing these objective measures were becoming increasingly important. Health-status instruments such as the Short-form 36 (SF-36) (Ware, Jr. & Sherbourne, 1992) and QOL measures such as the World Health Organization Quality of Life (WHOQOL) (WHO, 1996) were available but these questionnaires were very long and difficult to administer. Moreover, they were generic measures with an objective of assessing the impact of a condition on overall health status and QOL. A standardized patient-rating scale that can quantify the constructs of wrist pain and related MSKD was needed.

### **Steps in the Development**

The PRWE was developed in six steps as outlined below.

- 1) Survey of the International Wrist Investigators** - a survey questionnaire was sent to 151 International Wrist Investigators (IWI) asking them to define common practices in outcome measurement following wrist injury. Response patterns of the survey questionnaires were identified and the opinions expressed by the experts were used in determining the structure and the content of the PRWE. The survey questionnaire identified pain and functions during activities of daily living as key domains (MacDermid et al., 1998).
- 2) Item Generation** - a master list of specific wrist related items for the proposed questionnaire was generated by interviews of patients and experts in the area, literature describing the biomechanics of wrist function, and questions concerning pain and function from other patient-reported measures (MacDermid et al., 1998).
- 3) Item Reduction** - items measuring the construct of pain were reduced to cover frequency and intensity of pain. The items measuring wrist-related function were reduced in a way that they meet following criteria: 1) they are performed by either hand, 2) they are performed by majority of the patients, and 3) they are understandable to most respondents. The items in the function subscale were further divided into specific functions and usual functions to differentiate between specific daily activities and usual activities in the domains of self-care, work role, home life, and recreation (MacDermid et al., 1998).
- 4) Questionnaire Construction: Refining Items/Scoring System** - To keep the instrument brief and easy to use in a clinic, the questionnaire format was limited to five pain questions and ten function questions. Expert consensus and statistical analyses of pilot data were used to select the "best" items for the subscales. A 0 to 10 scale was selected because a numeric scale is more acceptable to patients, easier and score, and more responsive to change. A total score

out of 100 can be computed by equally weighting the pain score (sum of five items) and the disability score (sum of ten items, divided by 2) (MacDermid et al., 1998).

- 5) Pilot Testing** - preliminary analysis of the reliability was conducted before the final version of the questionnaire was developed (MacDermid, 1996).
- 6) Reliability/Validity Testing** - Patients with distal radius (n=64) or scaphoid (n=35) fractures were recruited to examine the test-retest reliability. The test-retest reliability for the total score of the PRWE was excellent over both the short term (2-7 days, ICC  $\geq$  0.90) and the long term (1 year, ICC = 0.91). The pain subscale also had excellent short-term and long-term reliability (ICC = 0.90, 0.91, respectively). The function subscale demonstrated excellent short-term reliability (ICC  $\geq$  0.88) in patients with distal radius fracture and moderate long-term reliability (ICC = 0.61) in patients with scaphoid fracture (MacDermid et al., 1998).

For the validity study, patients with distal radius (n=101) and scaphoid fractures (n=35) completed the PRWE and the SF-36, and had their grip strength, dexterity, and range of motion tested at baseline, two-month, three-month, and six-month follow-ups. Improvements in the PRWE and SF-36 scores of distal radius group over time were evaluated to assess construct validity. The PRWE had a statistically significant 74% improvement over 6 months, whereas the SF-36 physical summary score had a statistically significant 16% improvement (MacDermid et al., 1998).

To determine the criterion validity, Pearson correlations were conducted between the PRWE and the SF-36 subscales or impairment measurements. Moderate correlations were found between the PRWE total and impairment measures ( $r = -0.52, -0.61$ , for radius and scaphoid groups, respectively). The PRWE scores correlated higher with the SF-36 physical component summary scores ( $r = -0.46$  to  $-0.63$ ) than the SF-36 mental component summary scores ( $r = -0.30$  to  $-0.41$ ) (MacDermid et al., 1998).

### **Domains Measured - Linked with the ICF**

The International Classification of Functioning, Disability and Health (ICF) proposed by the World Health Organization provides a framework for classifying health-related domains (WHO, 2001). The ICF suggests that a health condition affects the domains of body functions and structures, activity, and participation within the context of personal and environmental factors (WHO, 2001). Pain subscale of the PRWE represents the body structure and function domain of the ICF, whereas function subscale represents the domains of activities and participation of the ICF (WHO, 2001). A brief outline of the domains of the PRWE and the aspects of dysfunction integrated in these domains is presented in the Figure 1. These aspects of dysfunction were adapted from the ICF coding guidelines (WHO, 2010).

<b>Domain of PRWE</b>	<b>Aspects of Dysfunction Integrated within PRWE</b>
Pain at the affected wrist	Frequency and intensity of pain as well as pain at rest, on repeated movements, and while lifting heavy object
Activities affected due to wrist injury	Household tasks, fine hand use, lifting, self-care, toileting
Participation	Participation in household, occupation-related, and recreational activities

### **PRWHE - Modified Version of the PRWE**

The objective of modifying the PRWE was to allow clinicians to also assess hand conditions using the PRWE, since most of the items represented on the PRWE are also relevant to the patients with hand injuries. The PRWHE has the same items and scoring system as the PRWE. The PRWHE is preferred in hand/wrist clinics as it is more specific and easier to use.

### **Changes between the PRWE and PRWHE**

- 1) In the PRWHE, the term “wrist” is replaced with “wrist/hand”.
- 2) The PRWHE has two optional questions on hand aesthetics (not part of the scale scoring).

Since these optional questions are not accounted for in the scoring, the PRWE and the PRWHE have same modes of administration and scoring instructions. Furthermore, the literature to date describing the psychometric properties of the PRWE can also be translated to the PRWHE. The PRWHE is the most current version of the questionnaire used in clinical practice and research. The administration, scoring instructions, interpretation of the scores, and the synthesis of the psychometric properties for the PRWE and the PRWHE are, therefore, presented together.

## Administering the PRWE

The PRWHE is free for administering in clinical practice as well as research trials and easily available (MacDermid, 2009). The PRWHE is suitable for self-administration or administration by a physiotherapist or a hand therapist. The instructions are clearly written to assist the respondents in answering the questions.

