Productive osseous changes about the wrist in rheumatoid arthritis

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Abstract. Radiographs of 225 consecutive patients with adult-form rheumatoid arthritis were examined for evidence of productive osseous changes about the wrist. The prevalence of new bone on the ulnar styloid was 10%. This form of new bone is probably due to overlying chronic tenosynovitis. A collar of new bone around the ulnar head is a result of degenerative change in the distal radioulnar joint. In general, productive osseous changes in rheumatoid arthritis may represent inflammatory periosteal bone formation, osteophytosis, or contact remodeling. We found no evidence of an association between diffuse idiopathic skeletal hyperostosis and extensive productive osseous changes in patients with rheumatoid arthritis.

Key words: Rheumatoid arthritis – Wrist – New bone

The presence of productive osseous changes in some patients with adult-form rheumatoid arthritis (RA) has been noted by several authors [2, 5, 15, 24]. In general, new bone formation is infrequent and inconspicuous in patients with RA. This relative lack of new bone formation may be helpful in distinguishing RA from other erosive arthropathies [1, 14].

In this study, we classify the productive osseous changes that occur about the wrist in RA and estimate their prevalence. Associations between these changes and other radiological findings are investi-

gated. We discuss the role that such productive changes play in differential radiological diagnosis.

Materials and methods

A sample was drawn from a computer print-out of patients seen at University Hospital between January 1982 and December 1983. The sample consisted of 225 consecutive patients over the age of 25 years who met American Rheumatism Association criteria for rheumatoid arthritis and had available hand or wrist films. The *study group* consisted of 40 patients with definite or classical RA who were judged by the authors to have productive osseous changes on the distal radius or ulna in at least one wrist.

New bone on the ulnar styloid was called an *ulnar styloid cap* (USC). Productive changes surrounding the articular surface of the ulnar head were called an *ulnar collar* (UC). Grading systems for extent and size were defined for USC and UC. For the ulnar styloid cap: Grade 0 (USC-0) indicates no productive change, Grade 1 (USC-1) indicates productive changes on part of the ulnar styloid, and Grade 2 (USC-2) indicates productive changes covering all of the ulnar styloid (Fig. 1). For the ulnar collar: Grade 0 (UC-0) indicates no productive change, Grade 1 (UC-1) indicates productive changes that surround the articular surface of the distal ulna without overlapping the head, and Grade 2 (UC-2) indicates productive changes that surround the articular surface and overlap the ulnar head (Fig. 2).

Lateral chest and frontal pelvis films were examined independently of those of the hands for evidence of diffuse idiopathic skeletal hyperostosis (DISH) as defined by Resnick and Niwayama [20]. Current radiographic criteria for DISH include continuous calcification or ossification along the anterolateral aspects of four successive vertebral bodies in the absence of significant discovertebral, apophyseal, or sacroiliac joint disease. By these criteria, thoracic spine involvement has been found in a very high percentage of patients with DISH [20]. Additional criteria have been proposed by Resnick [19] which include bony proliferation at sites of ligament and tendon attachment about the pelvis and in the appendicular skeleton.

Within the sample of 225 patients with RA, incidences were determined for each type and grade of productive change on the distal ulna. To quantify any associations between these findings, the chi-square statistic and the odds ratio were computed for selected pairs of findings [9]. Grading and statistical analyses were not possible for productive osseous changes on the radial styloid because of their infrequent occurrence.

