



Original article

Relationship between individual radiographic findings and disability in rheumatoid arthritis

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ABSTRACT

Objective: To evaluate if the duration of disease influences the link between different radiographic specific features and disability in rheumatoid arthritis (RA) and the influence of disease duration on this relationship.

Methods: Conventional x-rays of both hands of 96 patients with RA were evaluated independently by 2 readers using Kayes' modification of the Sharp method. Disability was evaluated with the Spanish version of the HAQ questionnaire.

Results: The mean HAQ was 1.39 (0.79). The mean total radiographic score was 0.8 (18% of the maximum possible score). Total and joint space narrowing scores only displayed a statistically significant correlation ($r=0.33$, $r=0.37$, respectively, $P<.05$) with disability in the late RA group (>7 years). Erosion and misalignment scores were not correlated with HAQ. There was a statistically significant correlation between the eating, dressing, and reach HAQ-categories and the total radiographic score in the late RA group ($r=0.48$, $P<.001$; $r=0.42$, $P<.01$; $r=0.3$, $P<.05$, respectively).

Conclusion: This work suggests that HAQ disability and radiographic damage are only related in cases with late RA. In this group, the subtotal radiographic score most related with disability is the joint space narrowing score.

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Relación entre las distintas lesiones radiográficas y la discapacidad en la artritis reumatoide

RESUMEN

Objetivo: Analizar la relación entre la discapacidad y las distintas lesiones radiográficas en los pacientes con artritis reumatoide (AR) y la influencia del tiempo de evolución de la enfermedad.

Métodos: Se realizaron radiografías anteroposteriores de ambas manos a 96 pacientes con AR. Dos lectores efectuaron la lectura de forma independiente y utilizaron el método de Sharp modificado por Kaye. La discapacidad se evaluó mediante la versión española del HAQ (Health Assessment Questionnaire "Cuestionario de Evaluación de la Salud").

Resultados: El HAQ (media \pm desviación estándar) fue de $1,39 \pm 0,79$. La puntuación media del daño radiográfico total fue de 0,8 (el 18% de la puntuación máxima posible). La discapacidad sólo mostró una correlación estadísticamente significativa con la puntuación total ($r = 0,33$; $p < 0,05$) y con la puntuación para la pérdida del espacio articular ($r = 0,37$; $p < 0,05$) en los pacientes con AR tardía (más de 7 años de evolución). Las puntuaciones para erosiones y para la alteración del espacio articular no mostraron correlación.

Palabras clave:

Artritis reumatoide

Discapacidad

Cuestionario de Evaluación de la Salud

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significativa con la discapacidad. En la AR tardía se encontró una correlación estadísticamente significativa entre las categorías del HAQ correspondientes a comer ($r = 0,48$; $p < 0,001$), vestirse ($r = 0,42$; $p < 0,01$) y alcanzar ($r = 0,3$; $p < 0,05$) con la puntuación total del método de Kaye.

Conclusiones: En el presente trabajo la discapacidad evaluada mediante el HAQ sólo se relaciona con el daño radiográfico en los pacientes con AR tardía. En este grupo, la pérdida del espacio articular es el hallazgo radiográfico que más se relaciona con las discapacidad.

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Introduction

Rheumatoid arthritis (RA) is a disease characterized by chronic inflammation of the synovial membrane that can lead to joint destruction and the resulting loss of function. The evaluation of radiological damage and functional capacity are 2 essential variables when assessing the outcome of the disease. The HAQ (Health Assessment Questionnaire) is one of the most widely used instruments to evaluate the functional capacity of RA patients.¹ On the other hand, there are diverse methods to measure radiological damage.

The relationship between loss of function and radiological damage is weak, but increases as the disease progresses.² The separate study of the different radiological lesions such as alignment, joint space, and erosions provides added information when explaining the clinical situation to RA patients.³

The early loss of joint space is related to future loss of function⁴ in patients with recently diagnosed RA, even more than erosions.

The objective of this article is to evaluate through a transversal, exploratory trial, the relationship between the different radiological lesions and functional capacity, as well as the influence of disease progression on this relationship. The relationship between radiological damage and the degree of limitation for the performance of different daily tasks was analyzed.

Material and methods

Patients. Ninety-six patients diagnosed with RA according to the criteria proposed by the American College Rheumatology⁵ were included. Ten rheumatologists working in 10 separate clinics belonging to the public health network hospitals in Spain, participated in the study. Every rheumatologist included 10 consecutive patients from their clinics. Those with severe invalidating diseases concomitant to RA were excluded.