### **Reference Time-frame**

Wrist/hand injuries where the PRWHE is commonly used are usually acute in nature and the clinical status changes frequently. Therefore, a longer reference time-frame is inappropriate for the PRWHE when used in this patient population. A reference time-frame of 1 week has been used and is relevant for the PRWHE.

### **Scoring Instructions**

It is suggested that the clinicians quickly check the PRWHE form once patient completes it. Necessary feedback and guidance can be provided to complete all the questions represented on the PRWHE in case the patient has left any question unanswered. This will reduce the non-response of any item and increase confidence in interpreting the final scores.

To score individual subscales of the PRWHE:

Pain Score = Sum of the 5 pain items (out of 50) —————> Best Score = 0, Worst Score = 50

Function Score = Sum of the 10 function items,  
Divided by 2 (out of 50) —————> Best Score = 0, Worst Score = 50

### **Computing the Total Score**

Total Score = Sum of pain + function scores —————> Best Score = 0, Worst Score = 100

Responses to the fifteen items are added to derive a composite score out of 100, where pain and disability are equally weighted. Higher scores on the subscales represent greater pain or functional disability.

### **Common Issues Arising while Scoring**

1) How are missing data treated?

If there is an item missing, you can replace the item with the mean score of the subscale.

2) What if patients leave the question blank because they cannot do a particular function?

Make sure the patients understand that they should have answered “10” for that item and make corrections, if necessary.

3) What if patients rarely perform the task?

If patients are unsure about how to answer a task that is rarely performed, encourage them to estimate their average difficulty. Their estimate will be more accurate than leaving the question blank.

4) What if patients do not do the task?

If patients never do the task, they should leave the question blank.

Again, it is critical that clinicians check the responses on the PRWHE form to avoid the issues outlined above.

### **Availability of PRWE in other languages**

Patient-reported outcomes that are developed in English need cultural adaptation and translation prior to using in patients whose primary language is not English (Guillemin, Bombardier, & Beaton, 1993). PRWE has been translated in Chinese (Hong Kong) (Wah, Wang, & Ping, 2006), German (Hemelaers, Angst, Drerup, Simmen, & Wood-Dauphinee, 2008), Swedish (Wilcke, Abbaszadegan, & Adolphson, 2009), Dutch (Brink, Voskamp, Houpt, & Emmelot, 2009), Japanese, (Imaeda et al., 2010), and Hindi (Mehta & MacDermid, 2010) languages. The relevant data of the studies that assessed different language versions of the PRWE has been provided in the tables in subsequent sections.

## Psychometric Properties of the PRWHE

The knowledge regarding the psychometric properties of an outcome measure is important for applying the measure in clinical practice. These properties vary in different clinical and cultural contexts.

The discussion of the psychometric properties of the PRWHE is elaborated below. Current evidence around each psychometric property of the PRWHE is summarized and their implications for the clinical practice are provided.

### **Reliability**

Some important terms that are commonly used to describe the reliability of a single score are defined prior to discussing the reliability of the PRWHE.

- The **test-retest reliability** refers to the ability of an instrument to provide consistent results at two different occasions when the underlying clinical condition is stable. Intraclass correlation coefficient (ICC) is used for determining the test-retest reliability of the measure. The ICC value of  $> 0.75$  shows excellent reliability.
- Each instrument can demonstrate some degree of error while measuring the outcome. Researchers conduct psychometric studies to quantify this error and derive **standard error in measurement (SEM)**. The SEM of an instrument is considered while determining whether change in the score on a second occasion truly reflects a change in clinical status or merely reflects an error in measurement.
- **Minimal detectable change (MDC)** is calculated for each measure based on its SEM to determine a “true change” in the score. One of the two possible values are provided to denote the MDC. One is  $MDC_{90}$  and the other is  $MDC_{95}$ , which reflect 90% and 95% confidence respectively in the given value of the change in the score of a measure.
- At times this true change in score does not translate into patient-important recovery. In other words, patients do not perceive that their condition has changed even though there is a true change in the score. For patients to experience clinically important difference, the score has to change as much as or more than the value of the **minimal clinically important difference (MCID)**. The MCID is often used synonymously with **minimally important difference (MID)**.
- **Internal consistency** denotes the homogeneity of the outcome measure’s questions and scales. Cronbach’s alpha (CE) is used for reflecting the internal consistency. A CE value of 0.8 means good and 0.9 means excellent internal consistency.

**Table 1. Reliability of the PRWE in Published Studies**

<b>English Version</b>			
<b>Study</b>	<b>Type of Reliability</b>	<b>Patient Population</b>	<b>Summary of Literature</b>
(MacDermid et al., 1998)	<b>Test-Retest Reliability</b>	<p>Short-term (2-7 days)</p> <ul style="list-style-type: none"> <li>○ 28 patients with acute distal radius fracture (DRF) (18 females and 10 males; age = 60.3 ± 11.2)</li> <li>○ 36 treated DRF (24 females and 12 males; age = 44.7 ± 10.2)</li> </ul> <p>Long-Term (1-year)</p> <ul style="list-style-type: none"> <li>○ 35 patients with one-year old Scaphoid fracture (1 female and 34 males; age = 34.0 ± 10.0)</li> </ul>	<p>Acute and Treated DRF:</p> <ul style="list-style-type: none"> <li>○ Total ICCs &gt; 0.90</li> <li>○ Pain ICCs &gt; 0.90</li> <li>○ Function ICCs &gt; 0.85</li> </ul> <p>Scaphoid Group:</p> <ul style="list-style-type: none"> <li>○ Total ICC = 0.91</li> <li>○ Pain ICC = 0.90</li> <li>○ Function ICCs &gt; 0.61</li> </ul>
(Schmitt & Di Fabio, 2004)	<b>Test-Retest Reliability, SEM, MDC<sub>90</sub>, MID</b>	<ul style="list-style-type: none"> <li>○ 211 patients (50.2% Females and 49.8% males; age = 47.5 (18-88)) with upper extremity (UE) musculoskeletal disorders; n = 20 for patients with distal UE diagnosis, mean follow-up = 3 months</li> </ul>	<p>ICC = 0.91</p> <p>SEM = 5.22</p> <p>MDC<sub>90</sub> = 12.2</p> <p>MID = 24.0</p>
<b>German Version (PRWE-G)</b>			
(John et al., 2008)	<b>Test-Retest Reliability</b>	<ul style="list-style-type: none"> <li>○ 103 patients (84% Females and 16% males; average age = 67.7 ± 9.8) treated with RIAP for symptomatic carpometacarpal arthritis approximately 6.2 years earlier from the date of</li> </ul>	<p>ICC</p> <ul style="list-style-type: none"> <li>○ Total ICCs &gt; 0.78</li> <li>○ Pain ICCs &gt; 0.87</li> <li>○ Function ICCs &gt; 0.86</li> </ul> <p>SEM</p> <ul style="list-style-type: none"> <li>○ Total SEM &gt; 8.12</li> <li>○ Pain SEM &gt; 10.54</li> </ul>

