Rheumatology 2006;45:757–760 doi:10.1093/rheumatology/kei270
Advance Access publication 17 January 2006

Concise Report

Prevalence of radiographic osteoarthritis—it all depends on your point of view

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***Objectives*. Knee pain and disability in older people may occur in the apparent absence of radiographic osteoarthritis. However, the view chosen to define radiographic osteoarthritis may be critical. We have investigated the prevalence and compartmental distribution of radiographic osteoarthritis in people with knee pain using different combinations of three separate radiographic views.**

***Methods*. We performed a population-based study of 819 adults aged 50 yr and over with knee pain (part of the Clinical Assessment Study – Knee [CAS(K)]). Three radiographic views were obtained: weight-bearing posteroanterior (PA) semiflexed/metatarsophalangeal view; supine skyline; and supine lateral.**

***Results*. Complete data for all three views were available on 777 subjects. The distribution of compartmental radiographic osteoarthritis was 314 (40%) combined tibiofemoral/patellofemoral, 186 (24%) isolated patellofemoral, 31 (4%) isolated tibiofemoral and 246 (32%) normal. Hence, the overall prevalence of radiographic osteoarthritis was 531/777 (68.3%) in this symptomatic population. Using a PA view alone (reflecting tibiofemoral osteoarthritis only) would identify 56.7% of the 531, whilst the addition of a skyline or lateral view increased this to 87.0%. When using both skyline and lateral views in addition to the PA view, 98.7% cases of radiographic osteoarthritis were identified. In addition to prevalence, compartmental distribution altered markedly when different combinations of views were used.**

***Conclusions*. Multiple views detect more radiographic osteoarthritis than single views alone. When different combinations of views are used, the prevalence and compartmental distribution of osteoarthritis changes and this may alter the accepted relationship, or lack of it, between symptoms and radiographic change.**

KEY WORDS: Osteoarthritis, Diagnosis, Imaging, Knee, Epidemiology.

Assessing the relationship between radiographic features of knee osteoarthritis and pain and disability is complex, and the choice of radiographic view may be critical. Previously, a lack of correlation between symptoms and radiographs has been found [1]. One possible explanation is that radiographs do not detect minor osteoarthritis changes and this has been demonstrated when compared with magnetic resonance imaging studies [2]. Alternatively, studies often have incomplete views of the joint and when the views are extended to encompass all aspects of the knee joint, the prevalence of radiographic changes of osteoarthritis is likely to be higher.

The choice of views to identify radiographic osteoarthritis of the knee has evolved over the last few decades. Earlier studies used anteroposterior (AP) views only but this restricted imaging to the tibiofemoral joint [3, 4]. As the importance of the patellofemoral joint and its probable contribution to knee symptoms was recognized [5], it began to be routinely imaged. This, however, required views additional to the traditional AP/posteroanterior (PA) approach, either a skyline or lateral, opinions differing as to which was the most appropriate [6, 7]. It became clear that the patellofemoral joint should be included, as the addition of either a skyline or lateral increased detection of radiographic osteoarthritis markedly, with similar detection rates for each view [7]. The skyline view has been demonstrated to be more reliable for measuring joint space width than the lateral approach [8], but the latter has the advantage of imaging the posterior aspect of the tibiofemoral joint, which is missed by the traditional AP/PA view of this joint. Differing views and combinations of views might affect not only the total number of subjects classified as having osteoarthritis but also the distribution of different patterns of compartmental involvement within the knee joint. Such differences may then be reflected in varying levels of associations with symptoms and disability.

We have carried out a study with the objective of establishing the prevalence and compartmental distribution of radiographic osteoarthritis in people aged 50 yr and over with knee pain, using different combinations of views.

Methods

Selection of cases

Participants were part of a large prospective study of knee pain and knee osteoarthritis in the general population: the Knee Clinical Assessment Study, CAS(K). Ethical approval was obtained for all stages of the study from the North Staffordshire Local Research Ethics Committee and all participants provided written consent.

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Submitted 27 July 2005; revised version accepted 22 November 2005.

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All patients aged 50 yr and over registered with one of three general practices in North Staffordshire were invited to take part in a two-stage postal survey. The following question was included in the survey: 'Have you had pain in the last year in and around the knee?' [9]. This has been validated as a question which can be used to identify everyone with knee pain in this age group of the population. Those who indicated that they had experienced knee pain were invited to attend a research clinic. This consisted of clinical interview, physical examination, digital photography, plain X-rays of both knees, anthropometric measurement and a brief self-complete questionnaire. A detailed description of the study has been described previously [10].

For this study, the radiographs of only one knee per individual were analysed, the 'index knee'. In patients with unilateral knee pain, the 'index' was the single painful knee; in those with bilateral pain, it was the most painful knee. In situations where participants felt both knees were similarly painful, the index knee was selected at random.

Radiography

Three views of the knee were obtained for each subject at clinic: the weight-bearing PA semiflexed/metatarsophalangeal view according to the Buckland-Wright protocol [11]; a skyline view; and a lateral view. The last two views were obtained in the supine position with the knee flexed to 45°. All films were obtained in one radiology department by a team of six radiographers, who had all undergone training to standardize the X-rays and met for regular quality control sessions.

