Hand function and adaptive equipment use in patients with rheumatoid arthritis

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ABSTRACT

Objectives: Evaluation and characterization of hand function in patients with rheumatoid arthritis (RA) and, secondarily, identification of the use of adaptive equipments.

Material and methods: Firstly, a written informed consent was obtained and then an anonymous questionnaire was filled by RA outpatients observed at the rheumatology consultation. Those with no other musculoskeletal or neuromuscular disorders that would determine major functional impairment of hand function were included. Sociodemographic and clinical variables were collected and the Cochin Hand Functional Scale (CHFS) was applied. Classical deformities of hand and/or wrist were observed and recorded by the attending physician.

Results: A total of 79 patients were enrolled. In the overall sample, most patients were female (69.60%), with a mean age of 59.72 ± 11.77 years and with a mean diagnosis duration of 11.72 ± 8.29 years. The majority (73.40%) had at least one hand or wrist deformity, the most frequent being atrophy of the interosseous muscles, followed by ulnar deviation of the metacarpophalangeal joints and piano key deformity of the wrist. The mean CHFS score was 17.94 ± 18.26 points with a minimum and maximum value recorded of 0 and 80 points, respectively. The presence of hand deformities, Health Assessment Questionnaire score (HAQ), hand pain and diagnosis duration were correlated with the CHFS score. Six patients had assistive devices and only in one case it was used to overcome hand's functional impairment.

Conclusions: Most patients presented at least one classic RA deformity after a mean diagnosis duration of approximately 12 years and under pharmacological treatment. Despite this, most patients scored significantly below CHFS maximum score, but only 18 reported no difficulty in any of the tasks mentioned in the scale. The fact that only a minority of these patients had assistive devices should alert us to the need for a more thorough functional assessment and identification of needs among RA patients.

Keywords: Rheumatoid arthritis; Adaptive equipment; Hand function.

INTRODUCTION

Rheumatoid arthritis (RA) is an autoimmune systemic disease where joint involvement predominates. It's characterized by persistent, progressive, additive and symmetrical inflammatory synovitis, pain, morning stiffness, joint edema, range of motion (ROM) limitation and muscular atrophy[1-5]. Clinical spectrum is broad and ranges from mild non-erosive disease to severe inflammation with irreversible cartilage damage, joint destruction and extra-articular manifestations, which may result in the development of important deformities[2,6]. Of all potentially affected joints, hand and wrist are most often involved resulting in functional impairment[1,4-9]. These joints may be affected at an early stage with installation of deformities in the first two years[6,5] or even in the first year of illness[10].

Classically, RA may result in the development of deformities of the wrist (piano key deformation, dropped wrist), metacarpophalangeal joints (MCP) (volar subluxation), fingers (swan neck deformity, boutonnière deformity, mallet finger) and thumb (Z-thumb, thumb adductus)[1].

Although there is evidence that more than 90% of patients have articular involvement of the hand[11], its severity will be lower nowadays since the appearance of more effective therapies[1]. Indeed, more recent studies[5,8,9] report smaller percentages of hand deformities.

Patients frequently describe difficulty in performing

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activities of daily living (ADL) which may result from deformities, pain, ROM deficits, decreased muscle strength or fatigue of the upper limbs[11]. Given that hand function is an essential factor impacting quality of life[8], its assessment is important in the approach of these patients, helping in the evaluation of treatment response and the need for strengthening or establishing non-pharmacological strategies, namely adaptive equipment (AE) and joint protection strategies.

The aim of this study was to characterize hand function in RA patients and, secondarily, to identify the use of AE in order to overcome the reported difficulties.

MATERIAL AND METHODS

This was an observational, cross-sectional and analytical study. Participants were consecutively recruited by their rheumatologist between August and October 2018, during routine clinical consultations. Inclusion criteria were defined as adult patients (≥18 years) with RA diagnosis, according to 2010 ACR/EULAR RA criteria. Those with another musculoskeletal or neuromuscular disorder that would determined an important functional impairment of the hand were excluded based on expert opinion. Patients with RA and concomitant hand OA were included. One patient with amputation of middle finger was excluded.

