

Research Article

The Relationship Between Hand Function and Activity Performance in Patients with Rheumatoid Arthritis

 Mustafa Can Kilic,¹  Bilge Basakci Calik,²  Veli Cobankara,³  Ayse Balkarli⁴

¹Special Cagri Rehabilitation Center, Aydin, Turkey

²Department of Physical Therapy and Rehabilitation, Pamukkale Universty, Denizli, Turkey

³Department of Rheumatology, Pamukkale University Faculty of Medicine, Denizli, Turkey

⁴Department of Rheumatology, University of Health Sciences Antalya Training and Research Hospital, Antalya, Turkey

Abstract

Objectives: The aim of this study was to evaluate the relationship between hand function and activity performance in patients with rheumatoid arthritis (RA).

Methods: A total of 40 patients (mean age: 50.7±9.9 years) with RA were included in the study. The demographic data of the patients were recorded and the severity of pain was measured using a visual analogue scale. Hand grip strength was measured with a hand dynamometer, and palmar grip strength, lateral grip strength, and tip grip strength were measured with a pinch meter. Hand function was evaluated using the Nine-Hole Peg Test, and the Michigan Hand Outcome Measure, and the Canada Occupation Performance Measure (COPM) was used to assess performance in daily activities.

Results: There was a significant negative relationship between pain and COPM performance ($p=0.008$; $r=-0.411$) and satisfaction scores ($p=0.006$; $r=-0.424$), and there was a positive correlation between hand function scores and COPM performance ($p=0.000$, $r=0.574$) and satisfaction scores ($p=0.000$; $r=0.638$).

Conclusion: The results of this study indicated that pain and inadequate hand function influence the performance of activities in individuals with RA. Teaching strategies to cope with pain and to protect hand function will improve the ability to participate in daily activities for these individuals and will contribute positively to their independence.

Keywords: Activity participation and performance, hand function, rheumatoid arthritis

Rheumatoid arthritis (RA) is an autoimmune disease which starts with pathological damage, primarily devastating peripheral joints and surrounding tissue and is characterized by chronic polyarticular, systemic, inflammatory joint involvement. Persistent inflammation of the synovia and symmetrical joint deterioration are typical.^[1]

The chronic progression of RA is a cause of severe dysfunction, with disability mostly occurring in the hand and wrist. The changes seen in the wrist include a narrowed joint space, scapholunate dislocation, ulnar dorsal dislocation, and extensor carpi ulnaris tendon volar dislocation. As

these joints play a key role in daily living activities (ADL), their involvement causes disability in the short, medium and long-term of the disease for different reasons.^[2,3] Changes in the anatomical structure, range of motion, muscle strength, sense and coordination affect hand dexterity in patients with RA. Deformities cause anatomical destruction and may reduce the level of mobility. Decreased muscle strength is one of the reasons of reduced function, with 20-50% decreased muscle strength noticed during the illness^[4] Pain, swelling and deformities affect hand functions negatively thus the disease affects daily living activities.

Address for correspondence: Mustafa Can Kilic, MD. Special Cagri Rehabilitation Center, Aydin, Turkey

Phone: +90 543 729 07 42 **E-mail:** fztcankilic@hotmail.com

Submitted Date: August 29, 2018 **Accepted Date:** September 20, 2018 **Available Online Date:** November 15, 2018

©Copyright 2018 by Eurasian Journal of Medicine and Investigation - Available online at www.ejmi.org



RA has an impact on a patient's physical, emotional and social functions in the early period because of chronic insufficiency. Due to insufficiency caused in the chronic course of RA, the patient's physical, emotional and social functions are affected from the beginning of the disease with 60% of patients suffering functional limitation in the early period. Moderate and severe activity limitation results in a reduced quality of life. Functional disability and quality of life determine the treatment needs of patients and these are key parameters that affect their treatment compliance and satisfaction.^[5,6]

There are many studies in the literature evaluating hand functions in RA patients. Besides, we see that studies examining these functional deficiencies that come to these societies are mostly in terms of participation in work activities.^[7] In this study, it is desired to emphasize that the disability caused by pain and consequently the individuals have limited activity participation. We therefore aimed to evaluate the relationship between hand function and activity participation performance in patients with RA.

