Incidence of Elbow Involvement in Rheumatoid Arthritis. A 15 Year Endpoint Study

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ABSTRACT. ***Objective.*** To evaluate the incidence of involvement and cause of destruction of humeroulnar (HU) and humeroradial (HR) joints in a prospectively followed cohort of 74 patients with seropositive and erosive rheumatoid arthritis (RA).

Methods. At the 15 year followup standard anteroposterior and lateral radiographs of 148 elbow joints were evaluated, and the grade of destruction was assessed by the Larsen method.

Results. Erosive involvement (Larsen grade 2) was observed in 75/148 (51%) elbows in 45/74 (61%) patients; 30 patients had bilateral and 15 unilateral involvement. The incidence of mild erosions (Larsen grade 2) was 49/148 (33%), and severe erosions (Larsen 3–5) 26/148 (18%). The 13 most severely involved (Larsen grade 4–5) joints were seen in 8 (11%) patients. Erosions were most often observed on the capitellum (64 joints) and the lateral epicondyle (58 joints) of the humerus (AP view) or on the olecranon of the ulna (52 joints). The Larsen score (0–100) for peripheral joints correlated significantly with the elbow joint Larsen grade on both sides: right, r = 0.53 (95% CI 0.34 to 0.68); left, r = 0.53 (95% CI 0.34 to 0.68).

Conclusion. After 15 years more than half of the elbows and almost 2 of 3 patients with RA showed definite involvement of the elbow joint. Erosions were most often located on the capitellum and the lateral epicondyle of the humerus or the olecranon of the ulna. Severe destruction was most often bilateral. (J Rheumatol 2001;28:70–4)

Key Indexing Terms:

RHEUMATOID ARTHRITIS | RHEUMATOID ELBOW | HUMEROULNAR JOINT
HUMERORADIAL JOINT | RADIOGRAPHY | LARSEN METHOD

The elbow joint is composed of 3 bones: the humerus, the radius, and the ulna. The humeroulnar articulation (HU) permits flexion and extension, the humeroradial articulation (HR) enables axial rotation, and the radioulnar articulation (RU) allows pronation and supination[1,2]. In addition to these movements the elbow has to work as a fulcrum for the forearm lever and as a weight-bearing joint[2,3]. To fulfil these functions the elbow must be free from pain, mobile, and stable[3]. Involvement of the elbow in rheumatoid arthritis (RA) may result in considerable functional disability in the upper extremity[4].

Gschwend found evidence of elbow involvement in 53% of a series of 300 patients with 10 years' average duration of RA[5]. Ljung, *et al* detected radiological rheumatoid involvement in 24/47 (51%) elbows with a mean disease duration of 17 years[6]. Freyberg found both clinical and radiological evidence of elbow involvement in 21/56 (38%) patients with a history of RA ranging from 5 to 25 years[7].

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Diagnostic evaluation and preoperative planning of rheumatoid elbow is based on conventional radiography[3,8,9]. The early development of radiographically demonstrable joint damage is well known in the peripheral joints, whereas data on the elbow joints are scarce and longterm inception cohort studies are not available[10].

We assessed the 15 year incidence of involvement and the nature of destruction of elbow joints in an inception cohort of 74 patients with rheumatoid factor (RF) positive and erosive RA.

MATERIALS AND METHODS

During the period 1973–75 a total of 121 patients with recent (< 6 months) RA were studied at the Rheumatism Foundation Hospital, Heinola. The selection criteria, data collection strategy, and details on the patients are described[11,12]. At the 3 year followup 102 patients had RF positive and erosive RA. Subsequently, a total of 24 patients had died, and 4 patients failed to attend the 15 year followup. Thus, 74 patients (56 women, 18 men) were the subjects of this study; the age at onset ranged from 17 to 66, mean 42 (SD 12) years.

Radiographs of all the 148 elbows, including the cases with previous surgery, were taken at the 15 year followup as part of a radiographic survey study. The following standard positioning was used for anteroposterior (AP) views: patient sitting with shoulder in 90° flexion and elbow extended in 180° on the examination table, the hand supinated, the radius and the ulna in the same plane, palm facing upwards. The following standard positioning was used for lateral views: patient sitting with shoulder in 90° abduction and elbow in 90° flexion on the examination table, the hand supinated, thumb facing upwards. The same radiographer confirmed correct positioning and took

radiographs by the standard technique. Erosive changes (> 1 mm), osteophyte formation, cystic changes, and subchondral sclerosis were examined separately for the humerus, the ulna, and the radius and were recorded according to their anatomic location. All elbow joints were graded by the Larsen method on a scale of 0–5[13].

With the Larsen score of 0–100, the wrists, 10 metacarpophalangeal joints, and 8 metatarsophalangeal joints had previously been graded and summed, and this result was used to allow comparison[12].