		recruitment; n = 51 for test-retest reliability which was examined two weeks after the first assessment	<ul style="list-style-type: none"> <li>○ Function SEM &gt; 7.81</li> </ul>
	<b>Internal Consistency</b>		<ul style="list-style-type: none"> <li>○ Total CE &gt; 0.97</li> <li>○ Pain CE &gt; 0.92</li> <li>○ Function CE &gt; 0.96</li> </ul>
	<b>MDC<sub>95</sub></b>		<ul style="list-style-type: none"> <li>○ 22.5</li> </ul>
(Hemelaers et al., 2008)	<b>Test-Retest Reliability</b>	<ul style="list-style-type: none"> <li>○ 44 patients (64% females and 36% males; average age = 56.3 ± 15.3) with acute DRF; n = 42 for test-retest reliability which was examined 5-7 days after the first assessment.</li> </ul>	<ul style="list-style-type: none"> <li>○ Total ICCs &gt; 0.94</li> <li>○ Pain ICCs &gt; 0.86</li> <li>○ Function ICCs &gt; 0.95</li> </ul>
	<b>Internal Consistency</b>		<ul style="list-style-type: none"> <li>○ Total CE &gt; 0.89</li> <li>○ Pain CE &gt; 0.81</li> <li>○ Function CE &gt; 0.85</li> </ul>
<b>Chinese Version (PRWE-Hong Kong)</b>			
(Wah et al., 2006)	<b>Internal Consistency</b>	<ul style="list-style-type: none"> <li>○ 47 patients (38% females and 62% males; average age = 46.4 ± 15.6) with different wrist injuries were assessed with the PRWE-HK; assessment at baseline and six weeks later</li> </ul>	<ul style="list-style-type: none"> <li>○ Pain CE &gt; 0.78 on 1<sup>st</sup> assessment, and 0.92 on 2<sup>nd</sup> assessment)</li> <li>○ Function CE &gt; 0.92 1<sup>st</sup> assessment, and 0.95 on 2<sup>nd</sup> assessment</li> </ul>
<b>Swedish Version (PRWE-S)</b>			
(Wilcke et al., 2009)	<b>Test-Retest Reliability</b>	<ul style="list-style-type: none"> <li>○ 99 patients (80% females and 20% males; average age = 58 ± 18) with DRF participated; 50 patients were assessed at 7 weeks and 6 months after the injury and 49 were assessed at 7 weeks and at 4 months after the injury; re-test interval was between 1-14 days for both groups.</li> </ul>	<ul style="list-style-type: none"> <li>○ Reliability for the total score was assessed by Kendall's W coefficient which was 0.79 and the Spearman's rank coefficient which was 0.99</li> </ul>
	<b>Internal Consistency</b>		<ul style="list-style-type: none"> <li>○ Reported for the total score and was between 0.94-0.97 for the groups</li> </ul>

<b>Dutch version (PRWHE-DLV)</b>			
(Brink et al., 2009)	<b>Test-Retest Reliability</b>	○ 58 patients (27 Females and 31 males; average age = 45) with a variety of wrist/hand conditions; 50 patients were assessed 2 days later.	ICC ○ Total ICC = 0.89 ○ Pain ICC = 0.88 ○ Function ICC = 0.88 ○ Appearance = 0.58
	<b>Internal Consistency</b>		CE ○ Total CE = 0.92 ○ Pain CE = 0.89 ○ Function CE = 0.91 ○ Appearance = 0.95
<b>Japanese version (PRWE-J)</b>			
(Imaeda et al., 2010)	<b>Test-Retest Reliability</b>	○ 117 patients (59% females and 41% males, average age = 50 ± 19) with a variety of wrist/hand conditions; 70 patients had surgery of which 50 patients in total were assessed pre-operatively as well as post-operatively after 3 months; re-test interval was between 1-2 weeks.	○ ICC = 0.92 ○ Pain ICC = 0.86 ○ Function ICC = 0.93
	<b>Internal Consistency</b>		CE ○ Reported for the total score (0.95) and for the subscales (0.90-0.96)
<b>Hindi version (PRWE-H)</b>			
(Mehta & MacDermid, 2010)	<b>Test-Retest Reliability</b>	○ 50 patients (22 females and 28 males, age 46.3 ± 14.3 with DRF; assessed at baseline, 2-3 days later, and 4-5 weeks later.	ICC ○ Total ICC = 0.81 ○ Pain ICC = 0.76 ○ Function ICC = 0.85
	<b>Internal Consistency</b>		CE ○ Total CE = 0.89 ○ Pain CE = 0.86 ○ Function CE = 0.92
	<b>SEM</b>		PRWE = 5.4
	<b>MDC<sub>90</sub></b>		PRWE = 12.5

DRF - Distal radius fracture; ICC - Intraclass correlation coefficient; SEM - Standard error of measurement;  $MDC_{90}$  - Minimal detectable change at 90% confidence level; MID - Minimally important difference; RIAP - Resection interposition arthroplasty; CE - Cronbach's alpha;  $MDC_{95}$  - Minimal detectable change at 95% confidence level

## Validity

Some important terms that are commonly used to describe the validity are defined prior to discussing the validity of the PRWHE.

