

## EXTENDED REPORTS

# Defining osteoarthritis of the hand for epidemiological studies: The Chingford Study

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## Abstract

**Objectives**—To explore the relative merits of clinical and radiological examination in defining hand osteoarthritis (OA) for epidemiological purposes.

**Methods**—A total of 976 women aged 45–64 years were selected from the general population and underwent a structured interview, clinical examination of the hand joints and radiography of the hands and knees. The inter-relationship of the clinical and radiological findings was examined, and also the association of each with hand symptoms and the presence of knee OA.

**Results**—Clinical and radiographic signs of hand OA generally correlated with each other, and each was associated with hand symptoms to a similar degree. When analysed in combination, they were only marginally better at predicting symptoms than when tested individually. However, when they were examined in relation to radiographic features of knee OA, there was a significantly stronger association with radiographic features of hand OA than with clinical features.

**Conclusions**—Hand radiology provides a better overall assessment of osteoarthritis than physical examination of the interphalangeal joints or carpo-metacarpal joint; in situations where radiology is not available clinical examination is a viable substitute.

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In Western populations osteoarthritis (OA) is estimated to affect the joints of the hand in some 70% of men and women aged 65 years and over.<sup>1</sup> Hand OA is important both as a

cause of pain and minor disability, and because it often indicates a systemic tendency to OA which may also involve the weight-bearing joints, notably the hip and knee.<sup>2</sup> Epidemiological studies of hand OA require explicit diagnostic criteria to classify the disease in the general population. Most studies to date have used a system for grading radiographic severity that was developed by Kellgren and Lawrence.<sup>3,4</sup> However, the Diagnostic and Therapeutic Criteria Committee of the American College of Rheumatology (ACR) recently concluded that radiography was of less value than clinical examination for classifying symptomatic OA of the hand.<sup>5</sup>

Clinical examination is cheaper and safer than the use of x rays, and if it allows satisfactory case definition then it should be the diagnostic method of choice. We have used data from a population-based survey of rheumatic disease in women aged 45–65 years to explore further the relative merits of clinical and radiological examination in defining hand OA for epidemiological purposes.

## Patients and methods

The study sample comprised 1003 women aged 45–65 selected from the age-sex register of a large general practice in Chingford, east London. Women from this practice are similar to the UK general population in terms of weight, height and body mass index. The response rate of the sample was 78%, and further details of the lifestyle characteristics of these women have been reported elsewhere.<sup>6</sup> Each woman was interviewed with a standard questionnaire, which among other things asked about lifetime history of pain or stiffness in the interphalangeal joints of the hands and of pain in the first carpo-metacarpal joints. After the interview, a physical examination was performed which included assessment of osteoarthritis in the hands and knees. Each interphalangeal joint was clinically graded according to the presence and severity of bony swelling (table 1). First carpo-metacarpal joints were classified according to the presence or absence of palpable squaring of the thumb base. Each knee joint was assessed for bony swelling and crepitus.

The women were also asked to have a radiographic examination of the hands (antero-posterior [AP]) and knees (standardised weight bearing AP view). All radiographs were assessed by a single trained observer who was

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Table 1 Definition of clinical and radiographic grades

Clinical		First carpo-metacarpal joint	
Interphalangeal joints		First carpo-metacarpal joint	
0	No bony swelling	0	No palpable squaring
1	Possible bony swelling	1	Palpable squaring
2	Definite bony swelling, not severe		
3	Severe bony swelling but no deformity		
4	Severe bony swelling with deformity		
Radiographic			
Grade 0	None	No features of OA	
Grade 1	Doubtful	Minute osteophyte, doubtful significance	
Grade 2	Minimal	Definite osteophyte, unimpaired joint space	
Grade 3	Moderate	Moderate diminution of joint space	
Grade 4	Severe	Joint space greatly impaired with sclerosis of subchondral bone	

blind to the earlier clinical findings. Osteoarthritic changes in the interphalangeal and first carpo-metacarpal joints of the hands were graded according to the scheme devised by Kellgren and Lawrence (table 1) using the figures and legends of the original atlas.<sup>4</sup> Osteoarthritis was deemed to be present in the knees if changes of Kellgren and Lawrence grade two or higher (the presence of osteophyte and joint space narrowing) were observed in either knee.

