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Original article

Association between hip morphology and prevalence, clinical severity and progression of hip osteoarthritis over 3 years: The knee and hip osteoarthritis long-term assessment cohort results

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ABSTRACT

Objective: To assess the effects of variations in hip morphology on prevalence, clinical severity and progression of hip osteoarthritis.

Methods: From 2007 to 2009, we conducted a study of 242 patients aged between 40 and 75 years with symptomatic lower limb osteoarthritis, as part of a population-based osteoarthritis cohort study in France. Standard radiographs of both hips were obtained at baseline and at three years. The progression of hip osteoarthritis was evaluated according to the radiological Kellgren-Lawrence score (KL) and clinical severity from the scores on a Visual Analogic Scale (VAS) for pain recorded yearly. Five measures were used to describe hip morphology: centre edge angle, acetabular index (AI), vertical centre anterior angle, acetabular depth and neck-shaft angle.

Results: Of the 484 hips studied, 205 (42%) showed osteoarthritis at baseline and 16 (11 right and 5 left) underwent joint replacement during the follow-up. AI was the morphological measure most consistently and strongly associated with radiographic osteoarthritis at baseline (odds-ratio = 1.05, 95% CI: 1.01–1.08 per degree of angle change), clinical severity (correlation coefficient with VAS during 3 years = 0.15, P = 0.004), radiological progression (odds-ratio = 1.05, 95% CI: 1.00–1.10 per degree) and joint replacement (hazard ratio = 1.18, 95% CI: 1.07–1.29 per degree).

Conclusions: Acetabular obliquity and especially AI is strongly, and likely causally, associated with the existence, severity and progression of hip osteoarthritis.

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1. Introduction

Hip osteoarthritis (OA) has become a serious public health issue. It is responsible for significant morbidity and disability, especially in the elderly; it is also the source of substantial costs [1]. This economic burden will undoubtedly increase in the forthcoming decades, and recent studies suggest that the prevalence will double by 2030 [1]. Guillemin et al. [2] estimated the prevalence of symptomatic hip OA in France as being between 2% and 6%.

Numerous studies have been published about risk factors for hip OA. They include both demographic factors such as age [3], and familial or ethnic susceptibility [4,5], and acquired factors, notably overweight [6], physical workload [7], and intense sports activities [8].

Although the role of developmental dislocation of hip joint and hip dysplasia has long been suspected [9,10], the association between hip dysplasia and OA has not been rigorously established and still remains controversial. In a recent systematic review, Harris-Hayes et al. concluded that there was only "limited evidence to suggest that bony abnormalities found in acetabular dysplasia and femoroacetabular impingement are associated with OA" and called for further studies [11].

The objective of this study was to assess the effects of various morphological features on prevalence, clinical severity and progression of hip osteoarthritis over time.

2. Patients and methods

2.1. Patients

The patients studied were enrolled in the KHOALA cohort (knee and hip osteoarthritis long-term assessment) which has been described in detail elsewhere [12]. Briefly, it is a multiregional population-based cohort of 878 patients with symptomatic lower limb OA. Patients were included from April 2007 to March 2009 and the inclusion criteria were:

- age from 40 to 75 years;
- symptomatic OA of at least one hip or knee according to the American College of Rheumatology criteria [13] and with a Kellgren-Lawrence (KL) score ≥ 2 [14].

The exclusion criteria were:

- joint replacement for the targeted joint;
- previous osteotomy for the targeted joint;
- severe comorbidity, that was threatening life or had a major impact on quality of life or health care consumption;
- history of rheumatic diseases other than OA;
- isolated patella-femoral OA.

Approval for this cohort was obtained from the regional ethics board (Comité de protection des personnes "Est 3"), and it has been registered at www.clinicaltrials.gov under the number NCT00481338.

The present study includes a subgroup of patients of this cohort for whom hip morphological measurements were available from another study [15], and who were followed-up for at least three years.

2.2. Data collected

Data were collected at baseline and after three years of follow-up during an outpatient visit, and each year with self-administered questionnaires. The data collected included demographic characteristics, and yearly data for pain (scored on a Visual Analogue Scale between 0, no pain, and 10, maximal pain), mobility, function (Harris Hip Score) [16], and health-related quality of life, as assessed from hip-specific (OAKHQOL) [17] or generic (SF-36) [18] questionnaires. Due to repeated measures, an area under the curve calculation was used to assess evolution of pain during the follow-up [19].

Antero-posterior pelvis and oblique or false profile (Lequesne) [20] weight-bearing views of both hips were obtained for all patients at baseline and for symptomatic or OA joints three years later. Overall, OA was scored with the KL score, and the location (lateral, medial, inferior, global) and severity of each radiological sign was noted *i.e.* osteophytes (from 0: none to 3: large osteophyte, on lateral, medial and inferior parts of the acetabulum and upper and lower faces of the head of the femur), joint space narrowing (JSN) (from 0: none to 4: complete disappearance of the joint space, as measured at the narrowest point of the joint space) and bone condensation (from 0: no condensation to 2: substantial condensation observed on the acetabulum and/or the head of the femur) and subchondral cysts (from 0: no cyst to 2; large cyst, either on the acetabulum or the femoral head). Details of each surgical intervention, including date and nature of the procedure, were collected.

The radiographic progression of hip OA over three years was displayed in tabular form [21] and further evaluated as a binary variable for each radiological sign and KL score. Osteoarthritis was considered to have progressed if there was an increase of at least one point in the KL score and was considered to be stable otherwise. The same method was used for each radiological sign. All radiological assessments were performed centrally by the same two readers (BM, EV), both experienced specialists in these assessments, and blind to the clinical and surgical data.

Five hip morphological variables (measured, as detailed elsewhere [22], before entry into the cohort study) were used to assess hip anatomy (Supplementary data, Fig. S1): Wiberg's centre edge angle (CEA) [23], HTE angle or acetabular index (AI) [24], acetabular depth (AD), neck-shaft angle (CC′D), and vertical centre anterior (VCA) angle on oblique views. We have previously shown that these measures are reproducible (intra-observer intraclass correlation coefficient values from 0.72 to 0.94 and inter-observer intraclass correlation coefficient values from 0.68 to 0.84) [22].

2.3. Statistical analysis

The association between hip morphology and osteoarthritis was evaluated both at baseline and after three years of follow-up. Some of the morphological variables studied did not follow a normal distribution, and sample sizes were small for some analyzes, so non-parametric tests were used. Dichotomic or multinomial logistic regression models were used for the analysis of binary or ordinal outcomes. Linear regression models were used for continuous outcomes after rank transformation. Cox proportional-hazard models were used for longitudinal analysis. Systematic adjustment for the delay between the diagnosis of hip OA and inclusion was performed in all analyses to take into account the truncation bias and OA extent at baseline. Other factors identified as confounders (i.e. statistically associated with both morphological variables and outcomes) were included in the models.

We studied the shape of the association between OA and morphological variables and in particular tested for the existence of thresholds of these variables over which there was a higher risk of OA. A method derived from that described by Nakamura was used [25]. From continuous variables, ten functions $f(x;s) = (x-s)+$ variables were created where function $()+$ is such that $(u)+ = u$ if $u \geq 0$; and $(u)+ = 0$ if $u < 0$; thresholds "s" were split every tenth percentile of the morphological variable. A backward stepwise model