



## Hand Strength in Rheumatoid Arthritis patients: its correlation with clinical and radiological variables

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### Abstract:

**Background:** In about 80-90 percent of people with rheumatoid arthritis (RA), the hands are affected. causing discomfort, stiffness, deformity, limited range of motion, and muscular weakening that have a significant impact on physical functioning and activities of daily living. The purpose of this study was to assess hand strength in patients with rheumatoid arthritis and see how it correlated with clinical and radiological characteristics. The participants in this study were 50 RA patients as defined by the criteria of ACR/EULAR 2010, another 50 seemingly healthy participants of similar age and sex were used. Hand Strength was assessed using with Jual hand dynamometer and radiological evaluation by Plain hand and wrist radiography were taken (P-A) and lateral. Hand Strength measured with a hand dynamometer was substantially greater in healthy controls. Health assessment questionnaire, score ranged from (0.05) to (4.50) with an average of (1.06 ±0.58). disability of the shoulder, arm and hand score ranged from (5.80) to (85.80) with an average score of (49.25 ±19.28). Cochin Hand Function Scale score among studied RA patients ranged from (0) to (79) with an average of (34.38 ±19.28). Mean HS in right hands were (13.98 vs. 36.34), in left hands were (12.90 vs. 38.22) in RA patients. HS was significantly higher among studied RA patients with no Loco-motor manifestations as compared with RA patients with Loco-motor manifestations in both right and left hands; (p-values= 0.021 & 0.047) in right and left hands respectively.

**Keywords:** Rheumatoid Arthritis, Hand strength, anti-CCP antibodies, DASH score

## **1. Introduction:**

RA is considered as an autoimmune chronic inflammatory illness, producing inflammatory cell infiltration with hyperplasia of the synovium, bone and cartilage degradation. [1]. Poor hand grip and strength is one of the RA activity diagnostic criteria and chronicity [2]. In people with RA, all body functions are impaired when compared to healthy ones because of joint discomfort, systemic lesions and weariness [3]. Patients with RA have been reported to have a poorer quality of life (QoL) [4]. Because the pathogenic inflammatory mechanisms of many rheumatic illnesses begin years before clinical appearance and diagnosis, and because morbidities that last for a long time reduce with vigorous treatment with disease-modifying medication, both are forming major difficulties [5]. Score of disease intensity calculated in 28 different joints is one of the activity measures in RA patients [6]. Larsen radiological score is another modality to determine the extent of articular damage caused by RA. The scale scores the amount of joint space narrowing, bony alignment and degree of joint erosion [7]. On the other hand, functional ability can be assessed using 3 questionnaires; the health assessment questionnaire (HAQ) [8], the Cochin Hand Function Scale

(CHFS) [9], the disability of the arm, shoulder and hand (DASH) questionnaire which is a tool for evaluating upper extremity functional impairment in a variety of situations [10]. Impaired muscle function, exacerbated by inactivity, might affect the hands' basic grasp and pinch capabilities [11]. The assessment of hand strength (HS) can be effective in detecting hand function impairment in patients with RA. The present study aimed to assess the HS in RA patients and its relations with clinical as well as radiological variables.

## **2. Patients and Methods:**

A case study with a control group performed in fifty patients clinically diagnosed to have RA defined by the 2010 ACR/EULAR classification criteria [12] and another 50 seemingly healthy participants of similar age and sex were used as a control group. The patients were chosen conveniently from faculty of medicine's: Beni-suef university hospital, Rheumatology and Rehabilitation Department's outpatient clinic and Beni-suef General Hospital. A written approval form allowed by Local Ethical Research Committee in Beni-sueif Faculty of Medicine was obtained from every participant prior to study initiation after

explanation of the study nature and procedure with an ethical committee approval number is FMBSUREC/03092019/Mohammed.

### **2.1 Inclusion criteria:**

The participants in this study were 50 RA patients as defined by the criteria of ACR/EULAR 2010 [12]. Joint symptoms; symptom duration, whether 6 weeks or >6 weeks; serology (containing anti-citrullinated peptide antibody (ACCP) and/or rheumatoid factor (RF); and (CRP and/or ESR as acute-phase reactants) are the four classification criteria of the ACR/EULAR 2010, with point scores for each

### **2.2 The following were used as exclusion criteria:**

Patients who have congenital hand problems or history of serious trauma to the hand as well as patients with neurological problems.