Firstly, a written informed consent was obtained and then an anonymous questionnaire was filled by RA outpatients after observation at the rheumatology consultation. Patients answered the questionnaires without clinician's intervention and clinical data were collected afterwards and independently. Patient's data collection was done by at least two independent investigators and statistical analysis was conducted by independent investigators.

VARIABLES DEFINITIONS

Sociodemographic (age, gender, education level, employment status) and clinical data [positivity for rheumatoid factor (RF) and / or cyclic citrullinated peptides antibodies (anti-CCP); disease activity; disability status; current medication and its start date; symptoms duration, RA diagnosis duration and time interval between symptoms and diagnosis] were collected. Disability status was measured by the Health Assessment Questionnaire (HAQ) - this score classifies disability status as low disability (0 to ≤ 1), moderate disability (> 1 to ≤ 2) and high disability (> 2 to 3).[12] Disease activity was assessed by 28-joint Disease Activity Score with four variables (DAS28 4v). This score classifies disease activity as remission (≤ 2.6), low disease activity (> 2.6 to ≤ 3.2), moderate disease activity (> 3.2 to ≤ 5.1) and high disease activity (>5.1).[13]

Hand function was assessed using Cochin Hand Functional Scale (CHFS)[14]. This instrument consists of 18 questions related to the performance of daily activities in the last month to which patients respond using a Likert scale from 0 ("no difficulty") to 5 ("impossible"). Total score varies between 0 (without any functional compromise) and 90 (maximum disability) points. Its reliability and viability have been demonstrated in patients with RA, osteoarthritis and systemic sclerosis[15]. Since it was not validated for the portuguese population, the validated brazilian version[16] was adopted.

The questionnaire also included questions on patients' handedness, morning stiffness (in minutes), hand pain in the last month [numerical scale from 0 (no pain) to 10 (maximum pain)] and use of AE. The deformities observed in each hand (hand interosseous atrophy, radial wrist deviation, piano key deformity, dropped wrist, MCP ulnar deviation, MCP volar subluxation, Z thumb, thumb adductus, swan neck deformity, boutonnière deformity, mallet finger) were recorded by the attending physician. The presence of stigmas of osteoarthritis (OA) was also recorded to evaluate its importance as a possible confounding variable. The variable "presence of any wrist or hand deformity" and "thumb deformities" (which included Z thumb and/or thumb adductus deformity) were created to facilitate statistical analysis.

STATISTICAL METHODS

Categorical variables are presented as frequencies and percentages and continuous variables as means and standard deviations (SD) or medians and interquartile ranges for variables with skewed distributions. Normal distribution was checked using Shapiro-Wilk test or skewness and kurtosis. Categorical and continuous variables were compared with the use of Student's t-test. Pearson's correlation coefficient (r) and its non-parametric equivalent Spearman's coefficient (ρ) were used to assess the strength and direction of the linear relationships between pairs of variables. Correlation coefficient values were interpreted as it follows: 0.90 to 1.00 (-0.90 to -1.00): very high positive (negative) correlation; 0.70 to 0.90 (-0.70 to -0.90): high positive (negative) correlation; 0.50 to 0.70 (-0.50 to

-0.70): moderate positive (negative) correlation; 0.30 to 0.50 (-0.30 to -0.50): low positive (negative) correlation; 0.00 to 0.30 (-0.00 to -0.30): negligible correlation.[17] Multiple linear regression was used to determine predictors of CHFS score and to adjust for confounding variables with analysis of covariance. Age, duration of symptoms, date of diagnosis, pain, morning stiffness, DAS28 4v and HAQ scores, dominant hand involvement, presence of any deformity and thumb deformities were included as covariates. All reported p-value are two-tailed, with a p-value < 0.05 indicating statistical significance. All analyses were weighted and performed using Statistical Package for the Social Sciences (SPSS) software version 23.