Scoring system

A single reader (R.C.D.) scored all films. The tibiofemoral joint was assessed using a PA view and, for the posterior compartment, a lateral view. The patellofemoral joint was assessed using a skyline and a lateral view.

A Kellgren and Lawrence (K & L) score was assigned to the PA and skyline views using the original written description, which included the presence of a 'definite' osteophyte for grade 2 [12]. For the lateral view, a standard atlas [13] was used to define the appearance of definite superior and inferior osteophytes. Posterior tibial surface osteophytes do not appear in this atlas but were judged on the same basis of severity as osteophytes shown in the lateral view.

Defining radiographic knee osteoarthritis

Tibiofemoral osteoarthritis was defined by a K & L score ≥ 2 on the PA view and/or the presence of definite osteophytes on the posterior tibial surface of the lateral view.

Patellofemoral osteoarthritis was defined by a K & L score ≥ 2 on the skyline view and/or the presence of a definite superior and/or inferior osteophyte on the patella surface of the lateral view.

Combined tibiofemoral and patellofemoral osteoarthritis was defined as the presence of tibiofemoral osteoarthritis and patellofemoral osteoarthritis occurring together in a single knee joint.

Any osteoarthritis in the knee joint was defined as K & L score ≥ 2 in the PA and/or K & L score ≥ 2 in the skyline and/or the presence of superior or inferior patella osteophytes on the lateral and/or the presence of posterior tibial osteophytes on the lateral view.

Repeatability

Intra-observer and interobserver repeatability was assessed in 50 subjects (100 knees); the second reader (P.C.) had previous experience of grading knee radiographs. Unweighted κ coefficients and exact percentage agreement were calculated.

Results

Eight hundred and nineteen individuals attended the clinic, of whom 777 had full radiological data in all three views. Forty-two were excluded [patients declined radiography (2); existing diagnosis of inflammatory arthritis confirmed by medical records (16); total knee replacement of index knee (15); unlabelled PA view (2); absent patella (2); skyline views deemed uninterpretable (5)]. Of the study population of 777, there were 420 females, mean age 65.5 yr (range 50–93). The overall mean body mass index was 29.6 kg/m^2 (range 17.0–51.6) with no difference between men and women. Repeatability was good, although intra-observer was better than interobserver repeatability. Posterior tibial osteophytes had the lowest κ scores, although intra-observer repeatability was still very good ($\kappa = 0.81$) and even the interobserver was sufficiently high ($\kappa = 0.49$) to justify its inclusion in the definition. Results of the intra-observer and interobserver repeatability are demonstrated in Table 1.

Using all three views of the index knee in the 777 participants studied, 531/777 (68%) had evidence of radiographic osteoarthritis. The distribution of compartmental osteoarthritis was 314 (40%) combined tibiofemoral/patellofemoral, 31 (4%) isolated tibiofemoral and 186 (24%) isolated patellofemoral, with 246 (32%) having no radiographic osteoarthritis.

Figure 1 illustrates (i) the total number of subjects who would be identified as having osteoarthritis and (ii) the compartmental distribution of osteoarthritis when different combinations of views were applied to the 777 people in our study population.

If only the PA view was used, 301 (56.7%) cases of osteoarthritis were detected from a possible 531. The addition of a skyline or lateral view substantially increased the total number of osteoarthritis cases detected to approximately 462 (87.0%) and altered the compartmental distribution. The detection rate was virtually identical regardless of whether the skyline or lateral was added to the PA. When both the lateral and skyline were added to the PA, the detection of osteoarthritis was much higher, at 524 (98.7%), and the number of subjects with isolated patellofemoral osteoarthritis increased considerably.

Assessing posterior tibial osteophytes in the tibiofemoral joint produced very few extra cases of radiographic osteoarthritis, but it did alter the compartmental distribution, with a large increase in the combined tibiofemoral/patellofemoral osteoarthritis group.

A total of 500 subjects had any patellofemoral osteoarthritis, of whom 305 demonstrated radiographic osteoarthritis on both the lateral and skyline. However, isolated changes occurred within the skyline and lateral view in 96 and 99 individuals, respectively.

Discussion

This study has shown that the number of subjects identified with radiographic osteoarthritis of the knee is affected by the number of views used to image the joint. The distribution of osteoarthritis within compartments of the knee is also influenced by the number

TABLE 1. Intra-observer and interobserver unweighted κ coefficients (exact percentage agreement)

Radiographic feature	Intra-observer	Interobserver
PA K & L score dichotomized at ≥ 2	0.98 (99)	0.76 (89)
Skyline K & L score dichotomized at ≥ 2	0.94 (97)	0.62 (90)
Superior and inferior lateral osteophytes	0.91 (96)	0.71 (87)
Posterior tibial plateau osteophytes	0.81 (92)	0.49 (78)