We have previously reported the reproducibility of the clinical and radiological assessments performed in the study.<sup>7,8</sup> For both the interphalangeal and carpo-metacarpal joint groups, assessments were sufficiently reproducible for epidemiological use (between-observer kappa statistics of 0.7 to 1.0), and there were no appreciable differences in the reproducibility of the clinical and radiological measures.

Twenty seven women declined radiography and the analysis in this paper is restricted to the 967 women for whom complete clinical information was also available. We examined the interrelation of clinical and radiographic features of osteoarthritis in the hands, and the association of each with hand symptoms and with the presence of clinical and radiographic osteoarthritis of the knees. The associations with osteoarthritis of the knees were assessed by logistic regression.

## Results

Clinical and radiographic grades were compared for 17 406 interphalangeal joints (table 2) and 1934 first carpo-metacarpal joints (table 3). For both sets of joints, high clinical grades tended to be associated with more severe radiographic abnormalities,<sup>7</sup> but the correlation between the two grading systems was far from perfect. For example, 11 interphalangeal joints were given the most severe grade (grade 4) on x ray but showed no bony swelling on examination, and two with severe clinical changes were classed as normal radiographically. Similarly, 11 of 37 carpo-metacarpal joints with grade 4 radiographic changes showed no abnormality on clinical assessment, while 62 with clinical signs were given a radiographic grade of zero. When the distal and proximal groups of interphalangeal joints were analysed separately, there was no appreciable difference in the association of clinical and radiographic fractures.

Women were asked whether they had ever experienced pain or stiffness in each of four groups of interphalangeal joints – right or left hand, proximal and distal. (The interphalangeal joint of the thumb was excluded from this classification). Table 4 shows the prevalence of symptoms according to the maximum clinical and radiographic grades of osteoarthritis in each joint group. The overall prevalence of symptoms was 19.8%, with rates rising from 10.9% in subjects with no signs or radiological evidence of disease to 93.1% in those with grade 3 or 4 changes both clinically and on x ray. Within each clinical grade, symptom

prevalence increased progressively with radiographic grade. Similarly, within each radiographic grade prevalence of symptoms increased as clinical changes became more severe. The relationships between hand symptoms and each of clinical and radiographic grades were highly significant ( $p < 0.01$ ) using likelihood ratio tests for linear trend.

Some 15% of first carpo-metacarpal joints were reported to have been painful currently or at some time in the past. Table 5 shows the prevalence of reported pain according to the clinical and radiographic grades of carpo-metacarpal joints. As in the interphalangeal joints, clinical and radiographic changes were independently and statistically significantly ( $p < 0.01$ ) associated with symptoms.

Osteoarthritis of the knee, defined as a Kellgren and Lawrence grade of two or higher in either knee, was found in 121 women, a prevalence of 12.5%. Table 6 shows the associations of radiographic osteoarthritis of

Table 2 Comparison of clinical and radiographic grade for 17 406 interphalangeal joints

Clinical grade	Radiographic grade					All grades
	0	1	2	3	4	
0	14 147	1044	230	24	11	15 456
1	481	173	75	2	0	731
2	481	246	218	23	5	973
3	38	37	63	42	24	204
4	2	4	6	10	20	42
All grades	15 149	1504	592	101	60	17 406

Table 3 Comparison of clinical and radiographic grade for 1934 first carpo-metacarpal joints

Clinical grade	Radiographic grade					All grades
	0	1	2	3	4	
0	1283	312	117	27	11	1750
1	62	39	38	19	26	184
All grades	1345	351	155	46	37	1934

Table 4 Prevalence (%) of symptoms in 3868 interphalangeal joint groups (proximal and distal) according to clinical and radiographic changes in those joints

Maximum clinical grade	Maximum radiographic grade			All grades
	0/1	2	3/4	
0/1	10.9	27.6	43.8	11.8
2	46.4	55.3	75.0	50.2
3/4	68.3	81.5	93.1	82.4
All grades	15.2	48.7	80.9	19.8

Table 5 Prevalence (%) of pain in 1934 first carpo-metacarpal joints according to clinical and radiographic changes

Clinical grade	Radiographic grade			All grades
	0/1	2	3/4	
0	7.9	22.2	47.4	9.7
1	53.5	71.1	80.0	63.6
All grades	10.6	34.2	65.1	14.8

**Table 6** Associations of radiographic osteoarthritis of knees with clinical and radiographic changes of osteoarthritis in hands