RESULTS

RA POPULATION CHARACTERISTICS

A total of 79 patients were enrolled. Sociodemographic and clinical characteristics are described in more detail in Table I. Most patients were female (n = 55, 69.60%), right handed (n = 72, 91.10%), with a median age of 59.72 ± 11.77 years and with a mean diagnosis duration of 11.72 ± 8.29 years. Approximately 72% (n = 57) and 61% (n = 48) of patients were RF and anti-CCP positive, respectively. Non-biologic disease-modifying anti-rheumatic drugs (DMARDs) were the most commonly prescribed medications (n = 68, 60.80%). Median DAS28 4v score was 2.60 (IQR = 3.50-2.12) and mean HAQ score was 0.70 ± 0.66. Hand pain had a mean score of 3.37 ± 2.62 points and morning stiffness presented a median duration of 5 (0.00; 15.00) minutes (Table I).

DEFORMITIES OBSERVED

Seventy-three percent (n = 58) of patients presented at least one wrist or hand deformity, more frequently hand interosseous atrophy (n = 34, 17%), followed by MCP deviation (n = 24, 12%) and piano key deformity (n = 23, 12%) (Figure 1). Most of these patients presented with dominant hand deformities (n = 48, 62%) and 42% (n = 33) with thumb deformities. Eighty-four percent (n = 66) had OA stigmata, concomitantly (Figure 1).

HAND FUNCTION

The mean score obtained in the CHFS was 17.94 ± 18.25 points, with a minimum and maximum score

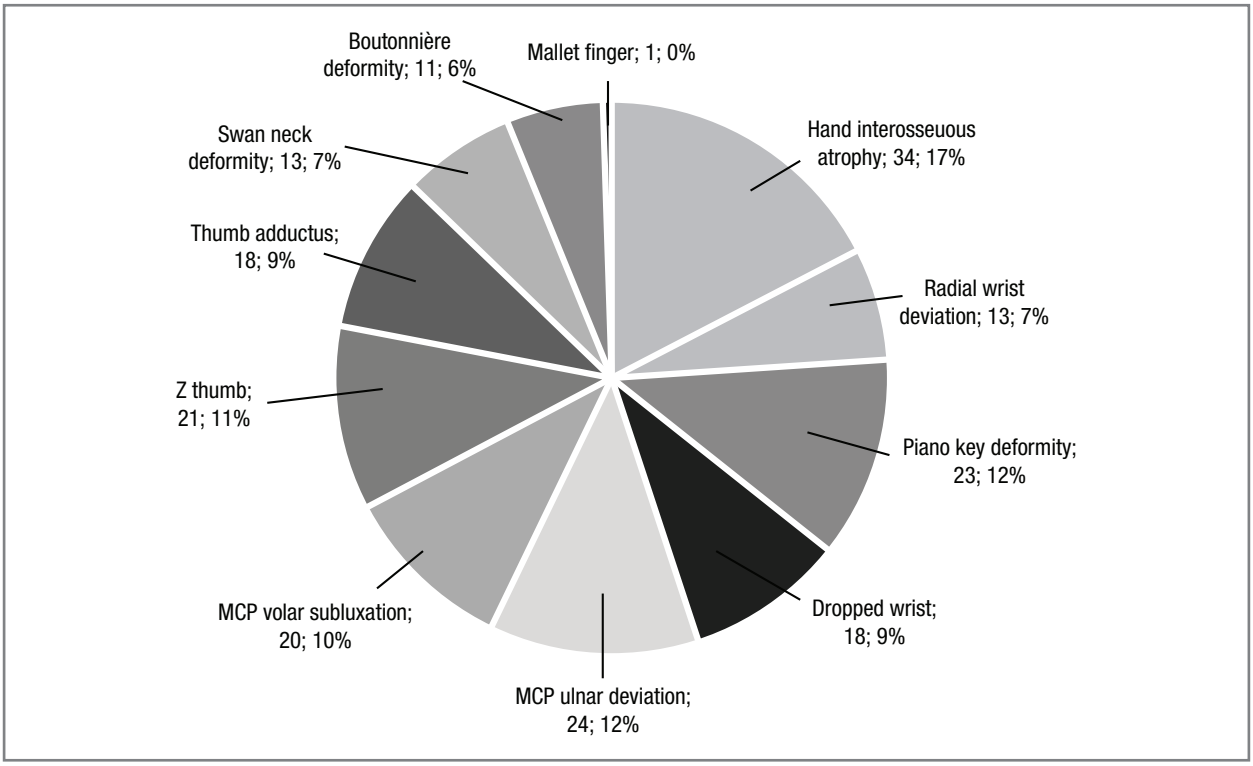

FIGURE 1. Distribution of wrist and hand deformities in the study population (n; %)

