Pyrophosphate arthropathy in the carpal and metacarpophalangeal joints

M. BOURQUI, T. L. VISCHER, P. STASSE, C. DOCQUIER, AND G. H. FALLET

From the Division of Rheumatology, University Department of Medicine, Hôpital Cantonal Universitaire, Geneva, Switzerland

SUMMARY The hand x-rays of a group of patients with generalised osteoarthritis alone were compared with those of patients with generalised osteoarthritis and chondrocalcinosis (CC). An arthropathy seemingly specific for CC could be identified in the metacarpophalangeal (MCP) and carpal joints. In the MCP joints it was characterised by subchondral rarefactions, deviation of the joint axis, joint space narrowing, and osteophytosis. Usually only the second and/or third MCP joints are affected. In the carpal joints similar subchondral cysts, sometimes associated with joint space narrowing, were found much more frequently in the group with CC. There was no direct relation with the presence of calcification.

Chondrocalcinosis (CC) is characterised by deposition of calcium pyrophosphate dihydrate in joint tissues. Although CC might be familial, or associated with a variety of diseases such as hyperparathyroidism or haemochromatosis, it is most common in elderly people without any detectable metabolic abnormality.^{1,2} A destructive arthropathy has been described in patients with CC,³⁻⁵ in whom it is more frequent than in a control population with generalised osteoarthritis (GOA).^{6,7} Other particular features of CC include radiological lesions compatible with osteoarthritis but situated at unusual sites.^{1,8} In addition several authors have been impressed by a particular radiological expression of osteoarthritis of the joints of the hands in patients with CC. The most typical features were subchondral cysts in the bones of the metacarpophalangeal (MCP) and carpal joints, sometimes associated with joint space narrowing and osteophytosis. Surrounding osteoarthritic lesions were often minimal.^{3-5,8-10}

Bensasson *et al.*¹⁰ and Resnick *et al.*⁸ and others^{11,12} compared the x-ray findings in patients with CC with those of matched controls without a rheumatological problem and found an increase of osteoarthritic lesions of carpal and MCP joints in patients with CC. To assess the specificity of a possible arthropathy of the hands in patients with chondrocalcinosis, we decided to compare the x-rays of the hands of subsequent patients with GOA and CC with the x-rays of

46 subsequent patients with GOA alone, matched for age and sex with the first group. Patients of both groups consulted us with osteoarthritic symptoms. The results indicate that in CC there seem to be particular arthropathies of the carpal and MCP joints.

Patients and methods

Two groups of patients were studied. The first group consisted of 46 patients, representing all patients with CC and GOA seen in this Division of Rheumatology between 1978 and 1980. A comparable group of control patients with GOA but not CC were selected from patients, both hospitalised and from the clinics, subsequently consulting physicians from the division of rheumatology for articular pain. The characteristics of both groups are shown in Table 1. All patients in this study had roentgenographs taken with conventional techniques, including the hands, anterior/posterior view (AP); the knees, AP views; the pelvis and shoulders, AP views. By means of the history, clinical examination, and routine biological tests, patients with rheumatoid arthritis, gout, Sudeck's dystrophy, secondary osteoarthritis, hyperparathyroidism, haemochromatosis, haemosiderosis, etc., were excluded from the study.

The diagnosis of GOA was made when on the radiographs 6 joints or groups of small joints showed evidence of degenerative joint disease such as narrowing of the joint space, sclerotic changes of the adjacent bone, and presence of osteophytes. These

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Correspondence to Dr T. L. Vischer, Hôpital Cantonal, CH-1211 Genève 4, Switzerland.

Table 1 Characteristics of the patients

	Number of patients	Age (years)	Sex
Generalised osteoarthritis	46	Median: 79 Mean: 76.8 Range: 55-95	38 F 8 M
Generalised osteoarthritis and chondrocalcinosis	46	Median: 77 Mean 76.5 Range: 53-95	33 F 13 M

Table 2 Osteoarthritis of the interphalangeal joints of the second to fifth fingers

No of joints with severe osteoarthritis (grades 3 and 4)	General osteoarthritis*		
	Alone	With chondrocalcinosis	p
Distal interphalangeal joints	100	78	NS
Proximal interphalangeal joints	89	55	≤0.02

*Forty-six patients with 368 joints in each group.

criteria are essentially those of Kellgren and Lawrence.¹³ The diagnosis of CC was made when radiological linear shadows of calcific density within hyaline or fibrocartilage were found in at least 2 joints and/or when typical, positively birefringent crystals were found in synovial fluid on at least at 2 occasions. From the 46 patients with CC 21 had both calcifications on radiographs and crystals in the fluid, whereas the others had only one of the two.