	<i>All odds ratios are adjusted for age in five year intervals</i>		
	<i>No with osteoarthritis of knee</i>	<i>Each variable examined independently OR (95% CI)</i>	<i>All variables examined simultaneously OR (95% CI)</i>
<b>Maximum clinical grade in interphalangeal joints</b>			
0/1	62	1	1
2	37	1.4 (0.9-2.2)	1.2 (0.8-2.0)
3/4	22	1.7 (1.0-3.1)	1.0 (0.5-2.0)
<b>Maximum clinical grade in first carpo-metacarpal joints</b>			
0	102	1	1
1	19	1.1 (0.6-1.9)	0.7 (0.4-1.3)
<b>Maximum radiographic grade in interphalangeal joints</b>			
0/1	71	1	1
2	32	1.5 (0.9-2.4)	1.3 (0.8-2.2)
3/4	18	2.0 (1.6-5.8)	2.4 (1.0-5.7)
<b>Maximum radiographic grade in first carpo-metacarpal joints</b>			
0/1	79	1	1
2	24	2.2 (1.3-3.7)	2.1 (1.2-3.6)
3/4	18	2.5 (1.4-4.7)	2.5 (1.2-5.2)

**Table 7** Associations of clinically defined knee osteoarthritis (bony swelling and/or crepitus) with clinical and radiographic changes of hand osteoarthritis

	<i>All odds ratios are adjusted for age in five year intervals</i>		
	<i>No with osteoarthritis of knee</i>	<i>Each variable examined independently OR (95% CI)</i>	<i>All variables examined simultaneously OR (95% CI)</i>
<b>Maximum clinical grade in interphalangeal joints</b>			
0/1	176	1	1
2	92	1.5 (1.1-2.0)	1.4 (1.0-2.0)
3/4	42	1.4 (0.9-2.1)	1.3 (0.7-2.3)
<b>Maximum clinical grade in first carpo-metacarpal joints</b>			
0	255	1	1
1	55	1.6 (1.1-2.3)	1.3 (0.8-2.0)
<b>Maximum radiographic grade in interphalangeal joints</b>			
0/1	216	1	1
2	71	1.2 (0.8-1.7)	1.0 (0.7-1.6)
3/4	23	1.1 (0.6-2.0)	0.8 (0.4-1.7)
<b>Maximum radiographic grade in first carpo-metacarpal joints</b>			
0/1	240	1	1
2	37	1.1 (0.7-1.6)	1.0 (0.6-1.5)
3/4	33	1.8 (1.1-3.2)	1.6 (0.9-2.9)

the knee with four different clinical and radiological indices of osteoarthritis in the hands. When the four indices were examined independently, all but the clinical grade of the first carpo-metacarpal joints showed a statistically significant association with radiographic disease in the knee. However, when all indices were analysed simultaneously in a logistic regression model, the association with clinical grading of the interphalangeal joints also disappeared. In contrast, the associations with radiographic changes in the interphalangeal and carpo-metacarpal joints remained significant and mutually independent. Table 7 shows the comparable data for the relationship between indices of hand osteoarthritis and physical signs of knee osteoarthritis. Bony swelling and/or crepitus, the two signs proposed as discriminatory by the ACR, were present in 310 women (32%). When the four hand indices were examined independently,

the associations were generally weaker than those found for radiographic knee osteoarthritis. When combined in the logistic regression, these relationships were little changed.

## Discussion

There is no absolute clinical, radiological, or pathological standard against which epidemiological definitions of hand OA can be tested.<sup>9</sup> In this study, therefore, we compared the associations of clinical and radiographic measures of the disease with reported symptoms and with radiographic OA of the knee, the large joint most often affected in association with hand OA.<sup>10</sup> Clinical and radiographic grades correlated with each other and were associated with symptoms to a similar degree. Moreover, when analysed in combination they were only marginally better at predicting symptoms than when tested individually. For example, the prevalence of symptoms in women with grade 3/4 changes in the interphalangeal joints on physical examination was 82.4%, while for women with grade 3/4 changes on x rays it was 80.9%. When both clinical and radiographic changes were graded 3/4, the prevalence rose to 93.1%. In contrast, there were marked differences in the relation of clinical and radiological changes to radiographic knee OA. Bony swelling of the interphalangeal joints on physical examination was significantly associated with radiographic OA of the knee when analysed in isolation, but after allowance for the findings on x ray of the hands, the relation disappeared. When clinically defined knee OA (bony swelling and/or crepitus) was used in this analysis, no clear pattern emerged. These findings suggest that hand radiology is a better predictor of knee disease than hand examination.

