

Determinants of the hand functions in patients with rheumatoid arthritis

Elif Durmus, Nurdan Paker, Derya Bugdayci, Goksen Goksenoglu

Istanbul Physical Medicine and Rehabilitation Education Research Hospital, Istanbul, Turkey

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Abstract

Aim: The aim of this study was to investigate the hand function determinants and related factors of the patients with rheumatoid arthritis (RA).

Material and Methods: Thirty nine patients with long standing rheumatoid arthritis were included in the study. Demographic, clinical and laboratory findings of the patients were recorded. Duruoz Hand Index Data (DHI) was used for the assessment of the hand functions. Disease activity was calculated by using Disease Activity Score (DAS) 28. In order to evaluate general disability, Health Assessment Questionnaire Disability Index (HAQ-DI) was used. Grip and pinch strengths of the patients were measured by the Jamar dynamometer.

Results: Among all the patients, 82.1% were women. Mean age of the patients were 58.03 ± 13.11 years. Mean disease duration was 9.69 ± 8.96 years. Mean grip strength was 16.58 ± 6.74 kg and pinch strength was 4.80 ± 1.75 kg. Statistically significant positive correlation was found between hand functions measured by DHI and morning stiffness, HAQ-DI, Visual Analog Scale (VAS) hand, VAS global, DAS 28 and pinch ($p < 0.01$).

Conclusion: In this study, the determinants of functional status of the hand were found as disability, being anti-citrullinated protein antibodies (ACPA) positive, disease activity and pinch in patients with RA.

Keywords: Rheumatoid arthritis; hand strength; pinch strength.

INTRODUCTION

Rheumatoid arthritis (RA) is a systemic, inflammatory, autoimmune disease characterized by chronic polyarticular joint involvement, initiating with pathological changes in synovial tissue, resulting primarily in destruction of peripheral joints and surrounding tissues. Persistent inflammation of joint synovium and symmetrical erosion occurring in joints are characteristic (1). RA is a disease that involves hands and leads to significant impairment of hand functions. Hand and wrist joints are frequently involved by arthralgia and arthritis. Articular and periarticular inflammation may cause damage on hand and wrist structures. In RA metacarpophalangeal joints may be impaired. Both the stability and the mobility of the metacarpophalangeal joints are important for the hand functions (2). Among the patients with RA, approximately fifty percent have tenosynovitis. The patients with RA may have flexor tendon ruptures in hands due to bone spurs and tenosynovitis. In patients with RA, complaints

concerning hand and wrist joints and loss of function are common. The 94% of the patients suffering from RA have at least one symptom concerning hand and wrist while 67% have at least one sign. Hand-related disorders appear within two years after the initiation of the disease. Due to the destructions of hand joints, ligament laxity, deterioration of muscular function and pain of hand and wrist, decrease in grip strength and restrictions in daily living activities may eventuate (3-5).

Determination of RA related loss of function is important for early diagnosis and initiation of appropriate treatment. Many scales have been created to evaluate the rheumatoid hand. Evaluating the functional status of hand in patients with RA is useful both for making the treatment decision and following the results of treatments (6).

Duruoz hand index (DHI), which is a specific test for evaluating the hand functions in patients with RA. DHI is as a valuable test as clinical assessment scales and

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Corresponding Author: Goksen Goksenoglu, Istanbul Physical Medicine and Rehabilitation Education Research Hospital, Istanbul, Turkey, E-mail: goksengoksenoglu@hotmail.com

laboratory results for disease follow up and evaluation of treatment efficiency (7).

Hand grip and pinch strenghts are imporant for hand functioning and they are the measurements showing the power of hand and fingers. Hand grip strength is correlated with general body strength and measures coarse grip while giving information on the use of hand in activities of daily living. Pinch is convenient for determining the fine motor skills which are important for activities in daily living (8).

It is critical to expose the disease-related and personal factors in patients with RA to protect the individuals' independence degrees. Therefore, the purpose of this study was to investigate the factors associated with hand functions evaluated with DHI among the patients with RA.