- The **construct validity** is perhaps the most common type of validity reported in the literature and it refers to the extent to which the instrument corresponds to theoretical constructs. The construct validity is assessed by assessing correlation between the instruments measuring similar constructs. Pearson's correlation (represented by r value) is used for determining the construct validity of the measure. The r value of  $> 0.70$  indicates excellent construct validity.
- The **content validity** refers to the extent to which the instrument adequately covers the concepts of interest relevant to population of interest.
- The **criterion validity** refers to the extent to which the instrument relates with a gold standard or more established measure.
- **Responsiveness (or longitudinal validity)** refers to the ability of the measure to accurately document changes in patient's status.

**Table 2. Validity of the PRWE in Published Studies**

<b>English Version</b>			
<b>Study</b>	<b>Type of Validity</b>	<b>Patient Population</b>	<b>Summary of Literature</b>
(MacDermid et al., 1998)	<b>Construct Validity</b>	○ 101 patients (70 females and 31 males; age = 50 ± 16) with DRF	○ Percentage of recovery measured and compared with SF-36 to examine construct validity, $p < 0.0001$
	<b>Criterion Validity</b>	○ 35 patients (1 female and 34 males; age = 34 ± 10) with scaphoid fractures	r values ○ with the impairment score 0.45 to -0.61 ○ with the SF-36 PCS 0.46 to -0.63 ○ with SF-36 bodily pain -0.54 to -0.73
(Jupiter, Ring, & Weitzel, 2002)	<b>Construct Validity</b>	○ 20 patients (14 females and 6 males, age = 68 (60-81)) with redisplaced DRF treated with plate and screw fixation	r values ○ with age = 0.36 ○ with PASE = -0.37 ○ with physician-based measures = 0.62 ○ with radiographic measures = 0.16
(MacDermid, Donner, Richards, & Roth, 2002)	<b>Construct Validity</b>	○ 120 patients (70% females and 30% males; age = 52 ± 15) with DRF	r values ○ with wrist physical impairment = -0.50 ○ with grip = 0.46 ○ with ROM = -0.41 ○ with dexterity = 0.31
(MacDermid & Tottenham, 2004)	<b>Construct Validity</b>	○ 60 patients (57% females and 43% males, age range from 21-75 years) were assessed following hand therapy interventions.	○ Relationship between the DASH and the PRWHE measured, $r = 0.72$

(Karnezis, Panagiotopoulos, Tyllianakis, Megas, & Lambiris, 2005)	<b>Construct Validity</b>	<ul style="list-style-type: none"> <li>○ 30 patients (19 females and 11 males; age = 46.1(18-76) with DRF treated with closed reduction and percutaneous fixation; Mean follow-up = 12 months</li> </ul>	<ul style="list-style-type: none"> <li>r values</li> <li>○ with degree of radial shortening = 0.58 (pain scale) and 0.53 (total score)</li> <li>○ r with palmer angle = -0.40 with pain scale</li> </ul>
(MacDermid, Wessel, Humphrey, Ross, & Roth, 2007)	<b>Construct Validity</b>	<ul style="list-style-type: none"> <li>○ 121 patients (81.7% females and 18.3% males), assessed 9-117 months following arthroplasty for carpometacarpal joint</li> </ul>	
(Alexander, Franko, Makhni, Zurakowski, & Day, 2008)	<b>Construct Validity</b>	<ul style="list-style-type: none"> <li>○ 326 patients (55% females and 45% males; age = 44.5 (18-89.7)) of hand conditions</li> </ul>	<ul style="list-style-type: none"> <li>r values</li> <li>○ with MASS07 = 0.81 with total score, 0.67 with the pain subscale and 0.85 with the function subscale</li> </ul>
(Arora et al., 2009)	<b>Construct Validity</b>	<ul style="list-style-type: none"> <li>○ 114 patients (68% females and 32% males; age = 79 years (70–97 years)); 53 treated with ORIF and 61 treated with cast for DRF</li> </ul>	<ul style="list-style-type: none"> <li>○ Correlation between radiographic signs of arthritis and PRWE was weak, <math>p &gt; 0.05</math></li> </ul>
<b>German Version (PRWE-G)</b>			
(John et al., 2008)	<b>Construct Validity</b>	<ul style="list-style-type: none"> <li>○ 103 patients (84% females and 16% males; age = <math>67.7 \pm 9.8</math>) treated with RIAP for carpometacarpal arthritis approximately 6.2 years earlier from the date of recruitment; n = 51 for test-retest reliability which was examined two weeks after the first assessment</li> </ul>	<ul style="list-style-type: none"> <li>r values</li> <li>○ with DASH = 0.70-0.82 for PRWE and its subscales</li> <li>○ with physical component subscales of the SF-36 = 0.32-0.54</li> <li>○ with ROM 0.25 and 0.49 with grip strength</li> </ul>