Statistical comparison between the groups was made using the Jonckheere test for ordered alternatives with exact p values (Monte Carlo estimate). Correlation was estimated by Spearman's coefficient method. No adjustment was made for multiple testing.

RESULTS

Ten synovectomies and one excision arthroplasty had been performed in 9 elbows of 7 patients (2 bilateral synovectomies). Excision of the head of the radius had been combined with synovectomy in 8 elbows. One elbow had undergone resynovectomy and one elbow (Larsen grade 5) excision arthroplasty after synovectomy. No total elbow replacement was done in this material.

Erosive involvement (Larsen grade 2) was observed in 75/148 (51%) elbow joints in 45/74 (61%) patients; 30 patients had bilateral and 15 unilateral involvement (11 on the right side and 4 on the left). The incidence of severely erosive elbows (Larsen grade 3–5) was 18%; these occurred among 17 (23%) patients, 9 of them presenting bilateral and 8 unilateral severe involvements. Only one (Larsen 3) of these unilateral severe cases had no evidence (Larsen < 2) of rheumatoid involvement on the contralateral elbow. The 13 Larsen grade 4 or 5 elbows were detected in 8 (11%) patients; 5 of these showed bilateral destructive (Larsen grade 4 or 5) involvement. Hand dominance had no influence on the grade of destruction. The correlation coefficient between Larsen grading on the right and left side was 0.77 (95% confidence interval 0.66 to 0.85).

The Larsen score (0–100) for peripheral joints correlated significantly with the elbow joint Larsen grade on both sides: right, r = 0.53 (95% CI 0.34 to 0.68); left, r = 0.53 (95% CI 0.34 to 0.68). The spectrum of destruction is presented in Table 1, together with the relation between the different groups of destruction in elbow joints and the Larsen scores for peripheral joints ($p < 0.001$).

The typical site of erosions on the AP view was on the capitellocondylar joint margin of the humerus, where these were detected in 64 (43%) joints (Figure 1). From the lateral view the erosions were most often observed on the olecranon, where it was detected in 52 (35%) joints. The distribution and frequency of erosive changes in both views are shown in Figure 2. The 15 year incidence and distribution of all radiographic findings are shown in Table 2. Osteophytes were detected on the ulna in 25 (17%) joints and occurred almost always (24 joints) on the medial joint margin. On the radius these were detected in 9 (6%) joints and equally often (6 joints) on the lateral (AP view) and superior (lateral view) joint margin. In 5 joints the osteophytes formed a collar around the upper rim of the radial head. Osteophytes of the humerus were detected only on the medial trochlear joint margin, in 8 (5%) joints. Cystic changes > 5 mm were detected on the ulna in 16 (11%) joints, most often on the olecranon, in 10 joints. On the humerus these occurred in 12 (8%) joints, always on the lateral condyle. Pseudocysts of the radius were detected on 4 (3%) joints. Minor cystic lesions were considered to constitute erosive changes. Subchondral sclerosis was seen on the ulna in 6 (4%), on the humerus in 3 (2%) joints, and on one (1%) radius. Three joints showed distinctive osteoarthritic degenerative features without rheumatoid involvement. Bony ankylosis was not detected in this material.

DISCUSSION

Several methods of evaluation have been developed for radiographic assessment of RA elbow joints, the Larsen method being the most widely used[13-16]. The 15 year incidence of erosions (Larsen grade 2) in our inception cohort with RA was 51%, which was considered rather high compared to figures (38 to 53%) from previous cross sectional studies[6,7]. In this study the incidence of mild erosions (Larsen grade 2) was 33%. de Carvalho, *et al* also observed that destruction of Larsen grade 2 was most common (44%) in their analysis of radiographs from 188 patients with a history of RA from 11 to 12 years[17]. The same result was detected by Ljung, *et al* in a cross sectional radiographic study: 16/47 (34%) elbows in patients with a mean disease duration of 17 years showed

Table 1. Radiographic assessment by the Larsen method of elbow joints in 74 patients with RA after 15 years' disease duration. The relationship between different grades of destruction and corresponding Larsen scores for hands and feet (0–100) is presented.

	Larsen Grade of Elbow Joint				p*
	0	1	2–3	4–5	
Right elbow joint					
Number of joints (%)	20 (27)	13 (17)	33 (45)	8 (11)	
Larsen score, mean (SD)	23 (18)	36 (20)	52 (23)	58 (30)	< 0.001
Left elbow joint					
Number of joints (%)	16 (22)	24 (32)	29 (39)	5 (7)	
Larsen score, mean (SD)	21 (13)	33 (23)	55 (21)	62 (27)	< 0.001

*Jonckheere test for ordered alternatives.