Several limitations should be considered in interpreting these observations. Firstly, our study sample was restricted to women aged 45-65 years. The validity of clinical and radiological diagnoses might vary with age and differ between men and women. The behaviour of single and multiple hand joint involvement may also differ in terms of the association between clinical examination, radiography and pain. Secondly, our information about symptoms concerned lifetime prevalence whereas recent prevalence would probably have been a more appropriate measure. The longer time span over which symptoms were ascertained may explain the higher prevalence of symptoms than in previous surveys.<sup>11-15</sup> Thirdly, the associations between clinical measures of OA and reported joint symptoms may have been exaggerated because the interviewer who examined the hands was already aware of the symptom history. In contrast, the radiographs were graded by a different investigator who did not know the earlier history and physical findings. If anything, this bias would exaggerate the merits of clinical assessment.

Our finding that radiological classification is superior to clinical grading is at variance with the ACR recommendations.<sup>5</sup> However, their

conclusion was based on the ability of clinical and radiological features to discriminate between patients with hand OA and patients attending a rheumatology clinic with other causes of hand pain, mainly rheumatoid arthritis. In the general population, where the prevalence of OA is much higher than that of other arthritis, accurate diagnosis depends more on distinguishing OA cases from people with no joint disease whatsoever. For this purpose, it appears that x ray must be more useful than physical examination. This observation is unlikely to be explained by differences in the reproducibility with which clinical and radiographic features were assessed. In previous studies,<sup>7,8</sup> we have shown that the between-observer variation in assessing bony swelling of the distal interphalangeal joint ( $\kappa = 0.68$ ) is not significantly different from that for assessment of osteophyte at the same site ( $\kappa = 0.58$ ). However, the definition of pain which we used in our study differed from that used in the ACR study, which enquired about pain on most days for at least one month during the previous year.

One previous population-based study<sup>15</sup> has examined the association between clinical and radiographic features of hand OA, as well as correlating hand involvement with knee disease. Assessments were made on 6584 men and women in Zoetermeer, The Netherlands, and strong relationships were reported between radiographic hand and knee OA. The presence of Heberden's nodes was also found to be highly predictive of radiographic OA at these two sites, although the overall prevalence of clinical signs of OA was substantially lower than that of radiographic OA. In contrast to the American College of Rheumatology Study,<sup>5</sup> the authors of this Dutch study concluded that radiography is the method of choice for the confirmation of hand OA in populations or subgroups within populations. Our results support this notion, but suggest that clinical examination might be an acceptable, albeit less preferable, option.

Radiographic assessment of OA is currently undergoing a reappraisal.<sup>5,9,16,17</sup> We used the Kellgren and Lawrence scheme for grading joints, but this system has several deficiencies.<sup>9</sup> They include inconsistent descriptions of the criteria by which grades are assigned, uncertain reproducibility, and overemphasis on isolated osteophyte formation. Recent epidemiological studies of hand OA have examined the reproducibility with which component radiographic features (joint space narrowing, osteophytes, sclerosis, cysts, deformity and collapse) are assessed,<sup>16,17</sup> and have led to the proposal of a new set of standard radiographs in which these features are graded separately.<sup>17</sup> The reproducibility of grading with these more explicit standards is greater, both within and between observers, than that using the Kellgren and Lawrence scales. Such improvements should further enhance the value of radiological assessment. Advances in our understanding of knee osteoarthritis also have relevance to our study. The patellofemoral compartment of the

knee joint is increasingly recognised as a site of involvement in osteoarthritis,<sup>18</sup> and one which results in knee pain and disability. This compartment was not assessed in either the Dutch study<sup>15</sup> or our own, an omission which might have reduced the performance of hand radiography further.

In summary, our findings in middle-aged women suggest that radiology is more useful than physical examination in the classification of hand OA for epidemiological studies in the general population, and that assessment should include examination of the thumb carpometacarpal joints as well as the interphalangeal joints. If radiographs are available, physical examination adds little. However, if radiographs cannot be obtained, clinical evaluation of the interphalangeal joints provides a good alternative index of disease.

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