All patient received a thorough history taking, clinical examination, laboratory investigation, (DAS-28) disease activity assessment [13], and (HAQ) functional disability and capacity assessment [8]. The Disabilities of the upper limb was assessed using (DASH) questionnaire score [10], Cochin Hand Function Scale to measure functional ability in the hand [14], HS was assessed using Jual hand dynamometer [15].

Radiological evaluation: Plain hand and wrist radiography were taken (P-A) and lateral. The existence of erosion was described as an erosive disease, and the Larsen score was used to assess it. [7].

### **• Statistical interpretation**

SPSS (statistical application for social science) was used to examine the data.) on an Operating System as follows;

- Mean, range and SD being used to define the quantitative values.
- Percentages and numbers being used to define the qualitative characteristics.
- In parametric data (SD less than 50% mean), Comparing quantitative variables was done using the t-test.
- Insignificant if the value of P is more than 0.05
- Significant if the value of P is less than 0.05
- highly significant statistically if the value of P is less than 0.01 [16]

### **3. Results:**

This study was carried on 50 patients with RA (comprising 44 females and 6 males who had a mean age of  $45.40 \pm 10.31$  years), and 50 apparently matched age and sex healthy participants as a control group, with a mean age of  $45 \pm 9.81$  years, comprising 41 females and 9 males. The clinical & laboratory and radiological variables of the patients with RA are shown in **Table (1) and (2)**.

**Table (1):** The clinical characteristics of RA patients.

	<b>Mean</b>	<b>SD</b>
Disease duration (years)	8.17	8.84
Number of swollen joints	5.22	5.17
Number of Tender joints	12.32	7.59
Duration of Morning Stiffness (h)	0.89	0.47
DAS-28	5.66	1.39
HAQ	1.06	0.58
DASH	49.25	19.30
COCHIN	34.38	19.28
<b>Extra-Articular Manifestation</b>	Frequency	Percent
Constitutional	5	10%
Skin	7	14%
Reynaud's Phenomena	17	34%
Eye	17	34%
CVS	16	32%
Pulmonary	11	22%
GIT	19	38%
Renal	18	36%

\* Disease Activity Score(DAS-28)  
 THE health assessment Questionnaire (HAQ)  
 The Disability of the Arm, Shoulder and Hand (DASH)  
 Cochin Hand Functional scale (CHFS)

**Table (2):** laboratory and radiological variables of the patients with RA

		Frequency	Percent
CRP	Negative	19	38%
	Positive	31	62%
RF	Negative	17	34%
	Positive	33	66%
Anti-CCP	Negative	19	38%
	Positive	31	62%

Larsen score		
Grade (0)	1	2%
Grade (1)	3	6%
Grade (2)	4	8%
Grade (3)	29	58%
Grade (4)	9	18%
Grade (5)	4	8%

Anti-citrullinated peptide antibody(Anti-ccp)  
 Rheumatoid factor (RF)  
 C-reactive protein(CRP)

(HS) measured with hand dynamometer was significantly higher among studied healthy controls in both hands. The mean Hand strength (HS) in right hands were (13.98 vs. 36.34) and left hands were (12.90 vs. 38.22) in RA patients and healthy controls respectively with a statistically significant p-value= 0.001(**Table 3**)

**Table (3):** Comparison of Hand strength (HS) between patients and controls.

	Variable	N	Mean	Std. Deviation	p-value
Rt. Hand	RA Patients	50	13.98	16.76	0.001*
	Healthy Controls	50	36.34	30.64	
Lt. Hand	RA Patients	50	12.90	13.66	0.001*
	Healthy Controls	50	38.22	30.66	

HS was significantly higher among studied RA patients with no Loco-motor manifestations (joint swelling, tenderness, deformity, instability and muscle wasting) in comparison with RA patients with Loco-motor manifestations in both right and left hands; (p-values= 0.021 & 0.047) respectively. **Table (4)**

**Table (4):** Relation of HS among RA patients to Loco-motor manifestations

	<b>Loco-motor</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>P-value</b>
Rt. Hand	No	15	22.2667	26.76209	0.021*
	Yes	35	10.4286	8.17559	
Lt. Hand	No	15	18.7333	22.23082	0.047*
	Yes	35	10.4000	6.66068	

HS was significantly higher among studied RA patients with negative CRP, anti-CCP antibodies as compared with RA patients with positive CRP, anti-CCP antibodies in both right and left hands. On the contrary, there were no significant associations between RF and HS in the studied RA patients in right and left hands **Table (5)**.