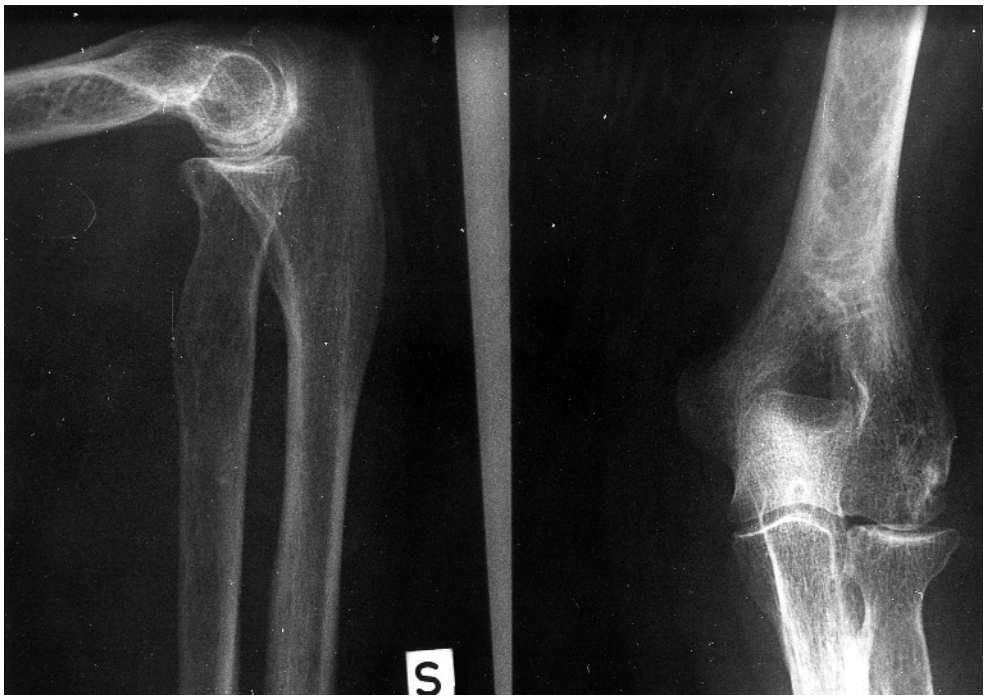

Figure 1. Erosive process on the capitellocondylar joint margin of the humerus. Cystic changes on the lateral condyle and the olecranon can also be seen in the anteroposterior view. Slight erosion on the olecranon on the lateral view. Larsen grade 2.

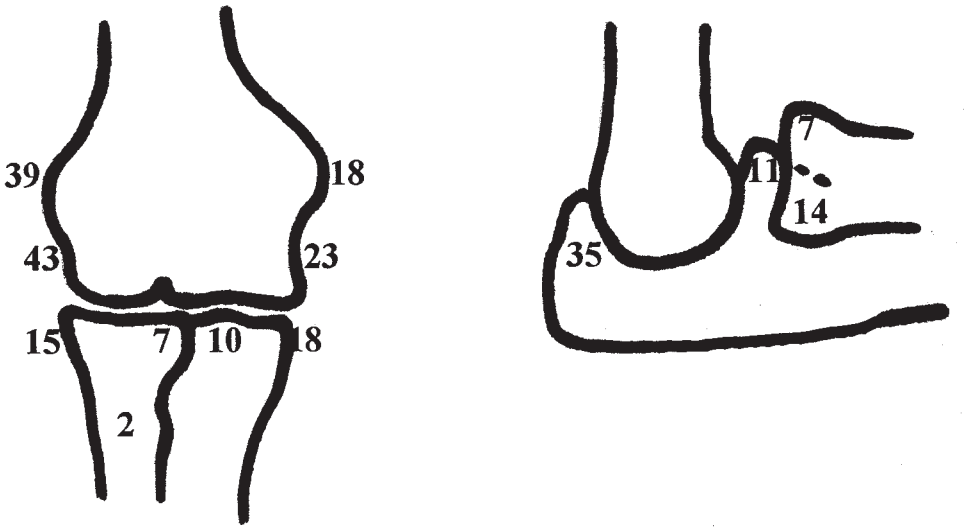

Figure 2. Distribution and frequency (%) of erosive changes in various anatomical sites of 148 rheumatoid elbow joints 15 years after disease onset. The illustration represents the anteroposterior and the lateral view of the right elbow.