Loss of function. Every patient completed a Spanish version of the HAQ.⁶ This questionnaire has 20 items on activities of daily living grouped in 8 categories: dressing and hygiene, getting up, walking, cleaning themselves, reaching, pressure, and other activities. Each response is graded in a 4 point scale (0, 1, 2, 3). The final score is the result of calculating the mean of the highest obtained values in each one of the 8 categories. Its value is set between 0 and 3.

Assessment of radiological damage. An anteroposterior x-ray of both hands was performed in all patients. No special protocol was employed for performing them. Reading of the x-rays was carried out in a centralized and independent manner: 2 researchers (a radiologist and a rheumatologist) were the only ones in charge, and a mean score was obtained. In order to measure the radiological lesions, the Sharp method modified according to Kaye⁷ was employed. With this system, erosions, joint space and misalignment are separately assessed. Forty measurements are performed on each hand, 14 for the joint space evaluation, 11 for erosions, and 15 for misalignment (Figure). In order to score erosions and the reduction in joint space, predefined radiological patterns were available as examples of scores in the metacarpophalangeal and proximal interphalangeal joints. Scores were obtained using the following scales:

- Erosions. 0 = normal, 2 = mild erosion, 3 = moderate erosion, and 4 = extensive erosion or intervened joint.
- Reduction in joint space. 0 = normal, 2 = mild reduction, 3 = moderate reduction, 4 = important reduction, and 5 = ankylosis or intervened joint.
- Misalignment. 0 = normal, 2 = subluxation, and 4 = dislocation.

Joints which could not be evaluated due to any other motive were not included in the mean score calculation.

The total mean score was obtained through the calculation of the arithmetic mean of 40 individual measurements. Range was set

between 0 and 4.35. The mean scores for erosions (range, 0 to 4) were also obtained, as were the joint line (range, 0 to 5) and misalignment (range, 0-4).

To study the intraobserver agreement, reading of 30 consecutive x-rays, picked at random was repeated 3 months after the initial observation. The mean score obtained by both observers was obtained independently and the interclass correlation coefficient (ICC) was calculated (fixed effect model). In a similar way, interobserver variability was measured, but with individual readings of each observer for the 96 patients.

Statistical analysis. Data was analyzed using the SPSS 9.0 (Statistical Package For The Social Sciences) software package. The relationship between the radiological findings and the HAQ were studied calculating partial correlations through Spearman's ρ correlation test. Calculations were adjusted for age, time since onset of disease, and the rheumatoid factor titer.

Table 1
Demographic and clinical characteristics of the 96 patients

	Mean (SD)	Minimum-maximum
Age, mean (SD), y	56 (13)	26-79
Time since onset, y	9 (7.8)	0.3-40
ESR, mm	39.4 (25.7)	1-11
CRP, mg/L	19 (19.3)	1-77
TJC	16.1 (11.8)	0-48
SJC	7.8 (6.7)	0-26
Ritchie index	13.4 (10.2)	0-45
Pain. VAS, mm	44.5 (28.2)	0-99
HAQ	1.39 (0.79)	0-2.875

Abbreviations: CRP, C-reactive protein; ESR, erythrocyte sedimentation rate, HAQ, Health Assessment Questionnaire; SD, standard deviation; SJC, swollen joint count; TJC, tender joint count; VAS, visual analog scale.

Table 2
Radiological damage in the 96 patients included into the study

		Mean (SD)	Median (minimal; maximum)
Total ^a (0-4.35)	Score	0.80 (0.58)	0.7 (0.04;2.83)
	% of maximum	18%	16%
Erosions (0-4)	Score	0.98 (0.74)	0.82 (0;3.35)
	% of maximum	25%	21%
Joint line (0-5)	Score	1.21 (0.89)	0.96 (0.11;3.66)
	% of maximum	24%	19%
Misalignment (0-4)	Score	0.31 (0.35)	0.2 (0;1.97)
	% of maximum	8%	5%

Abbreviations: SD, standard deviation. (): scoring range.

^a According to the Sharp method as modified by Kaye (complete description in the text).