(Hemelaers et al., 2008)	<b>Construct validity</b>	<ul style="list-style-type: none"> <li>○ 44 patients (64% females and 46% males; age = 56.3 ± 15.3) with DRF; n = 42 for test-retest reliability which was examined 5-7 days after the first assessment.</li> </ul>	<ul style="list-style-type: none"> <li>r values</li> <li>○ with DASH 0.62</li> <li>○ with SF-36 PCS 0.39 and with SF-36 MCS 0.45</li> </ul>
<b>Chinese Version (PRWE-Hong King)</b>			
(Wah et al., 2006)	<b>Construct Validity</b>	<ul style="list-style-type: none"> <li>○ 47 patients (38% females and 62% males; age = 46.4 ± 15.6) with different wrist injuries were assessed with the PRWE-HK; assessment at baseline and six weeks later</li> </ul>	<ul style="list-style-type: none"> <li>r values</li> <li>○ with SF-36 PCS 0.21-0.25 and with SF-36 MCS</li> </ul>
<b>Swedish Version (PRWE-S)</b>			
(Wilcke et al., 2009)	<b>Construct validity</b>	<ul style="list-style-type: none"> <li>○ 99 patients (80% females and 20% males; age = 58 ± 18) with DRF participated; 50 patients were assessed at 7 weeks and 6 months after the injury and 49 were assessed at 7 weeks and at 4 months after the injury; re-test interval was between 1-14 days for both groups.</li> </ul>	<ul style="list-style-type: none"> <li>Assessed using Wilcoxon signed rank test (for paired data) and Wilcoxon ranked sum test (unpaired data) - p values for the difference in the mean scores at 7 weeks and 4-6 months were &lt;0.05 for the patient groups</li> </ul>
	<b>Criterion validity</b>		<ul style="list-style-type: none"> <li>Spearman's rank coefficient (r values)</li> <li>○ 0.86 with the DASH at 7 weeks</li> <li>○ 0.91 with the DASH at 6 months</li> </ul>
<b>Dutch version (PRWHE-DLV)</b>			
(Brink et al., 2009)	<b>Construct validity</b>	<ul style="list-style-type: none"> <li>○ 58 patients (27 Females and 31 males; average age = 45) with a variety</li> </ul>	<ul style="list-style-type: none"> <li>r values</li> <li>○ with DASH = 0.84 for total score of the PRWE</li> </ul>

		of wrist/hand conditions; 50 patients were assessed 2 days later.	
(Imaeda et al., 2010)	<b>Construct validity</b>	<ul style="list-style-type: none"> <li>○ 117 patients (59% F; average age = 50 (19)) with a variety of wrist/hand conditions; 70 patients had surgery of which 50 patients in total were assessed pre-operatively as well as post-operatively after 3 months; re-test interval was between 1-2 weeks.</li> </ul>	r values <ul style="list-style-type: none"> <li>○ 0.81 with the DASH</li> <li>○ 0.26-0.46 with SF-36 subscales</li> <li>○ 0.70 with VAS - pain</li> </ul>
<b>Hindi version (PRWE-H)</b>			
(Mehta & MacDermid, 2010)	<b>Construct validity</b>	<ul style="list-style-type: none"> <li>○ 50 patients (22 females and 28 males, age 46.3 ± 14.3 with DRF; assessed at baseline, 2-3 days later, and 4-5 weeks later.</li> </ul>	r values <ul style="list-style-type: none"> <li>○ with VAS-pain = 0.59-0.74 for PRWE and its subscales</li> <li>○ with VAS-disability = 0.48-0.88</li> <li>○ with wrist ROM = 0.03-0.25</li> <li>○ with grip strength = 0.35-0.64</li> </ul>

DRF - Distal radius fracture; SF-36 - Short form 36; PCS - Physical component summary; PASE - Physical activity scale for elderly; ROM - Range of motion; DASH - Disabilities of arm, shoulder, and hand; PRWHE - Patient-rated wrist/hand evaluation; MASS07 - Modern activity subjective survey of 2007; RIAP - Resection interposition arthroplasty; MCS - Mental component summary; VAS - Visual analogue scale

**Table 3. Responsiveness (longitudinal validity) of the PRWE in Published Studies**

<b>English Version</b>			
<b>Study</b>	<b>Type of Responsiveness statistic</b>	<b>Patient Population</b>	<b>Summary of Literature</b>
(MacDermid et al., 1998)	<b>Effect Size</b> (0-6 months) (not reported in the paper but calculated manually)	<ul style="list-style-type: none"> <li>○ 101 patients (70 females and 31 males; average age = 50 ± 16) with DRF fractures;</li> <li>○ 35 patients (1 female and 34 males; average age = 34 ± 10) with scaphoid fractures</li> </ul>	<ul style="list-style-type: none"> <li>○ ES 3.06</li> </ul>
(MacDermid, Richards, Donner, Bellamy, & Roth, 2000)	<b>SRM</b> 0-3 months	<ul style="list-style-type: none"> <li>○ 59 patients (37 females and 22 males; average age 53 ± 18) with DRF</li> </ul>	PRWE - <ul style="list-style-type: none"> <li>○ Pain = 1.52</li> <li>○ Specific Function = 2.47</li> <li>○ Usual Function = 1.62</li> <li>○ Total = 2.27</li> </ul> DASH = 2.01 SF-36 subscales = 0.81-1.33
	3-6 months		PRWE - <ul style="list-style-type: none"> <li>○ Pain = 0.67</li> <li>○ Specific Function = 0.62</li> <li>○ Usual Function = 0.44</li> <li>○ Total = 0.74</li> </ul> DASH = 0.68 SF-36 subscales = 0.28-0.65
	0-6 months		PRWE - <ul style="list-style-type: none"> <li>○ Pain = 1.95</li> <li>○ Specific Function = 3.62</li> <li>○ Usual Function = 2.24</li> <li>○ Total = 2.95</li> </ul>

			DASH = 2.52 SF-36 subscales = 1.07- 1.29
	<b>Effect size</b>		PRWE -
	0-3 months		<ul style="list-style-type: none"> <li>○ Pain = 1.87</li> <li>○ Specific Function = 5.87</li> <li>○ Usual Function = 1.95</li> <li>○ Total = 3.16</li> </ul>
			DASH = 1.86 SF-36 subscales = 0.82-1.11
	3-6 months		PRWE -
			<ul style="list-style-type: none"> <li>○ Pain = 0.50</li> <li>○ Specific Function = 0.44</li> <li>○ Usual Function = 0.36</li> <li>○ Total = 0.50</li> </ul>
			DASH = 0.44 SF-36 subscales = 0.14-0.44
	0-6 months		PRWE -
			<ul style="list-style-type: none"> <li>○ Pain = 2.42</li> <li>○ Specific Function = 7.01</li> <li>○ Usual Function = 2.29</li> <li>○ Total = 3.91</li> </ul>
			DASH = 2.32 SF-36 subscales = 0.91-1.65
(MacDermid, Roth, & Richards, 2003)	<b>Effect size</b> (0 - 12 months) (not reported in the paper but calculated manually)	<ul style="list-style-type: none"> <li>○ 129 patients (68% females and 32% males; average age = 50 ± 15) with DRF</li> </ul>	PRWE -
			<ul style="list-style-type: none"> <li>○ Pain = 2.28</li> <li>○ Specific Function = 4.37</li> <li>○ Usual Function = 2.47</li> <li>○ Total = 3.46</li> </ul>
(MacDermid & Tottenham, 2004)	<b>SRM</b>	<ul style="list-style-type: none"> <li>○ 24 (out of 60 total) wrist patients (16 females and 8 males; age = 21-75)</li> </ul>	PRWE = 1.51 DASH = 1.37
	<b>Effect size</b>		PRWE = 1.49 DASH = 1.31