TABLE I. SOCIODEMOGRAPHIC AND CLINICAL CHARACTERISTICS OF RA PATIENTS

Male gender, n(%)	24 (30.40)
Age (mean±SD)	59.72 ± 11.77
Handedness, n(%)	
right hand	72 (91.10%)
left hand	3 (3.80%)
missing	4 (5.10%)
Education level, n(%)	
Illiteracy	5 (6.30)
Primary school	48 (60.80)
High school	18 (22.80)
Higher education	8 (10.10)
Employment status, n(%)	
Unemployed	7 (8.90)
Employed	22 (27.80)
Retired	48 (60.80)
Medical leave	1 (1.30)
Missing	1 (1.30)
Clinical characteristics	
Hand pain (mean±SD)	3.37 ± 2.62
Morning stiffness (minutes)	5 IQR 120
Symptoms duration (years, mean±SD)	15.22 ± 10.55
Diagnosis duration (years, mean±SD)	11.72 ± 8.29
Time interval between symptoms onset and RA diagnosis (years)	1 IQR 66
RF, n(%)	
positive	57 (72.20)
negative	21 (26.60)
missing	1 (1.30)
Anti-CCP, n(%)	
positive	48 (60.80)
negative	18 (22.80)
missing	13 (16.50)
Current medication, n(%)	
AINE	1 (1.30)
Corticóide	1 (1.30)
cDMARD	48 (60.80)
Associação cDMARDs	18 (22.80)

Anti-CCP: anti-cyclic citrullinated peptides antibodies, bDMARD: biological disease-modifying antirheumatic drugs, cDMARD: conventional disease-modifying antirheumatic drugs, DAS28 4v: 28 Joint Disease Activity Scale with four variables, RF: rheumatoid factor, HAQ: Health Assessment Questionnaire, IQR: interquartile range, SD: standard deviation

recorded of 0 and 80 points, respectively. Of the 79 patients only 18 had a minimum score of 0 points, meaning that the remaining 61 presented some degree of functional impairment in at least one of the tasks mentioned in the scale.

The most frequently questions classified with some degree of difficulty were questions number 9 - "Can you button your shirt?" (n = 53, 7.49%), number 15 - "Can you turn around door knob?" (n = 48, 6.78%) and number 6 - "Can you cut meat with a knife?" (n = 46, 6.50%). These same questions plus question 14 - "Can you write a letter with an ordinary pen?" being associated with at least "much difficulty" (grade 3). The degree of difficulty most frequently reported was grade 2, corresponding to "some difficulty".

With respect to the use of AE, only 6 patients reported using some utensil to assist in ADL. One patient did not specify the type of utensil used and only in one case it was specifically intended to compensate for hand impairment (cutlery with wide handle). These 6 patients were not those with the highest scores on CHFS (Table II).

CO-VARIABLES AND HAND FUNCTION

Data from the analysis performed are described in more detail in Table III. The variables age ($p = 0.034$, $r = 0.240$), symptoms duration ($p = 0.015$, $r = 0.275$), date of diagnosis ($p = 0.03$, $r = 0.246$), pain ($p < 0.001$, $r = 0.468$), morning stiffness ($p < 0.001$, $\rho = 0.399$), DAS28 4v score ($p = 0.001$, $\rho = 0.382$) and HAQ score ($p < 0.001$, $r = 0.618$) were positively correlated with the CHFS score. Most of these correlations were weak, with the exception of the HAQ score which presented a moderate correlation. Time interval between symptoms onset and RA diagnosis ($p = 0.234$) and duration of current therapy ($p = 0.160$) were not correlated with hand function.

