Carpal Collapse in Rheumatoid Arthritis — Prevalence and Clinical Significance: A Preliminary Study

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ABSTRACT. ***Objective.*** To evaluate the prevalence and clinical significance of carpal collapse in Mexican women with rheumatoid arthritis (RA).

Methods. We evaluated the carpal height ratio (CHR) of 97 women with RA and 90 healthy women. Using plain radiographs of both hands, measurements were performed by 2 radiologists in a single blind fashion. We analyzed functional class, characteristics and duration of the disease, and presence of rheumatoid factor (RF).

Results. CHR values of the controls were 0.49 ± 0.02 (values reported in American Caucasian women are 0.54 ± 0.04). Thirty-five patients had carpal collapse (defined as CHR ≤ 0.43) in the right hand, 30 in the left hand, and 23 bilaterally. Carpal collapse was associated with RF seropositivity and roentgenographic degree of progression ($p < 0.01$), as well as with cumulative dose of steroids. As 95% of the patients were right-handed, dexterity was not apparently affected. We observed no differences in Health Assessment Questionnaire, functional class, or disease duration between patients with and those without carpal collapse.

Conclusion. The definition of carpal collapse may have ethnic related differences. Carpal collapse is common in Mexican women with RA and it is not an indicator of functional limitations. (J Rheumatol 2001;28:1975–8)

Key Indexing Terms:
RHEUMATOID ARTHRITIS HAND CARPAL COLLAPSE

Rheumatoid arthritis (RA) has a worldwide distribution, affecting all ethnic groups, with a prevalence ranging from 0.9 to 2.5%, and a female predominance of 3:1[1,2]. It is a chronic inflammatory condition predominantly affecting synovium and causing symmetric polyarthritis of both small and large joints. It shows a tendency to erode and destroy both articular cartilage and subchondral bone, leading to functional limitations and disability[1,3]. Radiographic studies are considered the "gold standard" to evaluate the influence of diverse therapeutic approaches on the anatomic changes[4-6]. The rheumatoid hand characteristically shows early abnormalities in the second and third metacarpophalangeal joints. The wrists show bony erosions of distal ulna and its styloid process, usually associated with inflammatory changes in the prestyloid recess of the radiocarpal compartment. Less common abnormalities include resorption of the trapezium, radiocarpal luxation, and carpal fusion. Carpal collapse has been associated with seronegative RA in 2 studies[7,8]. Both included patients classified according to the 1958 Criteria[9]. There are few recent studies on carpal collapse, specifically using the current American College of Rheumatology (ACR) classification criteria for RA.

Several methods have been proposed for measurement of the radiocarpal height[10-15]. The most commonly used has been the carpal height index proposed by Stahelin, *et al*[10], which requires a normal wrist for comparison. The carpal height ratio (CHR) has been used to evaluate those with bilateral carpal compromise[11]. However, these indices have been evaluated mostly in Caucasian populations[10-13] and their values may not be applicable to other ethnic groups with differences in body size and proportions. There are no reference data for CHR in Mexican women.

Our aim was to evaluate the normal radiocarpal height in a population of healthy Mexican women, and using these values as controls to evaluate the frequency and factors associated with carpal collapse in Mexican women with RA.

MATERIALS AND METHODS

There are 540 patients currently under supervision in the Department of Rheumatology in the Hospital de Especialidades 1. We included 97 consecutive women with RA according to the 1987 ACR classification criteria[16] from an outpatient clinic population. The patients were considered eligible when they had disease duration of at least 6 months. We excluded those with a history of trauma, fracture, or surgery on any wrist, as well as patients with metabolic diseases and those for whom radiographs were unavailable. Patients' demographic and disease related data, including duration of RA, modified Steinbrocker functional classification[17], and radiographic classification of progression of RA[18], were recorded, and every patient completed a validated Spanish version[19] of the Health Assessment Questionnaire (HAQ).

Radiographs of both hands were obtained from all patients, following the technique described by Stahelin, *et al*[10]. Using those criteria, carpal height ratio was defined as the distance between the base of the radial subchondral

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plate and the base of the third metacarpal, and carpal height ratio was calculated as the ratio of carpal height (A) to the length of the third metacarpal (B), as illustrated in Figure 1. A separate control group consisted of 90 apparently healthy women, who lacked the exclusion criteria noted above (Figure 2). We considered the values in this control group as normal, with a mean CHR value of 0.49 (95% confidence intervals 0.48–0.49); carpal collapse was defined as CHR ≤ 0.43 with a sensitivity of 0.97 and specificity of 0.56. A receiver-operator characteristic (ROC) curve was constructed for this purpose (Figure 3) and frequency of carpal collapse was evaluated in the patients with RA. Plain radiographs of both hands were obtained using the same technique. Radiographic films were examined by 2 radiologists blinded to patient and control data, and they performed measurements separately in every case. The coefficient of variation was 5.1 for one radiologist and 5.2 for the other. We analyzed the frequency and clinical significance of disease associated factors in patients with and without carpal collapse.