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(Schmitt & Di Fabio, 2004)	<b>Effect size</b>	○ 211 patients (50.2% females and 49.8% males; age = 47.5 (18-88)) with upper extremity (UE) musculoskeletal disorders; n = 20 for patients with distal UE diagnosis, mean follow-up = 3 months	PRWE = 1.87 DASH = 1.67 SF-36 (PCS) = 1.51
	<b>SRM</b>		PRWE = 1.94 DASH = 1.76 SF-36 (PCS) = 1.22
	<b>Guyatt's Index</b>		PRWE = 1.16 DASH = 1.16 SF-36 (PCS) = 0.95
	<b>Reliable change proportion</b>		PRWE = 0.75 DASH = 0.70 SF-36 (PCS) = 0.48
	<b>MID proportion</b>		PRWE = 0.55 DASH = 0.50 SF-36 (PCS) = 0.55

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**Swedish Version (PRWE-S)**

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(Wilcke et al., 2009)	<b>SRM</b>	○ 99 patients (80% females and 20% males; average age = 58 ± 18) with DRF participated; 50 patients were assessed at 7 weeks and 6 months after the injury and 49 were assessed at 7 weeks and at 4 months after the injury; re-test interval was between 1-14 days for both groups.	PRWE = 1.4 - 1.7 DASH = 1.4
	<b>Effect size</b>		PRWE = 1.3 DASH = 1.2

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**Japanese version (PRWE-J)**

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(Imaeda et al., 2010)	<b>SRM</b>	○ 117 patients (59% females and 41% males; average age = 50 ± 19) with a variety of wrist/hand conditions; 70 patients had surgery of	<b>All patients</b>
			PRWE - ○ Pain = 1.73 ○ Specific Function = 1.13 ○ Usual Function = 1.13

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which 50 patients in total were assessed pre-operatively as well as post-operatively after 3 months; re-test interval was between 1-2 weeks.

○ Total = 1.55  
DASH = 1.30  
SF36 - PF = -0.56  
SF36 - BP = -0.79  
SF26 - RP = -0.67  
VAS (pain) = 1.75

**Patients with radius fracture**

PRWE -  
○ Pain = 1.81  
○ Specific Function = 1.59  
○ Usual Function = 1.50  
○ Total = 1.90

DASH = 2.13  
SF36 - PF = -0.80  
SF36 - BP = -0.61  
SF26 - RP = -0.73  
VAS (pain) = 2.00

**Effect size**

**All patients**

PRWE -  
○ Pain = 2.18  
○ Specific Function = 1.29  
○ Usual Function = 1.19  
○ Total = 1.92

DASH = 1.20  
SF36 - PF = -0.54  
SF36 - BP = -0.95  
SF26 - RP = -0.62  
VAS (pain) = 2.23

**Patients with radius fracture**

PRWE -  
○ Pain = 2.05  
○ Specific Function = 6.20  
○ Usual Function = 1.75  
○ Total = 3.32

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DASH = 2.05  
SF36 - PF = -0.85  
SF36 - BP = -0.67  
SF26 - RP = -0.71  
VAS (pain) = 2.96

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**Hindi version  
(PRWE-H)**

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(Mehta & MacDermid, 2010)	<b>SRM</b>	○ 50 patients (22 females and 28 males, age 46.3 ± 14.3 with DRF; assessed at baseline, 2-3 days later, and 4-5 weeks later.	PRWE = 2.66
	<b>Effect size</b>		PRWE = 2.16

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DRF - Distal radius fracture; ES - Effect size; DASH - Disabilities of arm, shoulder, and hand; SRM - Standardized response means; SF-36 - Short form 36; PCS - Physical component summary; PF - Physical functioning; BP - Bodily pain; RP - Role physical; VAS - Visual analogue scale

**Table 4. Comparative Scores of the PRWE in Published Studies**

<b>Study</b>	<b>Patient Population</b>	<b>Follow-up period</b>	<b>PRWE Mean (SD)</b>	<b>Comparators</b>
<b>Distal radius fracture</b>				
	<u>Volar plating</u>			
(Lattmann, Meier, Dietrich, Forberger, & Platz, 2010)	A total of 245 patients (185 females and 60 males; age 62 ± 18) who were treated with volar locking plate osteosynthesis for unstable DRF were followed for 1 year	6 weeks (n = 225)	Total score: 27 ± 21 Pain: 14 ± 10 Specific activities: 19 ± 17 Usual activities: 10 ± 10	Grip strength (kg): 14 ± 8 Wrist ROM: Flex 46 ± 18 Ext 46 ± 19 Sup 73 ± 21 Pron 81 ± 15
		3 months (n = 217)	Total score: 14 ± 14 Pain: 10 ± 11 Specific activities: 7 ± 12 Usual activities: 5 ± 8	Grip strength (kg): 20 ± 10 Wrist ROM: Flex 57 ± 18 Ext 59 ± 17 Sup 82 ± 12 Pron 84 ± 11
		6 months (n = 180)	Total score: 11 ± 17 Pain: 7 ± 10 Specific activities: 5 ± 10 Usual activities: 3 ± 7	Grip strength (kg): 23 ± 11 Wrist ROM: Flex 61 ± 16 Ext 61 ± 17 Sup 84 ± 13 Pron 86 ± 9
		1 year (n = 228)	Total score: 8 ± 16 Pain: 5 ± 9 Specific activities: 4 ± 9 Usual activities: 3 ± 7	Grip strength (kg): 25 ± 11 Wrist ROM: Flex 64 ± 15 Ext 64 ± 15 Sup 84 ± 12 Pron 87 ± 7