The radiographs of the hands were evaluated by 2 observers (M.B. and T.L.V.) during several sessions. The randomly chosen x-rays of 22 patients were

examined at the beginning of the evaluation and again at the end. The results of these 2 evaluations did not differ significantly from each other. The radiographs were coded; however, the evaluation was not completely blind, as the typical calcifications sometimes made the diagnosis of CC obvious.

The radiographs were evaluated in the following way: osteoarthritis of the interphalangeal joints, and the first MCP joint, and the joint between the navicular and the trapezium were graded according to Kellgren and Lawrence¹³ from 0-4. For second to fifth MCP joints the presence or absence of (1) subchondral cysts, (2) joint space narrowing, (3) deviation of the joint axis, and (4) osteophytosis were noted. For the carpal and wrist joints only joint space narrowing and cystic changes were noted. Calcific deposits were noted according to localisation and form.

Statistical evaluation was by the chi-square test with Yates's correction.

Results

Osteoarthritis of both the proximal and distal interphalangeal joints of the second to fifth fingers was rather more frequent and severe in the group with GOA alone (Table 2). Its appearance did not differ in the group with CC. This confirms our previous report on other groups of patients.⁷ Osteoarthritic changes were less frequent in the MCP joints. When osteoarthritis was graded after Kellgren and Lawrence,¹³ no difference was found between the 2 groups of patients. However, in the patients with CC a particular arthropathy was seen, mainly in the second and/or third MCP joints (Figs. 1, 2). As generally observed, subchondral rarefactions were most obvious, and they were often associated with malalignment, joint space narrowing, and osteophytosis.

As can be seen in Table 3, joints with subchondral cysts or with axis deviation were significantly more frequent in the CC group. If the 4 signs were taken

Table 3 Arthropathy of the metacarpophalangeal joints (without the thumb)

Number of joints with	Generalised osteoarthritis*		
	Alone	With chondrocalcinosis	p
(1) Subchondral rarefactions	6	26	≤.001
(2) With axis deviation	16	34	≤0.02
(3) Joint space narrowing	17	28	NS
(4) Osteophytosis	41	29	NS
With all 4 signs	4	17	≤0.01
Number of hands with at least one joint with all 4 signs	2	11	≤0.02

*Forty-six patients with 92 hands in each group.

Fig. 1 Hand with pyrophosphate arthropathy. There are subchondral rarefactions of variable size and form in the head of third metacarpal and the carpal bones. Subluxation of the third proximal phalanx. Relatively exuberant osteophytosis and free ossicles in the third metacarpophalangeal joint. In the second metacarpophalangeal joint there is some localised joint space narrowing. Arthrosis of the joints between the first metacarpal and trapezium and between the latter bone and the navicular. Calcification of the ligamentum triangulare.

together, the hands of patients with CC were much more often affected. One to 2 joints only, usually the second and third MCP, were involved. Deviation of the joint axis was usually slight and occurred in both lateral and forward directions. In the latter case it had to be distinguished from slight flexion deformities. The subchondral rarefactions had different aspects and were more frequently seen in the distal parts of the metacarpal bone than in the phalanges. The cysts were of different size, often with irregular margins. Sclerosis was not always present. The bone was generally well mineralised. Osteophytes were often exuberant. There was less sclerosis of the subchondral bone than is usually seen in ordinary osteoarthritis. Joint space narrowing might be present in isolation. Sometimes it was accompanied by an irregular abrasion of the surface. In CC calcifications were often seen round the MCP joints. Often they were not limited to the joint cartilage. But the arthropathy had no direct relation to the radiographically visible calcifications, and could occur in their absence.

The wrist and the carpal joints also seemed to be the site of an arthropathy related to chondrocalcinosis. The most typical findings in the wrists were again localised subchondral rarefactions. These were sometimes associated with joint space narrowing, but not necessarily so (Table 4). Erosive changes similar in appearance to those in the MCP joints were occasionally seen in CC hands. The subchondral rarefactions had a similar form to those seen in the distal metacarpal heads (Fig. 3).