**Table (5):** Relation of HS among RA patients to the CRP, Anti-CCP antibodies and RF.

	<b>CRP</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>P-value</b>
Rt. Hand	Negative	19	20.78	24.42	0.023*
	Positive	31	9.80	7.32	
Lt. Hand	Negative	19	17.78	20.08	0.047*
	Positive	31	9.90	6.22	
	<b>Anti-CCP</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>P-value</b>
Rt. Hand	Negative	19	19.5263	24.65849	0.030*
	Positive	31	10.5806	7.92370	
Lt. Hand	Negative	19	18.2105	19.72190	0.028*
	Positive	31	9.90	6.22	
	<b>RF</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>P-value</b>
Rt. Hand	Negative	17	16.5882	24.86729	0.435
	Positive	33	12.6364	10.75528	
Lt. Hand	Negative	17	16.8824	19.95583	0.141
	Positive	33	10.8485	8.61728	

No significant correlation was observed between swollen joints number or morning stiffness duration (h) and HS. While, HS was negatively correlated with tender joints number in both right and left hands as well as the disease duration (years), DAS-28, HAQ, DASH, Larsen grades, and CHFS **Table (6)**.

**Table (6):** HS and various assessed parameters among RA patients

Variable		Hand strength (HS)	
		Rt. Hand	Lt. Hand
Disease Duration (years)	r	-0.403	-0.459
	P-value	0.004*	0.001*
Duration of Morning Stiffness (h)	r	-0.179	-0.143
	P-value	0.214	0.320
Number of swollen joints	r	-0.190	-0.216
	P-value	0.187	0.132
Number of Tender joints	r	-0.497	-0.483
	P-value	0.001*	0.001*
DAS-28	r	-0.595	-0.624
	P-value	0.001*	0.001*
HAQ	r	-0.443	-0.498
	P-value	0.001	0.000
DASH	r	-0.677	-0.690
	P-value	0.001*	0.001*
CHFS	r	-0.601	-0.616
	P-value	0.001*	0.001*
Larsen radiological grades	r	-0.754	-0.781
	P-value	0.001*	0.001*

#### **4. Discussion:**

(RA) is a chronic immunological disease that attacks the synovial tissue and leads structural damage, functional impairment and joint degradation [17]. This is case control study that was designed to assess the hand strength in RA patients and its correlation with clinical and radiological variables.

In our study Larsen radiological grades were found to have a considerable negative connection with hand strength “radiological damage of hand joints are more to blame for hand function limitations”, also we found that hand Strength was significantly higher among studied RA patients with no Locomotor manifestations as compared with RA patients with Loco-motor manifestations, these findings are backed up by ten Klooster et al., 2019 research who noted that the degree of radiographic lesion in large and small joints was connected to physical impairment as determined by HAQ, they assessed the damage using the Sharp scoring system for minor joints and the Larsen grading instrument for major joints [18]. On the contrary to Birtane et al., 2008 who investigated the relationship between the Duruoz hand index (DHI) and radiographic results as well as disease activity in RA patients, they found that only patients in remission were studied to

see if there was a link between DHI and radiological scores, in all patient groups, a positive correlation was found between DHI and DAS-28. They discovered this intriguing conclusion in a group of individuals who showed no symptoms of activity, such as pain, stiffness, or swelling, and who did not have any confounding conditions that may restrict hand functioning. This group included RA patients who were on a long-term course and had developed cumulative damage to their hands as a result of previous exacerbations. They observed that, despite the absence of active hand involvement, RA patients adapted to their physical hand impairment throughout the course of the disease. they concluded that, in remission patients, there was no association between radiographic scores of any joint groups and DHI [19]