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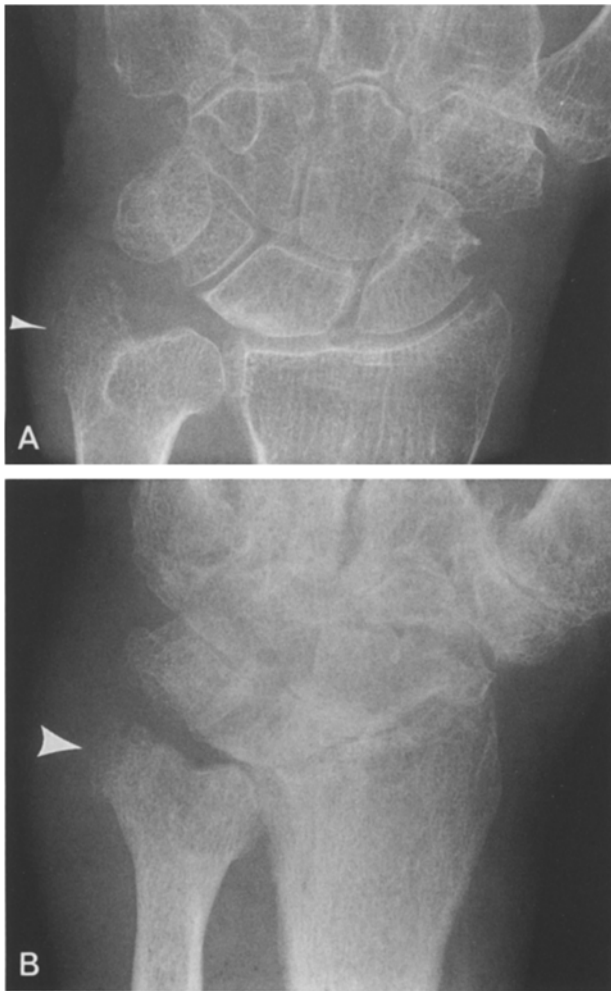
Fig. 1A, B. Ulnar styloid cap. **A** *Grade 1*. Productive changes on part of the ulnar styloid (*arrowhead*). **B** *Grade 2*. Productive changes covering all of the ulnar styloid (*arrowhead*)

Fig. 2A, B. Ulnar collar. **A** *Grade 1*. Productive changes which surround the articular surface of the ulna without overlapping the head (*arrowheads*). **B** *Grade 2*. Productive changes surrounding the articular surface of the ulna and overlapping the head

Clinical data

In the sample of 225 patients, there were 165 women (female-male ratio 2.8:1). The women averaged 56 years of age, the men 63 (Table 1). Of the 40 patients in the study group, 26 were women. Ages ranged from 30 to 79, averaging 56 years for both sexes (Table 1). For patients in the study group, the minimum age at onset of disease was 15 years; the average age was 41 years. The disease ranged in duration from 2 to 40 years and averaged 16 years. We note that the sex ratio and average ages in the sample agree with values obtained in other populations [23].

For 36 patients, the latex fixation test for rheumatoid factor was positive (dilutions ranging from 1:640 to 1:40,960). One patient who was seronega-tive at the time of the study later became a strong positive. No test results were available for three patients with long-standing disease.

Results

Productive changes on the distal ulna

In 11 men and 12 women an ulnar styloid cap (USC) occurred in at least one wrist. The incidence of USC in our sample of 225 patients was approximately 10% (Table 2), with equal frequency in both sexes. USC occurred bilaterally in 14 patients and unilaterally (without hand preference) in nine patients. The frequency of USC did not increase with age (Table 3). No ulnar styloid cap was present in 17 patients in the study group.

Table 1. Age distribution for sample and study group

Age (years)	Sample (N=225)		Study group (N=40)	
	Frequency	Percent	Frequency	Percent
20–29	6	2.7	0	0.0
30–39	29	12.9	6	15.0
40–49	23	10.2	5	12.5
50–59	60	26.7	9	22.5
60–69	69	30.7	10	25.0
70–79	35	15.6	10	25.0
80–89	3	1.3	0	0.0

Table 2. Prevalence of USC

Grade	Frequency			Total prevalence (percent)
	Males[a]	Females	Total	
USC-1	4	3	7	3.1
USC-2	8	9	17	7.6
USC-1 or 2	11	12	23	10.2

[a] USC-1 and USC-2 occurred in opposite wrists in one male

Table 3. Age distribution for USC

Age (years)	Frequency			Proportion with USC (percent)
	Males	Females	Total	
30–39	2	2	4	17.4
40–49	1	1	2	8.9
50–59	3	3	6	26.0
60–69	3	2	5	21.7
70–79	2	4	6	26.0

Table 4. Prevalence of UC

Grade	Frequency			Total prevalence (percent)
	Males[a]	Females[b]	Total	
UC-1	6	19	25	12.2
UC-2	5	5	10	4.4
UC-1 or 2	10	22	32	14.2

[a] UC-1 and UC-2 occurred in opposite wrists in one male
[b] UC-1 and UC-2 occurred in opposite wrists in two females

Table 5. Age distribution for UC

Age (years)	Frequency			Proportion with UC (percent)
	Males	Females	Total (N=32)	
30–39	1	2	3	9.4
40–49	2	3	5	15.6
50–59	2	5	7	21.9
60–69	2	6	8	25.0
70–79	3	6	9	28.1

Table 6. Productive changes in contralateral wrists

Left wrist	Right wrist	
	Present	Absent
Ulnar styloid cap[a]		
Present	14	5
Absent	4	202
Ulnar collar[b]		
Present	25	2
Absent	5	193

[a] Chi-square=112; odds ratio=141
[b] Chi-square=159; odds ratio=482

USC-2 occurred in 7.6% of cases in our sample (Table 2). In both grades, bilateral and unilateral involvement without preference to either side were equal in incidence. The minimum recorded duration of disease was 3 years for patients with USC-1 and 9 years for patients with USC-2.