Methods

Participants

The study included 40 RA patients, aged 18-65 years, who presented at Pamukkale University Rheumatology Department and were diagnosed with Rheumatoid Arthritis according to the American College of Rheumatology criteria.^[8] Patients were evaluated one by one by physiotherapist in Pamukkale University School of Physical Therapy and Rehabilitation. Inclusion criteria for the study were stable drug use for the last 3 months, stable symptoms, no neurological disorder that affected hand functions (peripheral nerve lesion, trauma, surgical operation, cerebrovascular events), no communication problems and out patient. Personal and disease-related data were recorded on a demographic registration form. Demographic information of age, gender, body mass index, dominant extremity, occupation, and smoking status were recorded. The onset and duration of the disease, exercise habits, and family history of rheumatism were also recorded on the registration form (Table 1).

The study was approved by Pamukkale University Noninvasive Research Ethical Committee, and meets the ethical standards of the Declaration of Helsinki. Each participant gave written informed consent signed.

Outcome Assessments

Pain

For the assessment of pain intensity, a Visual Analog Scale (VAS) was used. This scale consists of a 10 cm horizontal line and the starting point of 0 = no pain and 10 = the worst pain imaginable. Patients were asked to mark the intensity of pain on the line.^[9]

Table 1. Demographic data of RA patients

	Min	Max	Mean±SD
Age (Year)	32	65	50.7±9.9
Height (cm)	148	178	161±7.5
Weight (kg)	52	110	73.7±7.5
BMI (kg/m ²)	19	41	28.3±5
Dominant Extremity	n=40	%	
Right	36	90	
Left	4	10	
Gender	n= 0	%	
Male	6	15	
Female	34	85	
Disease Duration	14.1±9		
Family History	n=40	%	
Yes	20	50	
No	20	50	
Exercise Habit	n=40	%	
Yes	7	17.5	
No	33	82.5	
Smoking	n=40	%	
Yes	9	22.5	
No	31	77.5	
Alcohol	n=40	%	
Yes	4	10	
No	36	90	
Occupation	n=40	%	
Housewife	28	67.5	
Farmer	3	7.5	
Retired	2	5	
Worker	7	17.5	

Min: Minimum; Max: Maximum; SD: Standart deviation.

Handgrip Strength

Hand grip strength was measured with a Jamar hydraulic hand dynamometer (Sammons Preston, USA). Grip strength measurement were performed in the standard position recommended by the American Society of Hand Therapists. In this standard position, the patients are seated with hips and knees at 90° flexion, shoulders in adduction, forearms in a neutral position, elbows at 90° flexion, wrists at 0-30° extension with 0-15° ulnar deviation. The measurement was repeated three times with 15 seconds rest between each measurement. The average of the 3 measurements was used in the evaluation.

Pinchgrip Strength

Fine grip strength measurements were made with a finger dynamometer (Pinchmeter-Sammons Preston, USA). Pinch grip strength measurement were performed in the standard position recommended by the American Association of Hand Therapists. In this standard position, the patients

are seated with hips and knees at 90° flexion, shoulders in adduction, forearms in a neutral position, elbows at 90° flexion, wrists at 0-30° extension with 0-15° ulnar deviation. Measurements were taken of 3 different finger grips of pinch grip strength, lateral grip strength and tip grip strength. The measurement was repeated three times with 15 seconds rest between each measurement. The average of the 3 measurements was used in the evaluation.

Hand Dexterity: Nine-Hole Peg Test (NHP)

The Nine-hole Peg Test was used to measure of the hand skills in RA patients. This device contains a frame platform and storage box. A board 12.7×2 cm in area has 9 holes and 9 cylinders. In the test, the patient sits in front of the board and is instructed to remove the 9 cylinders from the storage box and place them into the holes, then to remove them from the holes quickly without stopping and to put them back in the storage box. The time taken to complete the test was measured in seconds with a stopwatch. The

test was performed twice in succession and the average of the results was recorded for each hand. The total test score was calculated as the average of the scores of both hands.^[10] The average measurements were taken from two separate trials of the right and left hand.

Hand Function: Michigan Hand Outcome Questionnaire (MHQ)

The Michigan Hand Outcome Questionnaire (MHQ) was used to evaluate hand functions in the RA patients. The MHQ consist of six sections and 57 different items. This test assesses how well patients can perform daily activities. Responses are given as a 5-point Likert scale where 1=the best situation and 5=the worst situation. Each section is scored between 0 and 100 with 0 representing the worst score and 100 the best score. MHQ is the most commonly used hand function scale and the Turkish validity study was conducted.^[11]