MATERIAL and METHODS

In this cross-sectional study 39 patients ≥ 18 -year-old, diagnosed as RA according to the 1987 American College of Rheumatology (ACR) criteria and 2010 American College of Rheumatology/European League Against Rheumatism RA classification criteria whose disease duration ≥ 1 year were included (9). They all were following by the outpatient clinic as a part of TRASD (Turkish League Against Rheumatism) Registry. Exclusion criteria were as follows: being < 18 years, having a history of fracture, trauma, cervical disc disease, psychiatric disorders, diabetes mellitus, neurological, or muscular disorders, operation concernng hand and wrist within last 2 years, having peripheral nerve lesion or tendon problems, that could affect hand functions. Two individuals who fail to do grip due to advanced hand deformity were also excluded.

The demographic characteristics of the patients such as age, gender, height, body weight were recorded. All of the patients underwent to a systemic and rheumatologic examination following a detailed history taking. Duration of disease, duration of morning stiffness, dominant hand, accompanying diseases, daily used medicines were questioned. Number of tender and swollen joints were recorded. In addition, rheumatoid factor (RF), anti-citrullinated protein antibodies ACPA, erythrocyte sedimentation rate (ESR), C reactive protein (CRP) values were noted. The cut-off level for ACPA positivity was set at ≥ 5 arbitrary units/ml (AU/ml), according to the manufacturer's instructions (10).

A written informed consent was obtained from each patient. The study protocol was approved by the Istanbul Physical Medicine and Rehabilitation Research Hospital Local Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Measurment tools

Duruoz hand index (DHI)

DHI is a functional assesment scale that is specifically developed for rheumatoid hand. It consists of 18 questions evalutating the activites of hand and wrist. The answers are assessed in 6 levels (0-5) with Likert scale and total

score varies between 0-90. Higher points demonstrates poorer functional status. The factor analysis of DHI is four-dimensional. These are the movements requiring strength and rotational activities, sensitive activites requiring manual skill, activities requiring finger grip strength activities and activities requiring finger skills. The validity of the DHI, developed in French population, was shown in Turkish population (7).

Disease Activity Score 28 (DAS 28)

DAS 28 is one of the RA disease activity scales which is assessed through a specific formula using number of tender and swollen joints examination findings of 28 joints, the general health status rated 0 to 100 that the patients with RA to be due to disease in the last 1-week period, and the sedimentation rate (ESR) (in mm / hr) or CRP value (11).

Health Assessment Questionnaire Disability Index (HAQ-DI)

HAQ-DI is a feasible scale consisting of 8 different categories totally with 20 items which beneficial for assessing the functional disabilities during activities of daily living. The sections forming the scale are the assignments like dressing, straightening up, eating, walking, providing hygiene, reaching and maintenance of daily routine and every section consists of two of three items. Every item is scored between 0-3 (without any difficulty:0,with some difficulty: 1, with much difficulty: 2, unable to do: 3). In addition, use of assisted device and assistance from another person is taken into consideration for every scoring. Every section is seperately scored. The mean value of eight section is obtained and a single HAQ score is determined that varies between 0-3. Turkish validity and reliability of HAQ was performed (12). HAQ is commonly used for evaluating the functional outcomes in patients with inflammatory polyarthritis and its subgroup rheumatoid arthritis. Furthermore, it is used for assessing treatment and efficiency of treatment in patients with RA (13).

Visual Analog Scale (VAS)

Pain intensity was assessed by a subjective Visual Analogue Scale (VAS). Individuals were asked to mark the severity of the pain on the scale of 10 cm (0: no pain, 10: unbearable pain). The value they marked was recorded as VAS score (14).

Grip strength

Grip strength was measured with Jamar® dynamometer(Sammons Preston; Bolingbrook, IL, USA). Through the American Society of Hand Therapists (ASHT) recommendation, hand grip strength measurements were made while the patient was in sitting position, the shoulder was in adduction and in neutral position, the elbow was is 90 degrees flexion and the forearm and wrist were in neutral position (15). First, it was demonstrated how to hold the device to the patients. Information was given about the measurement. The participants were asked to squeeze the dynamometer as soon as they feel ready with the maximum strength. Verbal encouragement

was done until the arrow is fixed. Three measurements were performed. 1 minute break was given in between the measurements. The mean value of the three measurements was calculated. The measurements were performed both with two hands respectively.

Pinch strength

Pinch measurements, through the recommendations of ASHT, were made while the patient was in sitting position, the shoulder was in adduction and in neutral position, the elbow was is 90 degrees flexion and the forearm and wrist were in neutral position (13). In the current study, the lateral grip strength that is performed with the compression of the pulp of the thumb and the lateral side of the index finger was measured with Jamar Pinch Gauge. The measurements were performed with the fingers of right and left hand. The mean value of three measurements was used.