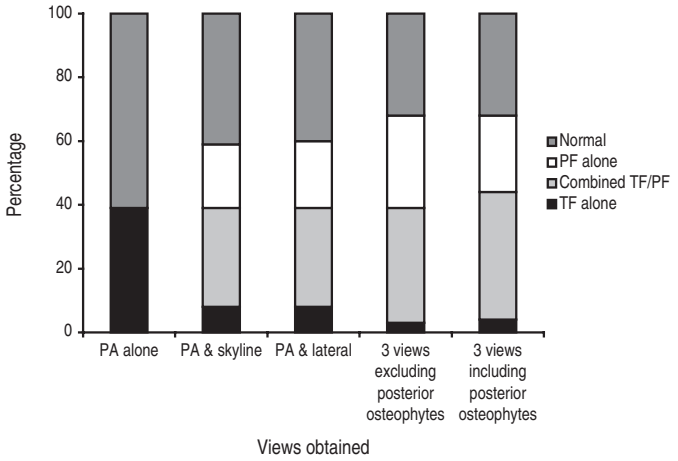

FIG. 1. Total number of subjects identified and compartmental distribution of radiographic osteoarthritis when different views are applied to the study population.

of views, and compartmental prevalence estimates of radiographic osteoarthritis in the population are consequently affected.

Participants were selected using the question 'Have you had pain in the last year in and around the knee?' Using this question to capture participants with knee pain rather than 'Have you ever had pain in or around the knee on most days for at least a month?' and 'Have you experienced any pain during the last year?' identified more knee pain sufferers, including those with intermittent acute pain. We chose this question to reflect our purpose of identifying all knee pain sufferers in the population [9].

Kellgren and Lawrence originally intended their definition to be applied to the AP view but the written description has enabled us to apply it to the skyline view. We used the widely accepted minimum score of 2 (i.e. a definite osteophyte and unimpaired joint space) to define the presence of radiographic osteoarthritis. Because of the difficulty in estimating joint space width on the lateral view, the K & L score was not applied to this view; instead a definite osteophyte was used as a marker of radiographic osteoarthritis, comparable to a K & L score of 2. The K & L score for PA and skyline views, and osteophyte score for the lateral, were combined to give a definition of radiographic osteoarthritis for the whole joint and each compartment. Although this is a 'new' grading system, we see it as a logical extension of the K & L method and it is comparable with the American College of Rheumatology (ACR) definition of an osteophyte [14]. Additionally it has the capacity to be subdivided and provide a grading system similar to the K & L whilst encompassing all three views. Our definition of radiographic osteoarthritis does rely on the presence of an osteophyte and does not rely on joint space width alone. Whether radiographic osteoarthritis could additionally be defined on the basis of mild joint space narrowing alone would need a comparison of radiographs between our population and those without knee pain. However, 53.3% of the group in our study defined as having radiographic osteoarthritis according to osteophyte presence had moderate to severe joint space narrowing on X-ray, compared with only 4.1% of the group with no osteophytes present. This suggests that we may be underestimating the presence of radiographic osteoarthritis in our population by excluding those with moderate to severe narrowing alone, but only by a small amount.

The presence of a 'definite' osteophyte that we used as the basic definition of radiographic osteoarthritis accords with the ACR criteria and corresponds to the definition used by Chaisson *et al*. [7] in their study of different radiographic views in the knees of symptomatic individuals. Our findings that lateral and skyline views separately increase the sensitivity of identifying 'any knee osteoarthritis' above that of the AP/PA alone is similar to that of Chaisson's group. However, we have added to those findings by estimating the prevalence of radiographic changes in a group of older people with knee pain from a population sample unselected by their use of health-care, and showing that (i) the additional individuals identified by lateral and skyline views overlap partly; (ii) that the attribution of osteoarthritis to compartments is strongly affected by the number of views; and (iii) that a supine skyline view is practical and quick and rarely gives poor radiographs when carried out in a District General hospital by regular but trained clinic staff.

We conclude, therefore, in contrast to Chaisson *et al*. [7], that all three standardized views can be easily and quickly obtained in clinical or research practice, and that the prevalence and compartmental distribution of radiographic changes identified in symptomatic people will be optimally established by doing so. However, our study has not established either that having all three views will provide better insight into the causes of knee pain or that having all three views will increase the usefulness of X-rays in the management of older patients with painful knees. We are currently addressing both these questions in further stages of the CAS(K) study.

Rheumatology	Key messages
	• The choice of radiographic view influences the prevalence and compartmental distribution of knee osteoarthritis. • Three standardized radiographic views of the knee can be obtained easily and quickly by clinical radiographers.

Acknowledgements

The authors would like to acknowledge the contributions of Dr George Peat, Dr Krysia Dziedzic, June Handy, Jonathan Hill, Helen Myers, Ross Wilkie, Dr Lawrence Wood and Dr Elaine Thomas to aspects of the conception and design of the study and to the acquisition of data. We would like to acknowledge Carole Jackson, Julia Myatt, Janet Wisher, Sue Stoker, Sandra Yates and Kath Hickson from the Department of Radiology, Haywood Hospital, who acquired all films. This study was supported financially by a Programme Grant awarded by the Medical Research Council, UK (Grant Code G9900220) and by Support for Science funding secured by North Staffordshire Primary Care Research Consortium for NHS service support costs.

The authors have declared no conflicts of interest.

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