Table 2. Pain, Hand Grip Strength, NHPT, MHQ and COPM of RA patients

	Min		Max		Mean±SD	
Pain intensity (cm)	1		10		5.8±2.9	
	Dominant			Nondominant		
Hand Grip Strenght	Min	Max	Mean±SD	Min	Max	Mean±SD
Hand grip strenght (kg)	2.2	45	19.3±8.3	2.2	42	17.8±8.9
Tip grip strenght (kg)	0.5	8.3	4.5±1.8	1	8.1	4.2±1.8
Pinch grip strenght (kg)	0.5	7	3.6±2.6	0.9	7.3	3.6±1.6
Lateral grip strenght (kg)	2	10.4	5.6±2.07	1	12.3	5.3±2.3
Nine Hole Peg Test	min		max		Mean±SD (n=40)	
Dominant hand point (sn)	14.6		32		21.3±4.3	
Nondominant hand point (sn)	15.6		35		22.0±4.7	
Total NHPT point (sn)	15.1		33.5		21.6±4.5	
Michigan Hand Q.	min		max		Mean±SD (n=40)	
Michigan overal hand func.	12.5		100		62.3±20.9	
Michigan ADL	5.67		100		65.2±23.9	
Michigan Work	15		100		51.5±29.4	
Michigan Pain	0		100		50.8±25.1	
Michigan Aesthetic	25		100		84.2±24.2	
Michigan Satisfaction	25		100		61.6±20.3	
MHQ total point	36.45		89.27		64.9±15.4	
COPM	min		max		Mean±SD (n=40)	
Performance	2.6		7		4.6±1.1	
Satisfaction	2.4		7		4.5±1	

NHPT: Nine hole peg test; MHQ: Michigan hand outcome questionnaire; COPM:Canadian Occupational performance measure; SD: Standart deviation

Activity Participation Performance: Canadian Occupation Performance Measure (COPM)

The COPM was used to evaluate activity performance and participation limitations. The COPM identifies the daily living activities performance and changes in the perception of patient satisfaction. It is a patient - centred, self - reported test that examines the patient’s perception of performance and satisfaction changes over time. It is used for both children and adults. The COPM includes 3 areas of occupational performance: self - care, productivity, and leisure. Participants are encouraged to define their daily living activities in these three areas which they have satisfaction and performance problems. Each activity includes three problems. The respondent scores each activity from 1 to 10 (1 least important, 10 most important), then determines the 5 most important and least important problems. The 5 most important activities are scored from 1 to 10 for performance and satisfaction, where 1 = impossible to perform and 10 = able to perform easily and with pleasure. Thus, the participants report their own opinion of performance and satisfaction. These performance and satisfaction scores are totalled and divided by the number of activities to give a total performance and satisfaction score. If the number of determined activities is less than 5, the total score is divided by only the number of determined activities.^[12]

Statistical Analysis

The statistical analysis was performed by SPSS version 20.0 (SPSS Inc, Chicago, Illinois, USA). Pearson Correlation coefficient were used to demonstrate relationship between variables. Descriptive statistics mean (\pm) standard deviation ($x \pm SD$) nominal variables the number of cases (n) and percent (%) are presented. The Pearson method were used to study correlations between different variables. In all statistical analyses, $p < 0.05$ was regarded as significant.

Results

The study included 34 females (85%) and 6 males (15%) with a mean age of 50.7 ± 9.9 years. The demographic data of the patients are shown in Table 1.

The pain score, gross and fine grip strength, hand functions and activity participation performance scores are shown in Table 2. In the assessment of activity performance limitations, a total of 43 problem activities were determined, including 13 activity problems in the self-care area, 23 in productivity and 11 in leisure. The most common problem activities in the self-care area were bathing (19.5%), standing (13%) and climbing stairs (8.6%), in the productivity area, these were cutting (20.7%), tidying a room (15.09%) and cleaning (9.4%), and in the leisure area, sightseeing

with friends (39.4%) and gardening (18.4%).

A statistically significant negative correlation was determined between pain and the MHQ ($p = 0.03$ $r = -0.464$) and COPM (pCOPM performance: 0.08 $r = -0.411$), (pCOPM satisfaction: 0.06 $r = -0.424$). No correlation was determined between pain and grip strength and NHPT ($p > 0.05$) (Table 3).

A statistically significant negative correlation was determined between NHPT and COPM performance ($p = 0.016$, $r = -0.378$) and satisfaction ($p = 0.013$, $r = -0.391$). Also A statistically significant positive correlation was determined between MHQ and COPM performance ($p = 0.00$, $r = 0.574$) and satisfaction ($p = 0.00$, $r = 0.638$). No correlation was determined between hand grip strength and the COPM (Table 4).

