Osteoarthritis and Cartilage xxx (2015) 1–4

Osteoarthritis and Cartilage

OARSI OSTEOARTHRITIS RESEARCH SOCIETY INTERNATIONAL

Brief Report

Evidence that meniscus damage may be a component of osteoarthritis: the Framingham study

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ARTICLE INFO

Article history:
Received 22 April 2015
Accepted 18 August 2015

Keywords:
Osteoarthritis
Radiography
Magnetic resonance imaging
Knee
Hand
Meniscus

SUMMARY

Objectives: The etiology of degenerative meniscus tear is unclear but could be related to a generalized osteoarthritic disease process. We studied whether radiographic hand osteoarthritis (OA) is associated with meniscus damage.

Methods: We examined 974 persons aged 50–90 years drawn via census tract data and random-digit dialing from Framingham, Massachusetts, United States. One reader assessed bilateral hand radiographs (30 joints) and another read frontal knee radiographs, all according to the Kellgren–Lawrence (KL) scale. A third reader assessed right knee 1.5-T magnetic resonance imaging (MRI) scans for meniscus damage. We calculated the prevalence of medial and/or lateral meniscus damage in those with one to two and three or more finger joints with radiographic OA (KL grade $\geq$2) compared to those without radiographic hand OA with adjustment for age, sex, and body mass index. We also evaluated the above association in persons without evidence of radiographic OA (KL grade 0) in their knee ($n = 748$).

Results: The prevalence of meniscus damage in the knee of subjects with no, one to two, and three or more finger joints with OA was 24.9%, 31.7%, and 47.2%, respectively. The adjusted prevalence ratio (PR) of having meniscus damage was significantly increased in those who had three or more finger joints with OA (1.40 [95% confidence interval (CI) 1.11–1.77]). The estimate remained similar in persons without evidence of radiographic OA in their knee (PR, 1.42 [95% CI 1.03–1.97]). The association was more robust for medial meniscus damage.

Conclusion: Results suggest a common non-age related etiologic pathway for both radiographic hand OA and meniscus damage.

Introduction

Meniscus damage is often present in the absence of knee trauma, and exists in about every third knee of middle-aged and older adults in the general population[1]. Despite the important role of meniscus damage in knee osteoarthritis (OA) development[2], there is limited knowledge of the etiology and pathogenesis in middle-aged and elderly persons[3,4]. Knee trauma, which classically is associated with meniscal injury in younger individuals, is often not reported[1,3]. It is possible that some individuals have an underlying predisposition for atraumatic meniscus damage that reflects an overall propensity for developing OA.

Thus, this study will address whether meniscus damage visible on magnetic resonance imaging (MRI) in persons drawn from the general population is also associated with OA in a distant set of joints in the hands. This would provide evidence that meniscus damage with aging is a part of an OA diathesis. In a prior report of

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http://dx.doi.org/10.1016/j.joca.2015.08.005
1063-4584/

risk factors for development of meniscal pathology, using a clinical diagnosis of Heberden's and (or) Bouchard's nodes, we found evidence of an association with the development of meniscal tear[3]. However, there is limited evidence if this holds true for actual *radiographic* changes of hand OA as correlation with the former is relatively low[5,6]. Hence, using cross-sectional data of middle-aged and elderly persons, we sought to investigate whether there is an association between *radiographic* evidence of OA in finger joints and meniscus damage of the knee.

Methods

Study design and subject recruitment

Subjects in the Framingham Osteoarthritis Study community cohort were randomly drawn from the town of Framingham, Massachusetts, United States. Framingham census tract data from the year 2000 and random-digit dialing were used to recruit subjects unselected for knee or other joint problems. The Boston University Medical Center Institutional Review Board approved the study[1].

To be included, subjects had to be at least 50 years of age, and ambulatory (use of assistive devices such as canes and walkers was allowed), with no plans to move out of the area for at least 5 years. Subjects with a history of bilateral total knee replacement, rheumatoid arthritis, dementia, or terminal cancer and those who had contraindications to MRI were excluded.[1]. Of 2582 individuals living in Framingham who were contacted, 1039 subjects were examined in the period October 2002–June 2005. We assessed the integrity of the medial and lateral meniscus in the right knee of persons who were willing and eligible to obtain MRI scans and whose scans were readable ($n = 991$)[1]. Of those, 974 obtained hand radiographs forming the final sample for analysis (Supplementary data 1).