Larsen grade 2 destruction[6]. The elbow seems to get involved rather late or the destruction does not always progress rapidly after initial erosions[6]. By measuring bone attrition Ljung, *et al* also concluded that the radiographic progression of elbow joint destruction in RA is slow[6]. Mutilating destruction (Larsen grade 5) was seen in 9 (6%) joints; 3 bilateral and 3 unilateral. Ljung, *et al* found 9% and de Carvalho 12% of Larsen grade 5 elbows in their series[6,17]. In our inception cohort study, in spite of one case, severe destruction (Larsen 3 to 5) of the other elbow spoke for bilateral involvement, and the greatest destruction (Larsen 4 and 5) was nearly always bilateral. Therefore, whenever one elbow shows evidence of

Table 2. Incidence of radiographic findings in 148 elbow joints 15 years after onset of RA.

Radiographic Finding	Humerus, N (%)	Ulna, N (%)	Radius, N (%)	Total N (%)	95% CI*
Erosions	74 (50)	58 (39)	30 (20)	75 (51)	43 to 59
Pseudocysts	12 (8)	16 (11)	4 (3)	25 (17)	12 to 24
Osteophytes	8 (5)	25 (17)	9 (6)	29 (19)	10 to 27
Subchondral sclerosis	3 (2)	6 (4)	1 (1)	8 (5)	2 to 10

*95% confidence interval for the total value of the percentage.

progressive destructive pattern the other should be monitored both clinically and radiologically carefully; in these cases the destruction seems to progress rapidly. Persistent synovitis or radiological erosions can be taken as indicative for urgent orthopedic consultation.

Total elbow joint replacements had not been performed in any of our 74 patients. However, there were 26 joints in cases we studied with Larsen grade of 3, 4, or 5, which stage of destruction has nowadays been used as a basis for considering arthroplasty for a painful elbow joint[3,6,18]. In the 1980s total elbow joint replacement did not come into question until Larsen grade 4 or 5 destruction and became established as a standard procedure in our hospital at the end of the followup period[19].

Early appearance of soft tissue effusion and osteoporosis were not evaluated in this study because of the transitory and subjective nature of these findings[1,20]. The mildest sign in the rheumatoid elbow joint, marginal erosion, could be detected most often on the capitellocondylar articular margin of the humerus, and almost all involved (Larsen grade 2) cases showed erosions at that site (Figures 1 and 2). We therefore assume that erosions occur first at that location, although it has been suggested that the medial joint margin reveals the small changes best[21]. On the AP view the erosive process seems to be more prominent on the lateral side, possibly due to thinner bone stock, whereas the lateral projection often shows erosions on the olecranon[21]. These shallow erosions usually result from involvement of the olecranon bursa[1,20]. Erosions of the radial head and the coronoid process of the ulna were not common, although they are described in the literature as typical[15,20]. However, in advanced cases the erosive process affected most of the joint margins, leading to deformities of the original bony outlines, as described[15,20,21].

Cystic changes > 5 mm in diameter were recorded most often on the olecranon of the ulna. This is an important finding since prominent cystic lesions of the olecranon process can spontaneously or after minor trauma lead to fracture[22,23]. These joints should be followed radiographically, and if cystic formation progresses, surgical intervention is indicated. Minor cystic changes (< 5 mm) occurred predominantly close to the joint margins, especially the lateral condyle of the humerus (Figure 1); for this reason these were regarded as erosive findings, and not as true erosions. The appearance of these small pseudocysts was most often connected with erosive changes on the joints, which would suggest an erosive origin of these lesions, as we concluded with shoulder radiographs[25]. Most authors do not report these cystic changes at all; however, previously described micro- or pseudo-cysts are probably a manifestation of an early erosive process, as the site of origin suggests[6,15,20,21].

Osteophytes occurred most often on the medial side of the joint, which can be explained by the anatomical aspects of the elbow. The osteophyte formation took place on the trochlear joint margins of both the humerus and the ulna, usually in joints with at least moderate destruction and protrusion of the ulna into the trochlea. An interesting finding in 5 joints was the extensive osteophytosis forming a collar around the upper rim of the radial head. De Sèse, *et al* studied 39 rheumatoid elbows with reactive osteophytosis and found this same phenomenon in 13 cases[15].

Subchondral sclerosis was a late manifestation in the cases we studied and occurred only in severely damaged joints or in the 3 joints assessed as osteoarthritic, without rheumatoid involvement. When not purely degenerative, this is a secondary osteoarthritic change after longlasting rheumatoid involvement[21]. These joints often revealed osteophytes as well[15,21].

The Larsen score of 0–100 was significantly higher in our patients with hip, acromioclavicular, and glenohumeral joint destruction, and a similar result for elbow joints is shown in Table 1[24-26]. The polyarticular destruction of joints expresses the need for careful clinical and radiological followup of patients with seropositive RA. After 15 years almost 2 out of 3 patients with erosive RA also showed definite involvement in the elbow joint. The patients with the most severe elbow destruction seemed almost always to have bilateral destruction.

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