Discussion

The results of this study have shown that pain and inadequacy of hand function influence the performance of activity participation in RA individuals. So we think pain could be one of the major problems that created functional limitation in patients with RA, and this affected individuals' participation in activities negatively. Also the results demonstrated that patients stated that pain affected hand functions and activity participation performance and that due to the pain, the patients were restricted in domestic and outdoor activities, although they continued in their functional role despite the pain.

Sufficient muscle strength is required for a hand to be functional. According to a study by Bohannon et al.^[13] of

Table 3. Relation between Pain and Hand grip strength, NHPT, MHQ and COPM of RA patients

	Pain	
	p*	r
Hand grip strenght (kg)	.690	-.065
Pinch grip strenght (kg)	.776	.053
Tip grip strenght (kg)	.973	.006
Lateral grip strenght (kg)	.367	-.140
Nine hole peg test	.426	.129
Michigan overall hand func.	.001*	-.490
Michigan ADL	.001*	-.509
Michigan Work	.005*	-.434
Michigan Pain	.000*	-.589
Michigan Aesthetic	.398	-.137
Michigan Satisfaction	.006*	-.425
MHQ total point	.003*	-.464
COPM Performance	.008*	-.411
COPM Satisfaction	.006*	-.424

*Pearson Correlation; NHPT: Nine hole peg test; MHQ: Michigan hand outcome questionnaire; COPM: Canadian Occupational performance measure; ADL: Activities daily living.

Table 4. Relation between COPM and Hand grip strength, NHPT, MHQ

	COPM			
	COPM performance		COPM satisfaction	
	p*	r	p*	r
Hand grip strenght	.277	.176	.435	.127
Pinch grip strenght (kg)	.452	.122	.480	.115
Tip grip strenght	.146	.234	.168	.223
Lateral grip strenght	.071	.289	.100	.264
Nine hole peg test	.016*	-.378	.013*	-.391
Michigan overall hand func.	.003*	.453	.001**	.506
Michigan ADL	.000*	.651	.000**	.658
Michigan Work	.000*	.655	.000**	.665
Michigan Pain	.000*	-.727	.000**	-.648
Michigan Aesthetic	.335	.156	.107	.259
Michigan Satisfaction	.000*	.575	.000**	.598
MHQ total point	.000*	.574	.000**	.638

*Pearson Correlation; NHPT: Nine hole peg test; MHQ: Michigan hand outcome questionnaire; COPM:Canadian Occupational performance measure; ADL: Activities daily living.

the standardization of grip strength, the grip strength of the patients in the current study were seen to be negatively affected. Dedeoglu et al.^[14] measured maximum grip strength and fine grip strength and achieved similar results. In comparative studies with healthy subjects, RA patients have also been reported to have decreased grip force.^[15,16] We do not think that the grip strength of the RA individuals we evaluated in the presence of our control group is not very high. We think that depending on the pain, the muscular strength due to not being used due to the activity of the people is decreased.

Dexterity tests are important scales for the evaluation of hand functions. NHPT was selected for this study as it is simple to apply, quick and includes normative values for healthy individuals and has been previously used for RA patients.^[10,17] When the test duration was compared with the healthy person standardization studies, it was determined that the patients in the current study had longer test durations and hand functions were affected in terms of dexterity.^[10] The duration of the completion of the NHP test is also indicative of a deterioration in hand function of patients with RA.

There are many questionnaires for the assessment of hand functions in RA patients.^[18-25] The MHQ was used in the current study, as reliability and validity studies have previously been conducted for Turkey.^[11] The MHQ is the first approved, self-reported scale which includes information on functionality, activity of daily living, pain and aesthetic concerns.^[26] The MHQ has been used extensively in literature to assess hand functions of RA patients and evaluation results indicate that these patients have insufficient hand functions.^[27-30]

A significant relationship was determined between all the subtests of MHQ except aesthetics and the total score of COPM performance and satisfaction score. This result suggested that hand skills, pain and working difficulties directly affect and restrict activity participation performance. It is possible that even this evaluation method can be used to give an idea about pain, functionality and activity participation by analyzing the sub-tests in detail by this questionnaire evaluation. It has been suggested to us that aesthetic distress is not a very important factor for our population. The result of our study also showed that the relationship of MHQ in pain and activity participation performance was significant. This situation think that the pain may affect the hand functions and accordingly the activity participation performance of the person may decrease.