Statistical Analysis

For statistical analyses 2008 Statistical Software (Utah, USA) program was used. While evaluating the study data, in addition to descriptive statistical method (Mean, Standard Deviation, Median, Frequency, Ratio, Minimum, Maximum), Mann Whitney U test was used for the comparison of quantitative data. Mann Whitney U test was used in the parameters showing abnormal distribution two group comparison. Spearman's correlation analysis was used to evaluate the associations between parameters. For multivariate analysis; the effects of other risk factors on DHI total score were assessed with Bacward Stepwise regression analysis. P values <0.01 and <0.05 were considered as statistically significant.

RESULTS

The demographic and clinic characteristics of the patients were summarized in Table 1, laboratory results were given in Table 2. Table 3 shows the correlation results between DHI and age, educational status, marital status, disease duration, morning stiffness, number of tender joints, number of swollen joints, severity of hand-pain, severity of general pain, DAS 28, grip strength, pinch strength, ESR, CRP, RF, ACPA and HAQ-DI. Significantly negative correlation was found between DHI scores and ACPA levels as well as pinch ($p<0.05$). In contrast, significantly positive correlation was found between DHI scores and ACPA positivity, number of tender joints, DAS 28, severity of hand pain and severity of global pain ($p<0.05$). With taking the factors associated with DHI, multiple regression analysis was performed. Significantly positive correlation was detected between DHI and ACPA positivity, HAQ, DAS 28, ESR as well as pinch ($p<0.01$) (table 4).

Ten percent of the patients ($n=4$) have been using anti-TNF, 66.7% ($n=26$) were using DMARD and corticosteorid combination and 94.9% ($n=37$) were only using DMARDs. The most common comorbidity 35.9% ($n=14$) among the patients was high blood pressure. Fifteen percent were ($n=6$) having diabetes mellitus and 15.4% ($n=6$) were having dyslipidemia. 12.8% ($n=5$) were having thyriod disease while 2.6% ($n=1$) were having osteoporosis.

Table 1. Demographic and clinic characteristic

Demographic characteristics		
Variables	Mean±SD	Min.-max.
Age (y)	58.03±13.11	28-78
Gender (Female/male) n (%)	32/7 (82.1/17.9)	
BMI	28.44±4.78	20.5-43.0
Education (y)	4.87±3.16	0-13
Marital status (married/single)	29/10 (74.4/25.6)	
Hand dominancy (Right/left) n (%)	36/3 (92.3/7.7)	
Clinical characteristics		
Disease duration (years)	9.69±8.26	1-43
Number of tender joints (0-28)	5.46±6.42	0-24
Number of swollen joints (0-28)	0.49±1.14	0-6
Severity of hand pain (VAS)	38.97±26.93	0-90
Severity of global pain (VAS)	37.18±24.81	0-90
DAS 28 sedimentation score	3.88±1.32	1.36-6.48
DAS 28 CRP score	2.67±1.23	0.96-5.28
Morning stiffness duration (min)	40.00±54.55	0-240
Grip strength (kg)	16.58±6.74	3-36.6
Pinch strength (kg)	4.80±1.75	1.1-9.4
HAQ score	0.77±0.62	0-2.3
DHI score	12.08±14.19	0-59

SD:Standard deviation; Min.: Minimum; Max.: Maximum; BMI: Body mass index; VAS: Visual analog scale DAS 28: Disease activity score 28; HAQ: Health assesment questionnaire; DHI: Duruöz hand index

Table 2. Laboratory findings

		Min-Max	Mean±SD
ESR		5-611	46.69±94.82
CRP		0.3-5.2	0.87±0.95
		n	%
RF Positivity	present	20	51.3
	absent	19	48.7
RF level	<20	19	48.7
	20-99	10	25.6
	100-199	6	15.4
	200-299	1	2.6
	≥300	3	7.7
ACPA Positivity	Present	27	69.2
	absent	12	30.8

SD:Standard deviation; Min.: Minimum; Max.: Maximum; BMI: Body mass index; ACPA: Anti-citrullinated peptid /protein antibody