An ulnar collar (UC) occurred in at least one wrist in 10 men and 22 women. The incidence of UC in our sample of 225 patients was approximately 14% (Table 4). UC occurred bilaterally in 25 patients and unilaterally in 7 (5 on right, 2 on left). The frequency of UC increased slightly with age (Table 5). No ulnar collar was present in 8 patients in the study group. The incidence of UC-2 in our sample was 4.4% (Table 4). For UC-2, bilateral and unilateral involvement were approximately equal in frequency. The minimum recorded duration of disease for patients with UC-2 was 9 years.

Associations

Fourfold tables [9] were constructed to evaluate the following associations: (A) USC and UC in contralateral wrists (Table 6). (B) USC and UC in ipsilateral wrist (Table 7). For each table, the classic chi-square statistic was computed as a measure of statistical significance of any apparent association. A measure of the degree of association is given by the odds ratio. All values were found to be significantly large. Hence, one may say with a high degree of confidence that the observed associations are real and are not the result of chance sampling fluctuations. Grade 2 ulnar styloid cap and collar occurred together in the same wrist in

Table 7. Productive changes in ipsilateral wrist

Ulnar styloid cap	Ulnar collar	
	Present	Absent
Left wrist[a]		
Present	11	8
Absent	16	190
Right wrist[b]		
Present	13	5
Absent	17	190

[a] Chi-square=37; odds ratio=16
[b] Chi-square=53; odds ratio=29

9 patients for an incidence of 2% in our sample of 450 wrists.

Idiopathic skeletal hyperostosis

A lateral chest film was not available for one patient. Of the remaining 39 patients in the study group, only two had changes in the thoracic spine diagnostic of DISH. One of these patients had bilateral USC-0 and UC-1 without carpal fusion. The other had bilateral USC-2, bilateral UC-2, and unilateral carpal fusion. None of the other patients exhibited *any* anterior longitudinal ligament calcification or ossification while 15 of them had USC-2 and 8 had UC-2.

Radiographs of the pelvis were not available for 2 of the 37 patients with lateral chest films showing no evidence of DISH. Only 3 of the 35 patients with pelvic films exhibited enthesophytes at the iliolumbar and rectus femoris attachments. One of these patients had bilateral USC-1 and UC-0 without carpal fusion; a second had bilateral USC-0, UC-0 and UC-2 in opposite wrists, and bilateral fusion; the third had USC-0 and USC-2 in opposite wrists and bilateral UC-2 without fusion. The remaining 32 patients showed no productive osseous changes in either the thoracic spine or pelvis. The sacroiliac joints were either normal or exhibited mild degenerative changes.

Discussion

In this study, we examined only those productive changes which alter the external contours of the distal radius and ulna. This region of interest was selected because of the variety of productive changes that occur here and because of the importance of hand and wrist radiographs in the diagnosis of RA.

Productive changes may occur on nonarticular surfaces or at articular margins. New bone applied to cortical bone may initially have a laminar appearance, conforming to the cortical contour, or may appear amorphous, producing a contour bulge. In time, the laminar new bone may disappear or merge with the underlying cortex to produce a localized cortical thickening or a smooth reduction in the metaphyseal flare [4, 6]. In contrast, a styloid cap with an irregular and indistinct margin may eventually acquire the same radiographic texture as the underlying spongiosa as well as a fine dense marginal line. It is likely that tenosynovitis in overlying tendon sheaths contributes to the formation of styloid caps [7, 18]. In RA, radial styloid caps occur much less frequently than ulnar styloid caps. We found this difference in frequency to be far greater than that observed by Van Dam [24] and Berens et al. [3]. The rarity of the radial cap is probably related to the infrequent involvement of the extensor pollicis brevis and abductor pollicis longus tendon sheaths in RA [11]. In some patients, normal undulations in the contour of the distal radius caused by grooves for the abductor and extensor tendons of the thumb may simulate a radial cap [10]. In rare cases, an ossicle fused to the tip of the ulnar styloid or an anomalous styloid facet may simulate an ulnar cap [12].