Statistical analysis. Mean values (and confidence intervals) and one way ANOVA were recorded for CHR in both groups. A post-hoc analysis by Tukey's HSD test was carried out to establish any difference. Chi square test was used to analyze association of carpal collapse with disease duration, therapeutic variables, functional class, and radiographic stage. Student's t test for independent groups was used to study differences in HAQ values between groups, with a confidence level of 95%, and Kruskal-Wallis test was used to study differences between prednisone use and years since onset in both groups. All data were analyzed using Statistica v.5 software.

Figure 1. Carpal collapse in a patient with RA. Line A is the distance from the base of the third metacarpal to the subchondral plate of the distal end of the radius, and Line B is the distance between the distal margin of the third metacarpal and the base of the third metacarpal. The carpal height ratio, was measured as the ratio of A/B.

Figure 2. Healthy control without carpal collapse.

RESULTS

The 90 women of the control group had a mean age of 42.8 (95% CI 38.3–44.4) years and a mean CHR of 0.49 (0.48–0.49). The 97 women with RA had a mean age of 44 (40.7–47.2) years. Their mean CHR was 0.44 (0.43–0.46). Thirty-five patients had right-hand carpal collapse as defined above, and 23 had bilateral carpal collapse. Dexterity (95% of the patients were right-handed) was not apparently affected. Cumulative dose of prednisone was significantly higher in the group with carpal collapse ($p < 0.04$), regardless of side affected (Table 1). There were no differences in modified Steinbrocker functional classification, but patients with carpal

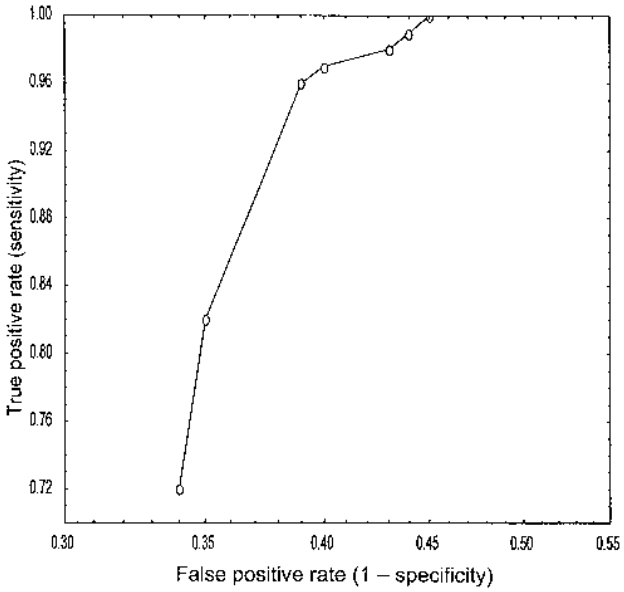

Figure 3. ROC curve of carpal height ratio for patients with RA and healthy controls. Sensitivity and specificity were calculated for each cutoff in 0.463, 0.451, 0.439, 0.430, 0.427, 0.415, and 0.408 values.

collapse of either side had a significant association with radiographic stage, and RF positivity was apparently associated with right-hand carpal collapse (Table 2). The differences in HAQ values (Table 3) of patients with right-hand carpal collapse, mean 0.812 (95% CI 0.618–1.007) and those without collapse, mean 0.686 (95% CI 0.571–0.8), did not reach statistical significance ($p > 0.05$).

DISCUSSION

Our goal was to determine if a simple, objective measurement of plain hand radiographs to define the presence of carpal collapse could be established as an independent marker of both objective and patient perceived functional limitations. We started by defining the normal values in our population. Carpal height ratio was found to be 0.54 ± 0.04 in Caucasian populations[10,12], while in our control group it was 0.49 ± 0.02 (0.48–0.49). If we had used the previously reported "normal" values, our prevalence of carpal collapse would be falsely increased, therefore we constructed a ROC curve to show the cutoff values to define normality, based on the findings in our healthy controls. We decided to use a CHR of 0.43 or less to define carpal collapse in our population. This value has a high sensitivity and a reasonable specificity (only one false positive and not a single true positive case lost to definition). This cutoff value was fundamental for further analysis of data.