Table 3. Correlation coefficients (r) between DHI score and other variables

Variables	DHI score	
	p	r
Gender	0.229	
Age	0.529	-0.104
Marital status	0.329	
Morning stiffness	0.077	0.286
RF level	0.411	-0.135
Anti-CCP level	0.012*	-0.397
Education years	0.438	0.128
Disease duration	0.051	0.315
Number of tender joints (0-28)	0.001**	0.585
Number of swollen joints (0-28)	0.672	0.07
Severity of hand pain (VAS)	0.002**	0.474
Severity of global pain (0-10cm)	0.018*	0.376
DAS 28 sedimentation	0.007**	0.426
DAS 28 CRP	0.002**	0.473
Grip strength	0.157	-0.231
Pinch strength	0.007**	-0.427
ESR	0.996	-0.001
CRP	0.388	0.142
HAQ score	0.001**	0.824

DHI: Duruoz Hand Index; SD:Standard deviation; Min.: Minimum; Max.: Maximum; *p0.05; **p0.01; r: Spearman's correlation coefficient; HAQ: Health Assessment Questionnaire ESR: Erythrocyte sedimentation rate

Table 4. Multiple regression analysis

Model	Unstandardized Coefficients		95.0% Confidence Interval for	
	B	P	Lower Bound	Upper Bound
VAS global	0.004	0.970	-0.0217	0.226
VAS hand	0.079	0.173	-0.036	0.193
Number of tender joints	0.063	0.884	-0.812	0.938
Morning stiffness	-0.699	0.833	-7.416	6.019
DAS 28 CRP	-0.765	0.810	-7.213	5.684
Disease duration (month)	0.015	0.227	-0.010	0.040
ACPA positivity	8.870	0.002**	3.375	14.364
DAS 28 sedimentation	-2.803	0.031*	-5.333	-0.273
Pinch (kg)	-1.824	0.043*	-3.591	-0.057
HAQ score	18.875	0.001**	13.239	24.511

DISCUSSION

In this study it was shown that in patients with RA, the factors related with the hand functions are disease

activity, number of tender joints, both global pain and localized pain in hand, disability, pinch, morning stiffness and ACPA positivity. The determinants of the functional status of the hand are the disability measured by HAQ-DI, ACPA positivity, disease activity and pinch.

In a previous study the factors that accompany severe disability progression that is measured with HAQ are advanced age, female gender, having long symptom duration, meeting the 1987 ACR criteria, severe disease activity calculated by DAS28 and low socioeconomic level in RA. Similarly to our study, it has been reported that there is significant correlation between hand's functional destruction and disease activity together with ACPA positivity in the same study (17). In a study investigating patients with early RA with ten years follow up, it was revealed that disability measured with HAQ accompany disease activity (18).

In a study performed by Dedeoğlu et al. (19) it was suggested that there is a strong correlation between the functions of hand and functional destruction, disability and grip strength. The same study revealed that there is a significant positive correlation between the functional status of the hand and the articular destruction in hand's articular destruction scores as well as disease duration. In addition, it was also suggested that the increase in functional disability was associated with the progression in articular destruction. The factors related with hand disability evaluated by HAQ were reported as disease duration, disease activity, grip strength and pinch in a study (20). Besides, since the pinch is a negative predictor of the functional status of the hand, this study points out the importance of pinch in hand functions and activities of daily living. Previous researches also demonstrated an association between pinch and the functional status of hand (19,20).

An additional important finding of this study was that another determinant of the functional status of hand was ACPA positivity. In a study performed by Quinn et al. (21) 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. In another study performed with 191 RA patients, it was found that the determinants of 5 years disability, measured with HAQ, were baseline HAQ scores, Ritchie index, ESR, CRP and presence of erosion (22). No significant relationship found between the functional status of hand and the hand grip in this study. This may be due to relatively small sample size.

The current study has strengths and limitations. The strength of this study is that the assessments were made face to face interviews by the same physician. Thus, personal differences that might arise in some measurements were excluded. The limitations of this study was having comparatively small and heterogeneous group of patients and lack of follow up period due to the cross-sectional design.

CONCLUSION

This study revealed that the determinants of functional status of the hand were found as disability, being ACPA-positive, disease activity and pinch in patients with rheumatoid arthritis.

Competing interests: The authors declare that they have no competing interest.

