Radiographic joint space in rheumatoid elbow joints. A 15-year prospective follow-up study in 74 patients


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Abstract

Objective. To evaluate radiographically the humeroulnar (HU) and humeroradial (HR) joint spaces in patients with long-term rheumatoid arthritis (RA).

Methods. An inception cohort of 74 patients with RA were followed for 15 yr. At the end-point, 148 elbows were radiographed by a standard method. The HU and HR joint spaces were examined from the anteroposterior radiographs by measuring the shortest tangential distance in the middle of the joints. Destruction of the elbow joints, assessed with the Larsen method on a scale of 0–5, was studied in relation to the joint-space measurements.

Results. Mean (s.d.) HU joint space (n = 148) in RA patients was 2.5 (1.1) mm, range 0–4 mm, 2.9 (0.8) mm in men and 2.4 (1.1) mm in women. Mean (s.d.) HR joint space (n = 140) was 2.3 (0.9) mm, range 0–4 mm, 2.5 (0.8) mm in men and 2.3 (1.0) mm in women. HU and HR spaces of the affected joints (Larsen grades 2–5) [1.9 (s.d. 1.1) and 1.8 (0.9) mm respectively] were notably narrower than those of the unaffected (Larsen grades 0–1) joints [3.1 (0.7) and 2.9 (0.6) mm]. All the joints graded as Larsen 4 or 5 (n = 13) had a value of 0 mm for both joint spaces. Both the HU and the HR joint-space narrowing was associated with increasing destruction (Larsen grading) of the joint. [r = −0.69 (95% CI −0.77 to −0.60) and r = −0.70 (−0.78 to −0.60)]. The monotonic narrowing was significantly increasing from unaffected (Larsen 0, 1), slightly (2), moderately (3) to severely (4, 5) affected joints (P < 0.001).

Conclusions. Joint-space narrowing is a frequent consequence of rheumatoid affection of the elbow joint. HR joint space decreases together with HU joint space; however, the HR joint space is already slightly narrower at the start. The narrowing is a rather late phenomenon, occurring only after erosive destruction. This should be borne in mind when using the Larsen method to evaluate changes in the elbow joint.

Key words: Rheumatoid arthritis, Elbow joint, Joint space, Radiography, Larsen method.
data collection strategy and details of the patients have been described elsewhere [13, 14]. At the 3-yr follow-up, 102 patients were positive for rheumatoid factor and had erosive RA. After the 3-yr check-up, 24 had died. Four patients failed to attend the 15-yr follow-up. Thus, 74 patients (18 males and 56 females) were the subjects of the present study. The age at the onset of disease ranged from 17 to 66 yr [mean 42 (s.d. 12) yr].

Anteroposterior (AP) and lateral radiographs of all 148 elbows were taken at the 15-yr check-up [mean 15 (s.d. 1) yr]. The following standard positioning was used for the AP view: patient sitting with shoulder in 90° flexion and elbow extended at 180° on the examination table, the table supinated, the radius and the ulna in the same plane, palm facing upwards. The same radiographer confirmed correct positioning and took the radiographs using a standard technique. The straight grapher confirmed correct positioning and took the same plane, palm facing upwards. The same radiograph was then taken, hand supinated, the radius and the ulna in flexion and elbow extended at 180°. The format was 18 x 24 cm.

The HU and HR joint spaces were measured from the midpoints of the articular surfaces of the head of the radius and the coronoid process of the ulna to the corresponding articular surfaces of the capitellum and the trochlea of the humerus. In this AP projection, the joint spaces were measured as the shortest perpendicular distances between the articular surfaces (Fig. 1). When the original bony outlines had disappeared and the ulna or the radius protruded into the humerus, the joint space was evaluated as 0 mm.

The elbow joints were classified according to the standard reference films of six Larsen grades from 0 to 5 [12]. Ten synovectomies and one excision arthroplasty had been performed in nine elbows of seven patients (two bilateral synovectomies). Excision of the head of the radius had been combined with synovectomy in eight elbows. One elbow had undergone resynovectomy and one elbow excision arthroplasty after synovectomy. No total elbow replacement had been done. The HR joint-space was not measured in the eight elbows with resection of the head of the radius.

Statistical comparison between elbows with different stages of destruction was performed using the Jonckheere test for ordered alternatives. Correlations were estimated with the Spearman correlation coefficient.

Results

There was no systematic right-left difference in either sex, and the measurements of the two sides were therefore pooled. Mean HU joint space (n = 148) in RA patients was 2.5 (s.d. 1.1) mm, range 0–4 mm [2.9 (0.8) mm in men and 2.4 (1.1) mm in women]. Mean (s.d.) HR joint space (n = 140) was 2.3 (0.9) mm, range 0–4 mm [2.5 (0.8) mm in men and 2.3 (1.0) mm in women]. The results of the measurements from different measuring sites for both men and women are presented separately for the right and left sides in Table 1. The Spearman correlation coefficients between right and left value were 0.54 [95% confidence interval (CI) 0.36 to 0.58] for the HU space and 0.61 (95% CI 0.44 to 0.74) for the HR space.

The mean (s.d.) HU and HR spaces of the affected joints (Larsen grades 2–5) [1.9 (1.1) and 1.8 (0.9) mm respectively] were narrower than those [3.1 (0.7) and 2.9 (0.6) mm] of the unaffected (Larsen grades 0 and 1) joints. All the joints graded as Larsen 4 or 5 had a value of 0 mm for both joint spaces. Only one non-erosive (Larsen grade <2) but clearly osteoarthritic elbow had a joint space (both HU and HR) of 0 mm. Joint-space narrowing of both HU and HR was associated with increasing destruction (Larsen grading) of the joint [HU, r = −0.69 (95% CI −0.77 to −0.60); HR, r = −0.70 (95% CI −0.78 to −0.60)].