There were significant differences between the presence of any wrist or hand deformity ($\mu = 21.76 \pm 18.97$ *vs* $\mu = 7.38 \pm 10.74$, $p = 0.002$), thumb deformities ($\mu = 23.33 \pm 19.67$ *vs* $\mu = 14.07 \pm 16.31$, $p = 0.025$), dominant hand involvement ($\mu = 24.25 \pm 19.40$ *vs* $\mu = 10.44 \pm 11.51$, $p = 0.044$) and hand function. Considering each deformity individually, hand interosseous atrophy ($p < 0.001$), dropped wrist ($p = 0.009$), ulnar deviation of MCP ($p = 0.001$), subluxation of MCP ($p < 0.001$) and Z-thumb ($p = 0.018$) were associated with a higher score in CHFS and therefore with greater functional compromise, contrary to the presence of piano key deformity ($p = 0.763$), radial wrist deviation ($p = 0.307$), mallet finger ($p = 0.098$), swan neck deformity ($p = 0.307$), boutonnière deformity ($p = 0.389$) and

TABLE II. ASSISTIVE DEVICES MENTIONED BY RA PATIENTS

	AD	CHFS score	Deformities	Marked items
Patient 1	Shoehorn	0	Non-dominant hand interosseous atrophy	–
Patient 2	Cutlery with wide handle	6	Dominant hand interosseous atrophy, radial wrist deviation, piano key deformity, MCP ulnar deviation	Q5, Q6, Q15, Q17, Q18
Patient 3	Bath chair, grab bar	27	Non-dominant hand MCP ulnar deviation and swan neck deformity; bilateral radial wrist deviation	Q1-Q18
Patient 4	Shoehorn	24	Bilateral MCP ulnar deviation and hand interosseous atrophy; dominant hand Z thumb	Q1, Q3, Q4, Q5, Q8, Q9, Q11, Q14, Q16-Q18
Patient 5	Bath chair	1	none	Q15
Patient 6	–	34	none	Q1-Q18

AD: assistive device, CHFS: Cochin Hand Function Scale, MCP: metacarpophalangeal joints, Q: question

thumb adductus (p = 0.208). There were no differences between function and gender (p = 0.555), current therapy (p = 0.121), RF (p = 0.938), anti-CCP (p = 0.702) and OA (p = 0.116) (Table III).

Regarding the predictor variables of the CHFS score, a multiple linear regression model was created. This model explained approximately 52% (adjusted R2 = 0.516) of variation in the CHFS. Only RA diagnosis duration (p = 0.039), pain (p = 0.012), HAQ score (p = 0.011) and deformities (p= 0.030) showed a statistically significant association with CHFS score (Table IV). Interestingly, a recent diagnosis was associated with a higher score on the scale and hence reflecting a worse functional performance. Note that the fact that the variable "presence of any wrist or hand deformity" is also associated with a negative B coefficient is related to the previous coding of this categorical variable (0 = "with deformity", 1 = "no deformity"); thus, lower values of the variable are associated with joint involvement and a higher score in CHFS and therefore with a greater functional compromise. Hand and wrist deformities (B = -10.82) and the HAQ score (B = 10.68) were the most predominant variables followed by reported hand pain (B = 2.56) (Table IV).

DISCUSSION

In our population, with a mean diagnosis duration of approximately 12 years, 73% of the patients showed at least one deformity classically attributed to RA: the most frequent was hand interosseous atrophy, followed by MCP deviation and piano key deformity. Horsten *et al.*[5] verified a similar prevalence (70% in the dominant hand and 66% in the non-dominant hand) in a sample of 200 RA patients after 2-4 years of disease duration. In another study[8] including 116 RA patients with an average of 11 years of disease evolution, prevalence of deformities was around 20%, with swan neck, Z thumb, mallet finger and boutonnière deformities being the most frequently observed. Johnsson *et al.*[9] verified the presence of at least one deformity in 59% of the 108 patients observed after 10 years of disease; in this study, the most common deformity was MCP ulnar deviation, followed by boutonnière and swan neck deformities.