In previous studies in literature evaluating the affected hand functions of RA patients and limitations of activity participation, in a study of 105 RA patients by Bodur et al.,^[31] changes in hand functions were found to affect activity participation performance. A 5 - year resrospective study of 189 RA patients by Bjork et al.^[32] showed that hand functions cause activity restriction. Delhag and Burckhardt at reported that RA hand functions cause ADL limitations and Dedeoglu at al concluded that affected hand functions in RA lead to ADL restrictions.^[3,14]

In our study, a statistically significant negative correlation was determined between the intensity of pain and activity participation performance and satisfaction. This result showed that pain could be major problem restricting the participation of patients in activities. Patients reported experiencing difficulties in activities such as bathing, standing and walking in the

self-care area, cutting, tidying a room and cleaning in the productivity area, and sightseeing with friends, gardening and praying in the leisure area. Many patients pointed out that they suffered from pain but at the same time were obliged to carry out tasks such as housework or employment activities. They stated that they performed the activities in spite of the pain but they could not perform the activity as they wished and were restricted. As the patients in the current study were mostly housewives, the problems encountered in housework were investigated. The interview determined problems in daily life, for which solutions were offered by the occupational therapy department.

No relationship was determined between grip strength and COPM performance. In a study by Figueiredo et al.^[33] of 42 hand - injured patients, a low - level relationship was determined between grip strength and COPM and it was argued that grip strength may not be important as previously thought and other factors could have an effect on activity participation performance.

This work has some limitations. First, the duration of illness among RA individuals was not considered to be in sight. The second and most important limitation is the absence of the control group.

Conclusion

The result of this study shows that pain can affect hand functions and activity participation performance. And also we think that the most important problem could be pain and therefore hand functionality was reduced in activities of daily living, which indirectly led to diminished activity participation performance indirectly.

Disclosures

Ethics Committee Approval: The study was approved by Pamukkale University Noninvasive Research Ethical Committee, and meets the ethical standards of the Declaration of Helsinki.

Financing: This article was supported by Pamukkale University Scientific Research Projects Coordination Unit. (Project No: 2014SBE004)

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

References

1. Minnock P, FitzGerald O, Bresnihan B. Women with established rheumatoid arthritis perceive pain as the predominant impairment of health status. *Rheumatology (Oxford)* 2003;42:995–1000.
2. Mathiesen FK, Rasmussen JO, Recht L, Lithman T. Impairment of grip function in rheumatoid arthritis-studies with a simple hand test. *Scand J Rheumatol* 1991;20:209–12.
3. Dellhag B, Burckhardt CS. Predictors of hand function in patients with rheumatoid arthritis. *Arthritis Care Res* 1995;8:16–20.
4. Häkkinen A, Kautiainen H, Hannonen P, Ylinen J, Mäkinen H, Sokka T. Muscle strength, pain, and disease activity explain individual subdimensions of the Health Assessment Questionnaire disability index, especially in women with rheumatoid arthritis. *Ann Rheum Dis* 2006;65:30–4.
5. Katz PP. The impact of rheumatoid arthritis on life activities. *Arthritis Care Res* 1995;8:272–8.
6. Salaffi F, Stancati A. Disability and quality of life of patients with rheumatoid arthritis: assessment and perspectives [Article in Italian]. *Reumatismo* 2004;56:87–106.
7. Bansback N, Zhang W, Walsh D, Kiely P, Williams R, Guh D, et al. Factors associated with absenteeism, presenteeism and activity impairment in patients in the first years of RA. *Rheumatology (Oxford)* 2012;51:375–84.
8. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO, et al. 2010 Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Arthritis Rheum* 2010;62:2569–81.
9. Jensen MP, Chen C, Brugger AM. Interpretation of visual analog scale ratings and change scores: a reanalysis of two clinical trials of postoperative pain. *J Pain* 2003;4:407–14.
10. Mathiowetz V, Weber K, Kashman N, Volland G. Adult norms for nine hole peg test of finger dexterity. *The Occup Ther J Res* 1985;5:25–38.
11. Öksüz Ç, Akel BS, Oskay D, Leblebicioğlu G, Hayran KM. Cross-cultural adaptation, validation, and reliability process of the Michigan Hand Outcomes Questionnaire in a Turkish population. *J Hand Surg Am* 2011;36:486–92.
12. Law M, Baptiste S, McColl M, Opzoomer A, Polatajko H, Pollock N. The Canadian occupational performance measure: an outcome measure for occupational therapy. *Can J Occup Ther* 1990;57:82–7.
13. Bohannon RW, Olsson A, Westropp NM. Reference values for adult grip strength measured with a Jamar dynamometer: a descriptive meta-analysis. *Lehman Physiotherapy* 2006;96:11–5.
14. Dedeoğlu M, Gafuroğlu Ü, Yılmaz Ö, Bodur H. The relationship between handgrip and pinch strengths and disease activity, articular damage, pain, and disability in patients with Rheumatoid Arthritis. *Turk J Rheumatol* 2013;28:69–77.
15. Walker PS, Davidson W, Erkman MJ. An apparatus to assess function of the hand. *J Hand Surg Am* 1978;3:189–93.
16. Jones AR, Unsworth A, Haslock I. A microcomputer controlled hand assessment system used for clinical measurement. *Eng Med* 1985;14:191–8.
17. Backman C, Cork S, Gibson G, Parsons J. Assessment of hand