All the HU and HR joint-space values for Larsen grades for both men and women are shown in Fig. 2. The mean (s.d.) HU joint spaces for Larsen grades 0–5 were as follows: grade 0 (n = 36), 3.2 (0.6) mm; grade 1 (n = 37), 3.1 (0.8) mm; grade 2 (n = 49) = 2.5 (0.6) mm; grade 3 (n = 13) = 1.4 (0.5) mm; grade 4 (n = 4) = 0 (0) mm; grade 5 (n = 9) = 0 (0) mm. The mean (s.d.) HR

![Fig. 1. HU and HR joint space measurement methods used in this study. See text for further details.](image-url)
The joint spaces were as follows: grade 0 ($n = 36$) = 2.9 (0.5) mm; grade 1 ($n = 37$) = 2.8 (0.7) mm; grade 2 ($n = 48$) = 2.1 (0.6) mm; grade 3 ($n = 10$) = 1.5 (0.5) mm; grade 4 ($n = 3$) = 0 (0) mm; grade 5 ($n = 6$) = 0 (0) mm.

The distribution of the elbow joints ($n = 148$) according to Larsen grading and mean HU and HR joint spaces for each stage (none = 0 to 1; slight = 2; moderate = 3; severe = 4–5) of destruction are shown in Table 2. The monotonic decrease in joint space between different stages of destruction was statistically highly significant ($P < 0.001$).

### Discussion

The results of the present study confirm the visually observed joint-space narrowing in rheumatoid elbow joints [4, 7–11]. The mean joint spaces of affected rheumatoid elbows were noticeably narrower than those of the unaffected (Larsen grades 0 and 1) joints. We know of no published figures describing normal variation of the joint spaces of the elbow. However, if the mean HU space of the unaffected minus two standard deviations (i.e. 1.7 mm) and the corresponding mean HR space minus two standard deviations (i.e. 1.7 mm) are considered to be the limit for pathological narrowing, almost one in three of the affected (Larsen grades 2–5) elbows fulfilled the criteria. There was neither HU nor HR space left in any of the joints with Larsen grade 4 or 5 destruction, as a consequence of remarkable cartilage destruction. The one unaffected (Larsen grade 1) joint of a carpenter without any HU or HR space left suffered from severe osteoarthritic changes. There were no other non-erosive joints with a joint space less than 2 mm. Therefore, we suggest that joint space less than 2 mm can be considered pathological for both the HU and the HR joint.

Significant joint space reduction did not occur until Larsen grade 4 destruction. However, Larsen grading is partly based on joint-space narrowing [12]. Even unaffected (Larsen grade 1) joints may have slight joint-space narrowing according to Larsen’s definition. On Larsen’s standard reference films of the elbow, HR joint space is slightly narrowed at grade 1 and the HR and the HU spaces are both clearly narrowed at grade 2. Moreover, these joint spaces have almost disappeared at grade 3 [12]. According to our results, erosions of the elbow joint are followed, not preceded, by joint-space narrowing (Fig. 2). This finding is supported by the radiographic assessment for rheumatoid elbow destruction described by Souter [4, 15]. The elbow seems to follow a slower course of cartilage destruction than the weight-bearing hip and knee joints in RA [1, 16, 17]. We have suggested previously that the absence of body weight on the glenohumeral joint may protect the articular cartilage from early thinning, but not from erosions on the articular margin [18]. The same phenomenon has now been observed in the elbow,
supports our findings in the shoulder. Therefore, we suggest that grading of destruction in the non-weight-bearing elbow joint should also be based on erosive destruction, not on joint-space narrowing. Larsen also emphasizes that bony erosion and destruction are the main changes seen when assessing the grade of destruction for all joints [12]. Joint-space narrowing without erosion can be classified as Larsen grade 1, even 0, as this may be due to degeneration without any rheumatoid involvement. However, from grade 2 onwards the degree of erosion should be decisive. Joint-space narrowing is present at Larsen grade 3 (Fig. 3) and the space has disappeared at the late stage of destruction (Larsen grades 4 and 5).

In the previous literature, which is based on visual observations, the site of joint-space narrowing in the rheumatoid elbow has remained controversial. Although most authors report joint-space narrowing in the rheumatoid elbow as a typical radiological finding, opinion is divided on which site is most affected and on the timing of this process in the course of elbow destruction. According to the present study, joint-space narrowing seems to be a symmetrical finding in both the HU and the HR joint, as described previously [7–9]. However, HR dominance has been reported by Resnick [11] and Stein et al. [19], which might be explained by the measurements on unaffected joints in our study. The HR joint space was already slightly narrower (2.9 vs 3.1 mm) than the HU space in the unaffected joints. However, at grade 3 the mean joint spaces were similar (1.5 and 1.4), before diminution to zero at grade 4. So HU joint destruction does not seem predominant either [10]. Symmetrical loss of both the joint spaces during the destructive process is supported by our observations; most of the destroyed joints had been radiographed previously when indicated clinically.

We conclude that joint-space narrowing in the rheumatoid elbow is an inevitable consequence of rheumatoid affection, and occurs equally in both the HU and the HR joints. The detection of rheumatoid involvement in the elbow joint should be based on erosions, not on joint-space narrowing on the radiograph. This should also be borne in mind when applying Larsen grading to the elbow joint.

References