Table 3
Correlation between radiological damage and the score of the Health Assessment Questionnaire and its subdimensions

	Radiological damage							
	Total		Erosion		Joint line		Misalignment	
	Not adjusted	Adjusted	Not adjusted	Adjusted	Not adjusted	Adjusted	Not adjusted	Adjusted
HAQ	0.27 ^a	0.18	0.20 ^b	0.10	0.26 ^b	0.19	0.20 ^b	0.16
Dressing	0.30 ^a	0.20	0.26 ^a	0.15	0.25 ^b	0.18	0.23 ^b	0.17
Getting up	0.05	0.01	0.01	-0.02	0.07	0.06	0.04	-0.02
Eating	0.26 ^b	0.27 ^a	0.18	0.13	0.23 ^b	0.25 ^b	0.29 ^a	0.38 ^c
Walking	0.14	0.04	0.08	0.01	0.16	0.07	0.11	-0.02
Hygiene	0.21 ^b	0.12	0.11	0.01	0.26 ^b	0.18	0.08	0.06
Reaching	0.30 ^a	0.20 ^b	0.26 ^b	0.16	0.27 ^a	0.18	0.25 ^b	0.17
Pressure	0.26 ^b	0.11	0.24 ^b	0.08	0.23 ^b	0.09	0.27 ^a	0.15
Activities	0.1	0.05	0.06	0.01	0.09	0.09	0.01	-0.03

Partial correlations are shown, not adjusted and adjusted for age, time since disease onset, and rheumatoid factor values.

Abbreviations: HAQ, Health Assessment Questionnaire.

^a $P < .01$.

^b $P < .05$.

^c $P < .001$.

Results

Ninety-six patients were included (67 women and 29 men). Mean age (standard deviation [SD]) was 56 (13) years (Table 1), with a mean time since onset of disease of 9 (7.8) years. The rheumatoid factor was positive in 77% of patients. HAQ was superior to one in 66% of cases, with as mean of 1.39 (0.79) and a median of 1375.

The mean score of radiological damage was 0.80 (18% of maximum possible score). Mean subtotal scores were 1.21 for the loss of joint space; 0.98 for erosions; and 0.31 for misalignment (Table 2). Hundred percent of patients had a score over 0 for loss of the joint line: 97% (93 patients) presented erosions and in 95% (91 patients) misalignment was detected.

Radiological damage could not be evaluated in 33 individual measurements (less than 0.5%). In 80% of these cases the reduction in the joint space could not be measured due to the presence of misalignment.

In the agreement study, the ICC for the mean score between the 2 observers was 0.98 (95% confidence interval [CI], 0.95-0.99) for the total score of the joint space it was 0.95 (95% CI, 0.88-0.97); for the alignment score it was 0.92 (95% CI, 0.84-0.96), and for erosions it was 0.94 (95% CI, 0.88-0.97). In the study of interobserver variation, the ICC for the total score was 0.93 (95% CI, 0.90-0.95); for the joint line 0.87 (95% CI, 0.82-0.90); for erosions it was 0.81 (95% CI, 0.75-0.86), and for misalignment it was 0.73 (95% CI, 0.68-0.78).

Relationship between the radiological lesion scores and the Health Evaluation Questionnaire

The HAQ score showed a statistically significant correlation with all of the scores of the radiological lesions, with partial correlation coefficients which varied between $r=0.20-0.27$; $P < .05$ to $.01$. However, this relationship is reduced when adjusting the calculations for age, disease duration, and rheumatoid factor titer (Table 3).

The effect of disease duration on the loss of function and radiological damage can be observed when analyzing separately the group of patients with a disease onset over or under 7 years. As is shown in Table 4, there is no relation between the HAQ and the radiological damage in patients with less than 7 years since disease onset. However, this relationship increases in patients with time since onset of disease of over 7 years and the correlation with the HAQ, the total radiological damage and the reduction in joint space reach statistical significance.

A detailed analysis of the relationship between the different subdimensions of HAQ and the radiological damage can be seen in Table 5. Radiological lesions present significant correlation with HAQ subdimensions related to eating, dressing, and reaching.

Table 4

Partial correlations between radiological damage and the Health Assessment Questionnaire in early and late rheumatoid arthritis (adjusted by age, time since onset of disease, and rheumatoid factor)

Number of patients	Time since disease onset (mean [SD])		Total	Joint line	Erosion	Misalignment
57	≤7 (4 [2])	HAQ	0.04	0.01	0.06	0.03
39	>7 (15 [7])		0.33 ^a	0.37 ^a	0.19	0.24

Abbreviations: HAQ, Health Assessment Questionnaire, SD, standard deviation.

^a *P*<.05.