Knee MRI

Knee MRI scans were obtained using a 1.5-T scanner with a phased array knee coil. We used three pulse sequences to assess meniscal integrity; sagittal and coronal fat suppressed proton-density turbo spin-echo. One reader (ME) read the right knee MRI scans for meniscus damage as previously detailed[1]. Readings were performed for each of the meniscal segments (the anterior horn, body, and posterior horn) for both the medial and lateral meniscus. We regarded an increased meniscal signal as indicative of a meniscal tear when it communicated with the inferior, superior, or free edge of the meniscal surface (or more than one of those) on at least two consecutive images (or for a radial tear, if it was visible on both the coronal and sagittal images). In this study we will refer to meniscus damage as the presence of a tear and/or partial or total destruction of either the medial or lateral meniscus. The reader was blinded to subject characteristics and clinical and radiographic data.

Hand radiography

One reader (IKH) graded the bilateral second to fifth distal interphalangeal, second to fifth proximal interphalangeal, first to fifth metacarpophalangeal, thumb interphalangeal, and thumb base (carpometacarpal/scaphotrapezial) joints for hand OA with use of a modified Kellgren and Lawrence (KL) scale. The details of these readings and reliability are as previously reported[7]. The observer was blinded to subject characteristics, clinical data, and other imaging data. We considered radiographic OA to be present in the joint if the KL grade was ≥ 2 (on a scale of 0–4, with higher numbers indicating more definite signs of OA).

Knee radiography

Of 991 subjects with readable knee MRI scans, 963 (961 had hand radiographs) underwent weight-bearing posteroanterior knee radiographs according to a fixed-flexion protocol. One musculoskeletal radiologist (PA), blinded to MRI scans and clinical and other study data, graded all films according to the KL scale with reliability as previously published[1]. Radiographic tibiofemoral OA was considered present if the KL grade was ≥ 2.

Clinic visit

At the clinic visit, subjects filled out a questionnaire including questions concerning any history of knee injury leading to a reduced ability to walk for at least 3 days or the use of crutches or a cane. We calculated the body-mass index as the weight in kilograms divided by the square of the height in meters.

Statistics

First, we divided the sample into three groups; persons with zero, one to two, or three or more finger joints with radiographic OA. We then calculated the prevalence of meniscus damage in at least one subregion of either the medial and/or lateral meniscus in those with one to two and three or more OA finger joints, respectively, as compared with those without OA in any finger joint. Second, we evaluated the number of hand joint groups that were affected out of the four; the distal interphalangeal (including the thumb interphalangeal) joints, the proximal interphalangeal joints, the metacarpophalangeal joints, and the two carpometacarpal/scaphotrapezial joints. We also evaluated medial and lateral meniscal damage separately. We report prevalence ratios (PRs) because the odds ratio overestimates the PR when the outcome is frequent. We calculated adjusted PRs using a Cox proportional-hazards model with a constant time period assigned to all subjects and robust variance estimation. We adjusted the primary model for age, sex, and body mass index. We were also interested in evaluating the knees completely free of radiographic findings equivalent to or suggestive of radiographic tibiofemoral OA, hence we evaluated the above associations in subjects with KL grade 0 in their right knee ($n = 748$). Finally, we performed a sensitivity analysis including self-reported right knee injury as a covariate in the models. All tests were two-tailed and we considered a *P*-value less than 0.05 to be statistically significant (STATA Release 11).

Results

Of the 974 subjects with readable right knee MRI scans and hand radiographs available, 56.9% were women, mean age was 62.3 years (range 50–90), and the mean body mass index was 28.6 kg/m^2 (range 16.6–55.6) (Table I).

Radiographic OA in at least one finger joint was present in 65.0%. Meniscus damage of the knee, i.e., in the medial or lateral compartment was present in 35.1% of the sample. The crude prevalence of meniscus damage in those without hand OA, OA in one to two finger joints, and OA in three or more finger joints was 24.9%, 31.7%, and 47.2%, respectively. The adjusted PR of having medial or lateral meniscus damage was significantly increased in those who had three or more finger joints with OA (PR, 1.40 [95% confidence interval (CI) 1.11–1.77]). The multivariable adjusted estimate remained similar in knees without evidence of radiographic OA (PR, 1.42 [95% CI 1.03, 1.97]) (Table II). Including knee injury as a covariate did not alter the above estimates of association (PR, 1.42 [95% CI 1.12–1.81] for all knees, and 1.42 [95% CI 1.02–1.98] for knees without evidence of radiographic OA).

Please cite this article in press as: Englund M, et al., Evidence that meniscus damage may be a component of osteoarthritis: the Framingham study, Osteoarthritis and Cartilage (2015), http://dx.doi.org/10.1016/j.joca.2015.08.005