The most common form of new bone arising from the articular margins of the ulnar head has been called an ulnar collar. The collar grows away from the articular surface, which it tends to encircle. As it enlarges, it overhangs the nonarticular surface of the ulnar head. The margin of an ulnar collar may sometimes be recognized as a dense arc or band superimposed upon the ulnar neck (Fig. 2B). Clearly, this is the growth pattern of an osteophyte, not periosteal apposition. These osteophytes may become very large. Their excessive growth may be related to the frequency with which pronation-supination movements are performed. This hypothesis would also explain the development of the equally large osseous proliferations about the radial head which are sometimes observed in patients with RA.

We have used the term *radial buttress* to denote a type of productive change that occurs on the ulnar aspect of the distal radius (Fig. 3). A radial buttress is a short flange of bone, continuous with the cortex, that often surrounds a contact erosion [13, 16]. When adjacent to an ulnar collar, its origin from contact remodeling is evident.

In some patients with volar subluxation of the scaphoid and/or lunate, a shelf-like extension from the volar margin of the radius is formed by contact

Fig. 3. Radial buttress. A flange of remodeled cortex (*arrowhead*) with adjacent ulnar collar (*Grade 2*)

Fig. 4. Radial shelf. Shelf-like remodeling of the volar margin of the radius with associated carpal subluxation

Fig. 5. Ulnar styloid cap (*Grade 2*) and ulnar collar (*Grade 2*) without carpal fusion

remodeling. The cortex and spongiosa of such a volar *radial shelf* are continuous with those of the underlying bone (Fig. 4). Similarly, in patients with medial subluxation of the lunate, a medial shelf may develop.

Styloid caps may be seen in a variety of arthropathies resulting in a chronic tenosynovitis. These include psoriatic arthritis [21, Fig. 30-4 A], Reiter syndrome [21, Fig. 31-10], and ankylosing spondylitis [21, Fig. 29–37], as well as gouty arthritis [25]. Ulnar collars may also be seen in these arthropathies as well as in CPPD crystal deposition disease [21, Fig. 44-22 E], syringomyelia [21, Fig. 70–12 C], Ehlers-Danlos syndrome [17], and in cases involving trauma to the distal radioulnar joint [8].

These observations suggest that radial and ulnar caps are a periosteal response to an overlying chronic tenosynovitis whereas an ulnar collar represents a degenerative response to instability or cartilage damage in the distal radioulnar joint. Hence, the presence of a styloid cap does not distinguish a seronegative spondyloarthropathy or gouty arthritis from RA. The presence of a styloid cap should, however, suggest an arthropathy such as rheumatoid arthritis, the seronegative spondyloarthropathies, or gouty arthritis, all of which may cause chronic tenosynovitis. In contrast, an ulnar collar may occur in any condition that predisposes to degenerative change in the distal radioulnar joint. These conditions include inflamma-

tory arthropathy, crystal deposition disease, neuroarthropathy, primary ligamentous laxity, and trauma.

In 1978, Resnick et al. [22] described eight patients with RA and DISH who presented with osteophytosis, bony ankylosis, the enlargement of the distal ulna called "mushrooming", and other findings which together were considered atypical for RA. These patients were mostly elderly males with long-standing disease. Examples in the literature suggest that the term "mushrooming" of the distal ulna corresponds to either USC-2, UC-2, or both (Fig. 5). It was postulated that this atypical presentation of RA was due to the underlying ossifying enthesopathy. However, in our study most of the patients with ulnar styloid cap and ulnar collar showed no evidence of DISH. In the sample consisting of 225 consecutive patients with RA, we found nine patients with USC-2 and UC-2 in the same wrist. Of this subset, only four (two men) had complete or partial carpal fusion, not necessarily in the same wrist. Only one of these patients, a 74-year-old female, showed evidence of DISH. Hence, in our sample we have found no correlation between the concurrent presentation of an enlarged ulnar styloid, a large ulnar capital osteophyte, and carpal fusion with findings of DISH in the thoracic spine or pelvis in patients with RA.

In conclusion, productive osseous changes about the wrist in RA may be caused by inflammatory periosteal reaction, osteophytosis, or contact remodeling. We have found no evidence of a causal relationship between DISH and productive changes in patients with rheumatoid arthritis. We believe that these changes are an expression of the rheumatoid syndrome determined by local conditions and are not caused by an underlying systemic ossifying enthesopathy.

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