(Arora et al., 2009)	<u>Volar plating</u> A total of 53 patients (36 females and 17 males; age 75.9 ± 4.8) who were treated with volar fixed-angle plate for DRF were followed for 1 year	1 year	Total score (Median (Interquartile Range)): 9.5 (0 - 12.6)	DASH (Median (Interquartile Range)): 11.1 (0 - 17.4) Wrist ROM: Flex 45 ± 10 Ext 57 ± 12 Sup 83 ± 10 Pron 82 ± 9
(Wilcke et al., 2009)	99 patients (79 females and 20 males; age = 58 (18)) with DRF; 50 patients were assessed at 7 weeks and 6 months after the injury and 49 were assessed at 7 weeks and at 4 months after the injury	7 weeks  4 months  6 months	Total Score: 45 ± 20 (n = 50) 50 ± 21 (n = 49)  Total Score: 22 ± 21 (n = 49)  Total Score: 19 ± 18 (n = 50)	No values provided for comparative measures
(Hemelaers et al., 2008)	44 patients (28 females and 16 males; age = 56.3 (15.3)) with acute DRF	4-6 weeks after the DRF	Total score: 44 ± 17 Pain: 53 ± 18 Functions: 35 ± 20	DASH: 51 ± 18 SF-36: PCS 38 ± 7 MCS 50 ± 12
(Grewal & MacDermid, 2007)	216 patients (168 females and 48 males; age = 55.2 (17.6)) with extraarticular	1 year after DRF	< 65 years of age Total score: 13.1 (acceptable alignment) Total score: 29.3 (unacceptable alignment)	< 65 years of age DASH: 9.2 (acceptable alignment) DASH: 23.2 (unacceptable alignment)

DRF			≥ 65 years of age	≥ 65 years of age
			Total score: 11.9 (acceptable alignment)	DASH: 15.4 (acceptable alignment)
			Total score: 18.3 (unacceptable alignment)	DASH: 19.7 (unacceptable alignment)
<hr/>				
(Harris, MacDermid, & Roth, 2005)	790 patients (539 females and 251 males) with DRF	1 weeks after DRF	Pain: 30.2 ± 11.6 Specific activities (0-60): 51.3 ± 14.1 Usual activities (0-40): 26.3 ± 11.9	SF-36 physical health (from 0-50): 37.2 ± 8.7 SF-36 mental health (from 0-50): 49.8 ± 11.2
		3 months after DRF	Pain: 17 ± 10.4 Specific activities (0-60): 19.4 ± 15 Usual activities (0-40): 11.4 ± 12.5	SF-36 physical health (from 0-50): 43.7 ± 8.9 SF-36 mental health (from 0-50): 51.5 ± 9.8 Wrist outcome measure (from 0-85, 85 = best): 59.6 ± 8.9
		1 year after DRF	Pain: 8.1 ± 9.5 Specific activities (0-60): 6.3 ± 10.3 Usual activities (0-40): 5.64 ± 12.6	SF-36 physical health (from 0-50): 49 ± 8.7 SF-36 mental health (from 0-50): 54.8 ± 7.5 Wrist outcome measure (from 0-85, 85 = best): 73.9 ± 7.4
<hr/>				
(MacDermid et al., 2003)	129 patients (68% females and 32% males; age = 50 (15)) with extraarticular and intraarticular DRF	Baseline	Total score: 75 ± 17.8 Pain: 33 ± 10.8 Specific activities: 54 ± 11 Usual activities: 28 ± 10	None reported
		2 months after DRF	Total score: 43.3 ± 23 Pain: 21 ± 11 Specific activities: 30 ± 18 Usual activities: 15 ± 11.7	None reported
		3 months after DRF	Total score: 28 ± 21.3 Pain: 15.3 ± 11 Specific activities: 17 ± 15	None reported

	Usual activities: 8.6 ± 9.5	
6 months after DRF	Total score: 20 ± 20.6 Pain: 11.7 ± 11.2 Specific activities: 11 ± 13 Usual activities: 5.8 ± 8.1	None reported
1 year after DRF	Total score: 13.5 ± 17 Pain: 8.4 ± 10 Specific activities: 7 ± 11 Usual activities: 3.5 ± 6	None reported

**Other DRF articles for reference:** (Wilcke, Abbaszadegan, & Adolphson, 2011; Hull et al., 2010; Anakwe, Khan, Cook, & McEachan, 2010; Othman, 2009; Mirza, Jupiter, Reinhart, & Meyer, 2009; Synn, Makhni, Makhni, Rozental, & Day, 2009; Wright, Horodyski, & Smith, 2005)

### Pathologies involving Carpal bones

(Croog & Stern, 2008)	21 patients (age = 38 (19-59 years range)) were assessed following proximal row carpectomy and date presented for 18 patients	Average 10 years (4-17 years range) after the proximal row carpectomy	Total score: 18 (0-81 points range)	QuickDASH: 12 (0-50 points range) Mayo Wrist Score: 84 (60-100 points range) <b>Wrist ROM:</b> Flex-Ext 105° (75°-145°) Flex 49° (25°-80°) Ext 56° (45°-70°) RD: 9° (0°-15°) UD 33° (25°-40°) Grip strength (Kg): 35 (23-66)
(Dias, Dhukaram, Abhinav, Bhowal, & Wildin, 2008)	71 patients with scaphoid fracture were randomized where 35 patients (31 males and 4 females; age 29.3 (16-50 years range))	Average of 91.8 months (80-106 months range) in the internal fixation group and 94.2	Mean (SEM) <b>Internal fixation group</b> Total score: 7 (1.6) Pain: 5.6 (1.3) Functions: 1.3 (0.5) <b>Cast immobilization group</b> Total score: 8.4 (2.2)	Mean (SEM) <b>Internal fixation group</b> Grip strength (%): 96 (3.4) Pinch strength (%): 96 (3.5) ROM: 92 (2.6) <b>Cast immobilization group</b> Grip strength (%): 99 (3.3)