Higher degree of radiographic anatomic damage and higher cumulative dose of prednisone were associated with carpal collapse of either side, but carpal collapse was not associated with a worse functional effect as defined by either Steinbrocker functional class or global or upper extremity HAQ values — a close correlation was found between global HAQ score (mean 0.729, 95% CI 0.624-0.834) and upper extremity HAQ values (mean 0.761, 95% CI 0.642-0.881). Carpal collapse is apparently parallel to other markers of radiographic damage. Its association with both seropositivity (generally considered to be associated with more aggressive disease) and higher cumulative dose of prednisone (generally used at higher doses and for longer periods of time in "difficult" cases) is evident in this study. Our patients with left-hand carpal collapse showed a poor association with seropositivity, but we found no other obvious associations with the side of carpal collapse, since 95% of our patients were right-handed. However, as with other attempts to link radiographically defined global indices or specific joint damage indices with disease course[20-23], the evaluation of CHR cannot predict functional outcome in RA.

It remains to be established if carpal collapse as an endpoint can be considered a reliable, objective, quantitative marker of response to therapy. It is unlikely that carpal collapse could be considered an early finding in RA. The relative sensitivity and specificity of CHR as a marker of structural damage in RA should be compared with other joint damage indices to explore its usefulness in this context[20-22].

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Table 1. Characteristics of controls and patients with RA.

	Controls	RA	RA, No Carpal Collapse	Right Hand Collapse	Bilateral Collapse
N	90	97	62	35	23
Age, yrs	42.8 (38.3–44.4)†	44 (40.7–47.2)†	43.9 (40.7–47.2)†	45.2 (40.7–48.8)*	43.9 (38.3–49.4)†
CHR, mm	0.49 (0.48–0.49)[a]	0.44 (0.43–0.46)[b]	0.48 (0.47–0.48)[c]	0.39 (0.37–0.40)[d]	0.38 (0.36–0.40)[e]
Years since onset		10 (8.3–11.6)†	9.2 (7–11.3)†	11.4 (8.8–14)†	11.9 (8.6–15.1)†
Prednisone cumulative dose, g/yr		1.3 (1–1.6)†	1.1 (0.7–1.5)†*	1.7 (1.2–2.3)††*	1.9 (1.2–2.5)††

* $p < 0.01$. † Nonsignificant difference. †† Nonsignificant difference, one way ANOVA test, between CHR and Age. Kruskal-Wallis test was used to find differences between years since onset and cumulative dose of prednisone in right-hand or bilateral carpal collapse in patients with RA. a,b,c,d,e, ($p < 0.001$); a vs b,d,e ($p < 0.008$); c vs d,e ($p < 0.008$); a vs c ($p > 0.05$); d vs e ($p > 0.05$). CHR: carpal height ratio.

Table 2. Carpal collapse of the right and left hand.

	Collapse n (%)	No Collapse n (%)	Chi square	p
Right hand				
FC I–II	30 (30.9)	53 (54.6)		
FC III–IV	5 (5.2)	9 (9.3)	0.001	NS
Radiographic stage				
I–II*	6 (6.2)	32 (33)		
III–IV*	29 (29.9)	30 (30.9)	11.16	0.0018
Positive RF, n = 70	32 (33)	37 (38.1)		
Negative RF, n = 27	3 (3.1)	25 (25.8)	10.98	0.002
Left hand				
FC I–II	26 (26.8)	57 (58.7)		
FC III–IV	4 (4.1)	10 (10.3)	0.04	NS
Radiographic stage				
I–II*	4 (4.1)	31 (32)		
III–IV*	26 (26.8)	36 (37.1)	9.75	0.0013
Positive RF, n = 70	24 (24.7)	46 (47.4)		
Negative RF, n = 27	5 (5.2)	22 (22.7)	2.31	NS

• Global hand radiograph, Steinbrocker classification. FC: Steinbrocker functional class, RF: rheumatoid factor, NS: not statistically significant.

Table 3. Functional status defined by HAQ and its association with carpal collapse.

	No Collapse	Right Hand Collapse	Bilateral Collapse	
N	62	35	23	
HAQ, mean, 95% CI	0.68 (0.57–0.80)	0.81 (0.62–1)	0.88 (0.50–2.18)	NS, p > 0 05

HAQ: Health Assessment Questionnaire.

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