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Elif Durmus ORCID: 0000-0003-1926-560X

Nurdan Paker ORCID:0000-0001-8957-1843

Derya Bugdayci ORCID:0000-0003-1906-4568

Goksen Goksenoglu ORCID: 0000-0002-4375-7754

REFERENCES

- Grassi W, De Angelis R, Lamanna G, et al. The clinical features of rheumatoid arthritis. *Eur J Radiol* 1998;27:S18-24.
- Dellhag B, Bjelle A. A five-year followup of hand function and activities of daily living in rheumatoid arthritis. *Arthritis Care Res* 1999;2:33-41.
- Ertel AN. Flexor tendon ruptures in rheumatoid arthritis. *Hand Clin* 1989;5:177-90.
- Horsten NC, Ursum J, Roorda LD, et al. Prevalence of hand symptoms, impairments and activity limitations in rheumatoid arthritis in relation to disease duration. *J Rehabil Med* 2010;42:916-21.
- Ursum J, Horsten NC, Hoeksma AF, et al. Predictors of stenosing tenosynovitis in the hand and hand-related activity limitations in patients with rheumatoid arthritis. *Arch Phys Med Rehabil* 2011;92:96-100.
- Mathiesen FK, Rasmussen OJ, Recht L, et al. Impairment of grip function in rheumatoid arthritis – studies with a simple hand test. *Scand J Rheumatol* 1991;20:209-12.
- Duruöz MT, Poiraudau S, Fermanian J, et al. Development and validation of a rheumatoid hand functional disability scale that assesses functional handicap. *J Rheumatol* 1996;23:1167-72.
- Fraser A, Vallow J, Preston A, et al. Predicting 'normal' grip strength for rheumatoid arthritis patients. *Rheumatology (Oxford)* 1999;38:521-8.
- Saroux A, Guedes C, Allain J, et al. From classification criteria to diagnostic criteria for rheumatoid arthritis. *Rev Rhum Engl Ed* 1996;63:159-61.
- Van Beers-Tas MH, Marotta A, Boers M, et al. A prospective cohort study of 14-3-3 η in ACPA and/or RF-positive patients with arthralgia. *Arthritis Res Ther* 2016;18:76.
- Van der Heijde DM, van't Hof MA, Van Riel PL, et al. Judging disease activity in clinical practice in rheumatoid arthritis: first step in the development of a disease activity score. *Ann Rheum Dis* 1990;49:916-20.
- Küçükdeveci A, Şahin H, Ataman Ş, et al. Issue in cross-cultural validity: 201 example from the adaptation, reliability, and validity testing of a Turkish version of the stanford health assessment questionnaire. *Arthritis Rheum* 2004;51:14-9.
- Bruce B, Fries JF. The stanford health assessment questionnaire: a review of its history, issues, progress, and documentation. *J Rheumatol* 2003;30:167-78.
- Dixon JS, Bird HA. Reproducibility along a 10 cm vertical visual analogue scale. *Ann Rheum Dis* 1981;40:87-99.
- Bohannon RW, Peolsson A, Massy-Westropp N, et al. Reference values for adult grip strength measured with a Jamar dynamometer: a descriptive meta-analysis. *Physiotherapy* 2006;92:11-5.
- Roberts HC, Denison HJ, Martin HJ, et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. *Age Ageing* 2011;40:423-9.
- Norton S, Fu B, Scott DL, et al. Health assessment questionnaire disability progression in early rheumatoid arthritis: systematic review and analysis of two inception cohorts. *Semin Arthritis Rheum* 2014;44:131-44.
- Courvoisier N, Dougados M, Cantagrel A, et al. Prognostic factors of 10-year radiographic outcome in early rheumatoid arthritis: a prospective study. *Arthritis Res Ther* 2008;10:R106.
- Dedeoğlu M, Gafuroğlu U, Yılmaz O, et al. The relationship between hand grip and pinch strengths and disease activity, articular damage, pain, and disability in patients with rheumatoid arthritis. *Turk J Rheumatol* 2013;28:69-77.
- Bodur H, Yılmaz O, Keskin D. Hand disability and related variables in patients with rheumatoid arthritis. *Rheumatol Int* 2006;26:541-4.
- Quinn MA, Gough AK, Green MJ, et al. Anti-CCP antibodies measured at disease onset help identify seronegative rheumatoid arthritis and predict radiological and functional outcome. *Rheumatology (Oxford)* 2006;45:478-80.
- Combe B, Cantagrel A, Goupille P, et al. Predictive factors of 5-year health assessment questionnaire disability in early rheumatoid arthritis. *J Rheumatol* 2003;30:2344-9.