	had internal fixation and 36 patients (31 males and 5 females; age 31.4 (16-61 years range)) had cast immobilization	months (73-110 months range) in cast group	Pain: 6.5 (1.5) Functions: 2.3 (0.8)	Pinch strength (%): 100 (3.3) ROM: 95 (1.4)
(Bicknell, MacDermid, & Roth, 2007)	28 patients (20 females and 8 males; age 53 ± 16 years (19-79 years) who had K wire fixation for metacarpophalangeal joint arthrodesis	Average of 47 ± 37 months (12-137 months range) after the surgery	Total score: 29 ± 28 Pain: 15 ± 17 Specific activities: 17 ± 18 Usual activities: 11 ± 12 Appearance: 2.4 ± 3.5	DASH: 28 ± 28 SF-36: PCS 40 ± 11 MCS 51 ± 13 <b>AUSCAN:</b> Pain 1.4 ± 1.2 stiffness 1.6 ± 1 function 1.5 ± 1.2 Grip strength: 21.4 ± 16 Key pinch grip: 6 ± 3.5 <b>CMC ROM (°):</b> Ext 41 ± 12 Abduction (°): 51 ± 16 Adduction (°): 6 ± 8
(MacDermid et al., 2007)	120 patients (98 females and 22 males; age 65.4 ± 8.1 years) with OA of the CMC who had undergone tendon interposition arthroplasty	Average of 54.2 ± 23.1 months after the surgery	Total score: 41.5 ± 28.3	DASH: 36.7 ± 24 SF-36: PCS 34.6 ± 11.4 MCS 47.9 ± 11.7 <b>AUSCAN:</b> Pain 1.6 ± 1 stiffness 1.4 ± 1.1 function 1.8 ± 1.1
(De, Robijns, & Degreef, 2006)	24 patients (6 females and 18 males; age 41 ± 14 years) with avascular necrosis of carpal bones and 27 patients	Average of 68 months (12-138 months range) after the surgery	<b>Avascular necrosis</b> Total score: 27 ± 28	<b>Avascular necrosis</b> DASH: 21 ± 22 Grip (Kg): 27 ± 11 <b>Wrist ROM (°):</b> Flex 35 ± 12 Ext 42 ± 17

(12 females and 15 males; age 48 ± 14 years) with either SNAC or SLAC; all treated with proximal row carpectomy	<b>SNAC/SLAC</b> 23 ± 23	<b>SNAC/SLAC</b> DASH: 16 ± 17 Grip (Kg): 30 ± 13 <b>Wrist ROM (°):</b> Flex 37 ± 15 Ext 44 ± 15
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**Other articles for pathologies involving carpal bones for reference:** (Kwon, Choi, Shin, & Baek, 2009; Konduru et al., 2006; Hildebrand et al., 2000)

**Other pathologies involving wrist/hand area**

(Imaeda et al., 2010)	117 patients (69 females and 48 males; age 50 ± 19 years) with a different wrist/hand conditions	Cross-sectional data was presented	Total score: 58.7 ± 24.3 Pain: 30.5 ± 11.5 Specific activities: 36 ± 21 Usual activities: 20.6 ± 12	DASH: 44.2 ± 28.2 SF-36: PF 37.9 ± 18.4 RP 30 ± 16.7 MH 44.4 ± 11 VAS (pain): 59.3 ± 24.3
(Seo, Park, & Kang, 2009)	16 patients (5 females and 11 males; age 26.9 (15-57 years) with different wrist/hand conditions	Pre-operative assessment	Total score: 23.1 (0-45) Functions (0-100): 39.2 (5-69)	DASH: 34.5 (5.8-56.7) MMWS: 72.5 (25-95) Grip strength (lbs): 69.7 (40-120) <b>Wrist ROM (°):</b> Flex 69.7 (40-90) Ext 76.7 (30-90) RD 15 (10-40) UD 29.1 (20-40)
		Follow-up 18.9 (12-38) months after the	Total score: 9.1 (0-34) Functions (0-100): 11.2 (0-48)	DASH: 10.5 (0.8-40.8) MMWS: 92.8 (70-100) Grip strength (lbs): 80.9 (40-130) <b>Wrist ROM (°):</b>

		surgery		Flex 70.9 (50-90) Ext 72.8 (60-80) RD 13.4 (10-20) UD 30.3 (25-60)
(Wah et al., 2006)	47 patients (18 females and 29 males; age 46.5 ± 15.6 (20-78 years)) with different wrist/hand conditions	Baseline	Total score: 57.47 ±19 Functions (0-50): 30.78 ± 12	Grip strength (% of unaffected side): 34 ± 20.82 SF-36: PF 64.68 ± 19.26 PCS 41.17 ± 12.27 <b>Wrist ROM (°):</b> Flex 38.21 ± 18.24 Ext 27.77 ± 21.87 RD 9.91 ± 6.69 UD 21.94 ± 8.47
		At 6 weeks follow-up	Total score: 43.28 ±23.61 Functions (0-50): 21.87 ± 13	Grip strength (% of unaffected side): 56.44 ± 26 SF-36: PF 70.53 ± 18.33 PCS 49.78 ± 19.12 <b>Wrist ROM (°):</b> Flex 47.66 ± 17.7 Ext 43.51 ± 15.43 RD 15.53 ± 12.19 UD 29 ± 12.21

**Other articles for different pathologies involving wrist/hand area for reference:** (Yao & Lee, 2011; Michlovitz, Hun, Erasala, Hengehold, & Weingand, 2004)

DRF - Distal radius fracture; ROM - range of motion; Flex - Flexion; Ext - Extension; Sup - supination; Pron - pronation; DASH - Disabilities of Arm, Shoulder, and Hand; SF-36 - Short Form 36; PCS - Physical component summary; MCS - Mental component summary; RD - radial deviation; UD - ulnar deviation; SEM - standard error of mean; AUSCAN - Australian/Canadian Hand Osteoarthritis Index; CMC - carpometacarpal joint; SNAC - scaphoid nonunion with advanced collapse; SLAC - scapholunate dissociation with advanced collapse; PF - Physical functioning; RP - role physical; VAS - visual analogue scale MMWS - Modified Mayo Wrist Score; RA - Rheumatoid arthritis

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