In agreement with our results BİRCAN et al., 2014 [20] who investigated the association between activity of the disease and the Grip Ability Test (GAT), as well as self-reported hand questionnaire in RA subjects. The morning stiffness duration, VAS for pain of daily life activities, VAS for limitation of finger flexion, DAS 28, HAQ, finger/hand function subscale, Arthritis Impact Measurement scale and Duruoz Hand Index ( $r=0.261$  to  $0.639$ ,



$p < 0.05$ ) all had positive significant relationships with GAT test. There was no significant relationship between disease duration and GAT or VAS for pain at rest. The disease activity and GAT, as well as self-reported hand questionnaires in RA subjects, were showed to have weak to moderate relationships.

Both grip and pinch strength are important indicators of the hand's functional integrity. Grip strength and three chuck pinch account for 14% and 10% of daily activities, respectively. In Erol et al., 2016 study, they found that RA group had significantly lower grip strength and all subgroups of pinch strength. Several studies have found that people with RA have lower grip and pinch strength, which is consistent with our findings [21]. Also Žura al., 2021 reported that, when compared to healthy people, both women and men with RA have lower handgrip strength. [22] Antibodies to antigens of citrullinated proteins and peptides (ACPA) have an essential role in RA pathogenesis and may be detected several years before inflammatory arthritis (IA) onset during autoimmunity preclinical period, they are an essential serological marker in RA diagnosis [23]

In our study, Hand Strength was significantly higher among RA studied

patients with anti-CCP negative antibodies as compared with anti-CCP positive antibodies RA patients in both right and left hands, also Durmus et al., 2019 study found significantly negative correlation between ACPA levels and (DHI) scores as well as pinch ( $p < 0.05$ ). In contrast, significantly positive correlation was detected between ACPA and DHI positivity, HAQ, DAS 28, ESR as well as pinch ( $p < 0.01$ ) [24]. In another study performed by Quinn et al. 2006 including early RA patients, it was demonstrated that RF and ACPA have prognostic value on functional outcomes. The prognosis estimation is important for early RA and determining the following treatment period, switching to aggressive treatment, planning of biological agents and coping with the disease [25].

Similar to our result Adams and his colleagues 2004 who are noted a strong link between DASH and both 3-point pinch strength and HS, DASH was shown to be the most accurate instrument for determining upper-limb functional ability [26]. Similarly, Palamar et al., 2017 concluded that patients with RA had strong relationships between lateral pinch strength, 3-point pinch strength, 2-point tip-to-tip and loss of hand function. This study looked at the links between

abnormalities of the thumb and index finger [27,28].

Regarding (CHFS) scores Poole et al. showed that reduced functioning abilities of the hands, as assessed by the CHFS, was associated with poorer HS, 3-point pinch strength and 2-point tip-to-tip in RA patient [29]. Tsai et al., 2017 illustrated that when compared to healthy controls, patients with RA have a considerably narrower thumb range of motion and lower hand grip scores. In RA studied patients, the thumbs movement range was moderately linked with hand strength., suggesting it may have an impact on RA patients' functional hand performance [30]. Another study, found a significantly link between HAQ and CHFS, confirming that involvement of hand in RA reduces overall functional capacity [31,32].

#### **5. Conclusion and Recommendations:**

Hand Strength was significantly higher among studied RA patients with negative anti-CCP antibodies as compared with RA patients with positive anti-CCP antibodies in both right and left hands.

Functional ability for studied RA patients was assessed by different tools; the health assessment Questionnaire (HAQ) scores, disability of the arm, shoulder and hand (DASH) scores, Cochin Hand Functional scale (CHFS) scores and disease activity

was assessed by Larsen radiological score which was used to determine the extent of radiographic changes due to rheumatoid arthritis.

Hand strength was moderately negative correlated with Disease Activity Score (DAS-28) in both right and left hands.

Patients with RA had weaker grip and pinch strength than those who did not have the condition. Grip and pinch strength were found to be strongly associated to overall functional ability as well as upper limb and hand function; however, they had moderate relationships with duration and activity of the disease

Limitations: small number of the studied cases

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Conflicts of interest: There are no conflicts of interest.

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