Bensasson *et al.*¹⁰ had found an increase in the frequency of arthrosis of the joint between the trapezium and the scaphoid in their group of CC patients as compared with non-rheumatological controls, whereas the usual arthrosis between the first metacarpal bone and the trapezium was no more frequent. We could not find this same difference between the 2 groups.

Discussion

The arthropathy of the MCP and carpal joints in patients with CC that we describe has some characteristic features. The subchondral rarefactions in

Table 4 Arthropathy of the carpal joints (subchondral rarefactions with or without localised joint space narrowing)

	Generalised osteoarthritis*		
	Alone	With chondrocalcinosis	p
Number of patients with arthropathy	8	26	0.001
Number of hands with arthropathy	11	42	0.001
with joint space narrowing	8	28	0.001
without joint space narrowing	3	14	0.02

*Forty-six patients with 92 hands in each group.

Fig. 2 Close view of the second to fourth metacarpophalangeal (MCP) joints of a patient with CC. Exuberant osteophytosis in the second and third MCP joints with joint space narrowing and axis deviation. Extensive irregular, subchondral rarefactions in the bones of the second and third MCP joints. Calcification of the joint cartilage and in the synovium can be seen in the third MCP joint. Irregular surface of the head of the second metacarpal bone. The third MCP joint does not show any abnormality.

Fig. 3 Wrist from a patient with chondrocalcinosis. Numerous irregular cysts mainly in the os capitatum. Calcification of the ligamentum triangulare. There is little joint space narrowing.

both the carpal bones and the bones of the MCP joints have been previously linked to pyrophosphate arthropathy.^{3-5 8 10} The association of the subchondral rarefactions with joint space narrowing and osteophytosis, which is often exuberant, has also been observed. Deviation of the joint axis seems to be another, less well recognised feature. It can go on

to subluxation and seems to be typical for the arthropathy. This arthropathy may lead to bone destruction, as seen also in some of our patients. Destruction begins with diffuse irregularities of the superficial bone. Any one of the signs described above may occur in isolation.

For several reasons we think that the radiologically defined arthropathy described in this paper is relatively specific for CC, though similar lesions have been described in osteoarthritis^{13 14} and have been found in a small number of our patients with GOA only. In osteoarthritis alone osteophytes are more frequent, as is subchondral sclerosis. Changes in the MCP joints are usually associated with severe changes in the other finger joints, which was not necessarily the case in our patients with CC. Degenerative changes in the carpal joints, if we disregard the first carpometacarpal joint and the joint between the trapezium and the navicular, are relatively rare in the absence of a history of trauma. This has been corroborated in our group with GOA.

The lesions described are also different from those of rheumatoid arthritis, as discussed already by Martel *et al.*¹⁴ In CC the lesions are limited to the second and third MCP and carpal joints; the other joints are usually normal and do not show generalised periarticular osteoporosis as typically seen in rheumatoid arthritis. If erosive changes occur in CC, they do not have the characteristics of the marginal erosions found in rheumatoid arthritis but are more diffuse.

Lesions similar to those described here in CC are a

recognised feature of haemochromatosis.¹⁵⁻¹⁸ However, many of the patients with such an arthropathy have signs of CC as well. It is therefore not clear whether haemochromatosis is the important factor or CC. In our patients we have excluded, by simple tests, most of the diseases which predispose for CC and which could participate in the responsibility for the arthropathy described. Both in our previous study¹⁹ and in other studies,²⁰ cases of secondary CC are rare when CC in elderly patients is investigated. It seems therefore likely that the pyrophosphate arthropathy of the hands described here is in relation to CC rather than to another known metabolic disease.

The pathogenesis of this arthropathy is unclear. Inflammation is closely associated with pyrophosphate arthropathy and might contribute to its pathogenesis. Another underlying metabolic defect might predispose to both calcium pyrophosphate deposition and the arthropathies associated with it. But, as long as the primary disturbances in CC are not established, all explanations remain speculative.

In conclusion, we have completed previous descriptions of a particular arthropathy of the MCP and carpal joints and shown its specificity by comparing a group of rheumatological patients with CC with another group with a similar degree of generalised osteoarthritis. This arthropathy can be differentiated from osteoarthritis and other joint diseases. Perhaps other subgroups of common osteoarthritis can be separated in the future, permitting more directed aetiological studies in a search for specific treatment for these conditions.

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