Table 5

Partial correlations between radiological damage and the categories of the Health Assessment Questionnaire in established rheumatoid arthritis (more than 7 years since onset of disease)

	Radiological damage			
	Total	Erosion	Joint line	Misalignment
HAQ	0.33 ^a	0.19	0.37 ^a	0.24
Dressing	0.42 ^b	0.33 ^a	0.43 ^b	0.31 ^a
Getting up	0.08	-0.05	0.17	0.03
Eating	0.48 ^c	0.27	0.48 ^c	0.51 ^c
Walking	-0.02	-0.09	0.06	-0.14
Hygiene	0.23	0.05	0.31 ^a	0.13
Reaching	0.38 ^a	0.35 ^a	0.38 ^a	0.23
Pressure	0.28	0.22	0.26	0.27
Activities	0.05	0.01	0.11	-0.03

Adjusted for age, time since onset of disease, and rheumatoid factor.

Abbreviations: HAQ, Health Assessment Questionnaire.

^a *P*<.05.

^b *P*<.01.

^c *P*<.001.

Discussion

Radiological damage is significantly correlated with the HAQ index in a weak manner when adjusted for disease duration.⁸ The relationship of disease activity and joint destruction with loss of function changes according to the progression of the disease. Guillemín et al² showed, in a transversal study, that loss of function depended overall on disease activity during the first years since onset (less than 5 years). After several prospective studies they corroborated these findings.^{9,10} Scott et al,¹¹ in their excellent review, concluded that radiological damage increasingly contributes to explain loss of function as time passes and RA progresses, with the relationship growing stronger after 8 years since onset of disease. According to this data, patients were divided into 2 subgroups, according to the time since the onset of disease. The cut point chosen had to be reduced (7 years) so that the subgroup with a larger disease progression had a more representative number of patients. A statistically significant correlation was only found between radiological damage and HAQ in patients who had more than 7 years since onset of disease.

When analyzed separately from the radiological lesions, a statistically significant relationship was seen with the reduction in joint space, but not with erosions or misalignment. In a prospective study with a 5-year follow up, the loss of joint space was the parameter that related to future loss of function.⁴ These findings can be explained because the measure of the joint space line reflects the status of the joint cartilage and its importance in joint function. In fact, one model indicated that 2 simultaneous mechanisms of joint damage coexisted in RA and led to different radiological lesions.¹² Chronic synovitis would cause the loss of cartilage and would be more intently related to clinical signs such as pain and swelling. On the other hand, synovial hyperplasia would lead to erosions and swelling, but its relationship to pain would be weaker. Therefore, the results of the present study are added to those of other authors and support the idea that erosions, loss of joint space, and misalignment provide independent

information when evaluating patients with RA, and should be included in all studies that analyze radiological damage.¹³ On the other hand, other studies indicate that the effect of some drugs on the progression of disease have a different intensity and depend on the radiological lesions evaluated.^{14,15} Kirwan et al¹⁵ communicated that prednisolone reduced progression of erosions but had no effect on cartilage.

Because of this, the difference measured in the joint space is very important for the follow-up of patients with RA. However, the present study has important limitations. On one hand, it is a transverse study with the resulting difficulty to control different confusion variables and, in addition, when dividing patients into 2 subgroups, the size of the sample on which the results are based is small. On the other hand, radiological damage in these patients as a whole is moderate. Another aspect to consider is that we did not analyze the presence of osteophytes, in other words, the influence that these patients might suffer from having associated osteoarthritis. This was because the method employed (as most of the radiological studies in RA) does not analyze this aspect. However, we did see (data not shown) that in the loss of joint line score, the carpal and metacarpal joints had more weight than the interphalangeal or trapezium-metacarpal joints. Therefore, we do not think that associated osteoarthritis was a determinant in the loss of joint space in the patients in this study. These results can be a starting point for other trials that evaluate in a differential manner the influence of the different radiological lesions on loss of function.

Data from the present study show that the radiological lesions in the hands are related with some of the HAQ categories that refer to upper extremity function in patients with late RA. It is unknown if the radiological lesions of the feet with correlate in a similar manner with those categories related to lower extremity function. The method chosen to assess the radiological damage (Kaye's modification of the Sharp method) is useful to evaluate separately the alignment, the joint space line and the erosion (Figure). Other current and more commonly employed methods jointly analyze the joint line and the alignment, such as that proposed by van der Heijde.¹⁶ However, the method proposed by Kaye has the limitation of not studying the feet lesions. All of the specific radiological findings are related to the category "dressing"; but the category "eating" only related with the loss of joint space and misalignment. The joint space was also related with the HAQ categories of "reaching" and "hygiene."

In conclusion, there only was a significant relationship between the HAQ score and radiological damage scores in patients with late RA. Score in the joint space damage were the ones most related with loss of function as measured by HAQ. This fact can reflect the role of preservation of joint cartilage in preventing loss of function. Findings with radiological measuring systems based on hand measurements relate to categories of the HAQ score that evaluate upper extremity function.

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