The majority of patients showed deformities in the dominant hand accordingly to another study[5] and 42% had thumb deformities, being this value below others reported in the literature[16].

The mean score obtained in the CHFS was approximately 18 points which is far below the maximum score of the instrument. This may be related to the low activity of the disease reported (according to DAS28 4v mean score) and the high mean disease duration, allowing the adoption of strategies by the patient to overcome the difficulties experienced[5,11]. However, it should be noted that only 18 patients didn't refer any difficulty in performing the mentioned tasks. Also, it were not those with the highest functional impairment who reported the use of AE. It is possible that those who had some kind of AE reported less functional im-

TABLE III. STUDY VARIABLES AND CHFS SCORE ANALISYS

Correlation coefficients		
Variable	**p-value**	**Correlation coefficient**
Age	0.034	r = 0.240
Duration of symptoms	0.015	r = 0.275
Diagnosis duration	0.030	r = 0.246
Time interval between symptoms onset and RA diagnosis	0.234	ρ = 0.137
Hand pain	<0.001	r = 0.468
Matinal stiffness	<0.001	ρ = 0.399
Current medication (years)	0.160	r = 0.161
DAS-28 4v	0.001	ρ = 0.382
HAQ	<0.001	r = 0.618
Student's t-test		
Variable		**p-value**
Gender		0.555
Current medication		0.121
RF		0.938
Anti-CCP		0.702
Any wrist or hand deformity		0.002
Radial wrist deviation		0.136
Piano key deformity		0.763
Dropped wrist		0.009
Hand interosseous atrophy		<0.001
MCP ulnar deviation		0.001
MCP volar subluxation		<0.001
Z thumb		0.018
Thumb adductus		0.208
Any thumb deformity		0.025
Mallet finger		0.098
Swan neck deformity		0.307
Boutonnière deformity		0.389
Dominant hand deformities		0.044
Hand OA		0.116

Anti-CCP: anti-cyclic citrullinated peptides antibodies, DAS28 4v: 28 Joint Disease Activity Scale with four variables, HAQ: Health Assessment Questionnaire, RF: Rheumatoid factor, MCP: metacarpophalangeal joints, OA: osteoarthritis

pairment, hence scoring less in CHFS. On the other hand, it reflects the insufficient prescription of adaptive utensils among these patients. In addition, the tasks most often indicated as being associated with at least some difficulty (buttoning a shirt, turning a round door knob and cutting meat with a knife) are tasks for which there are utensils that can facilitate their execution. AE not only facilitate daily tasks execution but also prevent the development of deformities and may delay its progression.

Other similar studies[8,9] showed a negative impact of hand and wrist deformities on ADL and prognostic value, since they were an early sign of severe disease. Bjork M *et al.*[19] prospectively evaluated 276 RA patients during the first three years of disease and found a significant deterioration in hand function which stabilized, albeit at a compromised level, after 3 months; the vast majority had DMARDs prescribed. Conversely, Adams J *et al.*[6] found a weak correlation between MCP ulnar deviation and hand function given by Disability of the Arm, Shoulder and Hand (DASH) score; the same was not true for grip strength. None of these studies took into account hand interosseous atrophy or used the CHFS. Different tests were applied for functional evaluation, namely DASH, Signals of Functional Impairment (SOFI), Grip Ability Test (GAT), range of motion, key grip, ball grasp, pen grasp, pinch grip and handgrip strength.

Older patients, longer diagnosis, higher pain, longer morning stiffness, higher DAS28 4v score and higher HAQ score were associated with a greater functional compromise. A positive correlation between disease activity assessed by DAS28 4v and hand function was also verified by Romero-Guzmán A *et al.*[20] In turn, Eberhardt K *et al.*[10] found a weak correlation between these two variables and showed a significant correlation between HAQ score and hand function, such as Dellhag B *et al.*[11] In this latter study, stiffness and grip strength were a strong negative predictor of subjective assessment of hand function.