- function: The relationship between pegboard dexterity and applied dexterity. *Can J Occup Ther* 1992;59:208–13.
18. Carthum CJ, Clawson DK, Decker JL. Functional assessment of the rheumatoid hand. *Am J Occup Ther* 1969;23:122–5.
 19. Keitel W, Hoffmann H, Weber G, Krieger U. Evaluation of the percentage of functional decrease of the joints using a motor function test in rheumatology [Article in German]. *Dtsch Gesundheitsw* 1971;26:1901–3.
 20. Kapandji A. Clinical test of apposition and counter-apposition of the thumb [Article in French]. *Ann Chir Main* 1986;5:67–73.
 21. Treuhaft PS, Lewis MR, McCarty DJ. A rapid method for evaluating the structure and function of the rheumatoid hand. *Arthritis Rheum* 1971;14:75–86.
 22. MacBain KP. Assessment of function in the rheumatoid hand. *Can J Occup Ther* 1970;37:95–103.
 23. Jebsen RH, Taylor N, Trieschmann RB, Trotter MJ, Howard LA. An objective and standardized test of hand function. *Arch Phys Med Rehabil* 1969;50:311–9.
 24. Neville C, Whalley D, McKenna S, Le Comte M, Fortin PR. Adaptation and validation of the rheumatoid arthritis quality of life scale for use in Canada. *J Rheumatol* 2001;28:1505–10.
 25. Duruöz MT, Poiraudreau S, Fermanian J, Menkes CJ, Amor B, Dougados M, et al. Development and validation of a rheumatoid hand functional disability scale that assesses functional handicap. *J Rheumatol* 1996;23:1167–72.
 26. Waljee JF, Chung KC, Kim HM, Burns PB, Burke FD, Wilgis EF, et al. Validity and responsiveness of the Michigan Hand Questionnaire in patients with rheumatoid arthritis: a multicenter, international study. *Arthritis Care Res (Hoboken)* 2010;62:1569–77.
 27. Taştekin N, Uzunca K, Birtane M. Romatoid Artrit'li Hastalarda, El Eklemlerindeki Hareket Açıklığı ve El Kavrama Kuvvetlerinin Hastalık Aktivasyonu, El Fonksiyonları ve Özürlülük ile ilişkisi. *Romatizma* 2006;21:13–17.
 28. Alderman AK, Arora AS, Kuhn L, Wei Y, Chung KC. An analysis of women's and men's surgical priorities and willingness to have rheumatoid hand surgery. *J Hand Surg Am* 2006;31:1447–53.
 29. Chung KC, Kotsis SV, Kim HM, Burke FD, Wilgis EF. Reasons why rheumatoid arthritis patients seek surgical treatment for hand deformities. *J Hand Surg Am* 2006;31:289–94.
 30. Chung KC, Squitieri L, Kim HM. Comparative outcomes study using the volar locking plating system for distal radius fractures in both young adults and adults older than 60 years. *J Hand Surg Am* 2008;33:809–19.
 31. Bodur H, Yilmaz O, Keskin D. Hand disability and related variables in patients with rheumatoid arthritis. *Rheumatol Int* 2006;26:541–4.
 32. Björk MA, Thyberg IS, Skogh T, Gerdle BU. Hand function and activity limitation according to health assessment questionnaire in patients with rheumatoid arthritis and healthy referents: 5-year followup of predictors of activity limitation (The Swedish TIRA Project). *J Rheumatol* 2007;34:296–302.
 33. Figueiredo IM, Sampaio RF, Mancini MC, Nascimento. Functional gains and their relationship with functional components among workers with hand injuries. *Brazilian Journal of Physical Therapy* 2006;10:421–7.