In our study, patients with at least one wrist or hand deformity, thumb deformity and/or dominant hand involvement presented greater functional deterioration. Considering each deformity, hand interosseous atrophy, dropped wrist, MCP lesion and Z-thumb were those associated with a greater functional compromise. It has been demonstrated that, given the crucial role of the thumb in hand's functional performance, its involvement in RA is associated with a deterioration of manual dexterity, functional performance and with a decrease in quality of life[16], similar to what occurs in the presence of MCP e IFP joint limitations due to prehension and fine motricity impairment.[11] Among these variables, the presence of any wrist or hand deformity, HAQ score, pain and diagnosis duration were predictors of hand function with the first two being associat-

TABLE IV. MULTIPLE LINEAR REGRESSION FOR PREDICTOR VARIABLES OF CHFS SCORE VARIABILITY

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model	B	Std. Error	Beta		
(Constant)	-10.507	11,169		0.941	0.352
Age	0.282	0.170	0.173	1.664	0.103
Symptom duration	0.706	0.382	0.375	1.849	0.071
Diagnosis duration	-0.864	0.407	0.389	-2.124	0.039
Hand pain	2.555	0.970	0.363	2.632	0.012
Matinal stiffness	-0.194	0.119	0.213	-1.627	0.111
DAS28 4v	-0.378	2.098	0.022	-0.180	0.858
HAQ	10.681	4.045	0.384	2.641	0.011
Dominant hand deformities	-0.001	0.014	-0.009	-0.091	0.928
Any wrist or hand deformity	-10.818	4.840	-0.246	-2.235	0.030
Any thumb deformity	2.865	4.237	0.076	0.676	0.502

DAS28: 28 Joint Disease Activity Scale with four variables, HAQ: Health Assessment Questionnaire, Sig: significance, Std: standard

ed with a greater variation in the CHFS score. The fact that a recent diagnosis is associated with a greater functional compromise may be related to an insufficient time for patients to adapt to the new health condition, and for therapy optimization. It may also be a phase of poor pain control. In addition, this aspect is in agreement with the possibility of the appearance of deformities at an early stage of the disease, as already mentioned.

Gender, current medication and treatment duration, time interval between symptoms onset and RA diagnosis, the positivity for RF and/or anti-CCP antibody and the presence of OA stigmas did not influence hand function. Although early institution of targeted therapy is associated with a better prognosis and clinical remission is a realistic target with the currently available drugs[3,21], the functional impact of RA on pain and hand function are still significant nowadays[22] and may be associated with unpredictable progression of the disease[4].

Other variables not analysed in this study may be associated with functional compromise, namely wrist and hand ROM and grip strength[7,8,11,21,23]. This could explain the fact that our multiple linear regression model only explains about 52% of the CHFS score variation.

This study is not without limitations. Firstly, our sample is quite small and would be advisable to collect data from larger samples. Also, in this study only self-administered questionnaires regarding hand function were applied, and this can be regarded as a limitation since it may be subject to errors of interpretation and illiteracy, especially given the education level reported. The prevalence of concomitant hand OA in our sample was quite high (84%) and although hand function among patients with hand OA was not different from those without OA stigmas, it should not be underestimated given its potencial impact on hand function. In addition, it will be of future interest to evaluate other predictors of hand function such as grip strength and also wrist and hand ROM.

CONCLUSION

Most patients presented at least one classic RA deformity after a mean diagnosis duration of approximately 12 years. Additionally to wrist and hand deformities, HAQ score, reported pain and a recent diagnosis were associated with a greater deterioration of hand function. Most patients presented some degree of difficulty in at least one of the tasks they were questioned about. However, only one patient had an AE that was intended to specifically address hand's functional impairment.

Early and frequent assessment of hand function in RA patients, especially among those with deformities, high HAQ score and hand pain is important in order to identify their needs; only then is it possible to counsel and promptly refer these patients to prevent or minimize functional loss. Besides the prescription of appropriate AE, teaching joint protection and energy

conservation strategies as well as the institution of other modalities of conservative treatment are crucial in the management of RA patients.

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