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The prevalence of radiographic femoroacetabular impingement in younger individuals undergoing total hip replacement for osteoarthritis

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Abstract

Femoroacetabular impingement (FAI) has been suggested as a major cause of primary hip osteoarthritis (PHOA). We assessed the prevalence of FAI detected radio-graphically in a cohort

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that underwent total hip replacement (THR) for PHOA. Two radiologists independently assessed the retrospective preoperative radiographs (AP pelvis and lateral) of 82 subjects <55 years of age scheduled for THR. Subjects were categorized as: definite FAI, no FAI, and not possible to exclude FAI. Definite FAI was present in 36 % of subjects. FAI is common in young subjects undergoing THR for PHOA.

Keywords

Epidemiology; Femoroacetabular impingement; Hip joint; Hip osteoarthritis

Introduction

Femoroacetabular impingement (FAI) has been proposed as a common cause of hip pain in young adults and an important cause of primary hip osteoarthritis (PHOA). The pathomechanical process is consequent to subtle deformities of the hip joint, leading to repeated abnormal bony contact and a sequence of articular damage, pain, and ultimately radiographic OA [1, 2].

Current literature describes two main types of FAI: cam and pincer-type impingement. Cam impingement is characterized by a bony prominence at the femoral head–neck junction. With hip flexion or internal rotation, the cam lesion is forced against the acetabular rim, potentially leading to cartilage avulsion and damage [3, 4] (Fig. 1a). In contrast, pincer impingement involves acetabular over-coverage of the femoral head. Impingement occurs at the limit of hip movement as the femoral head is forced against the protruding acetabulum, leading to circumferential labral injury and cartilage damage [2–4] (Fig. 1b). Cam impingement is more commonly found in younger athletic males, while pincer impingement occurs typically in middle-aged females [3, 5]. Often, patients present with features of both impingement types [6].

FAI has been reported mainly in the orthopedic, rehabilitation, and sports medicine literature with limited reporting in rheumatology journals [7]. The clinical findings include groin pain associated with hip rotation, sitting position, or sports activities or limited range of motion [6]. On physical examination, a positive “impingement test” reproduces the groin pain when the hip is flexed to 90 ° with internal rotation and adduction [6]. Although most orthopedic centers in North America and Europe offer surgical options for FAI to address hip pain [8], there are limited data on the epidemiology of FAI. We have assessed the prevalence of FAI in a young cohort that underwent total hip replacement (THR) for PHOA.

Materials and methods

This retrospective study, approved by the University of British Columbia Clinical Research Ethics Board, used a Joint Replacement Service database to identify subjects aged <55 years, who received a THR between January 2007 and December 2008 for PHOA. Exclusion criteria included hip infection, rheumatoid arthritis, fracture, congenital/developmental hip dysplasia, and other causes of secondary hip OA.

Preoperative radiographs (AP pelvis and lateral views) closest in time to the THR were retrieved for each subject. Two radiologists assessed radiographs using a scoring tool based on a literature review [6, 9–11] (Tables 1 and 2). Each subject was categorized into one of three groups: definite FAI, no FAI, or not possible to exclude FAI. The latter group included subjects in whom the degenerative changes made it difficult to discern radiographic features of FAI. In cases of definite FAI, subjects were further categorized as having cam, pincer, or mixed-type impingement. Interobserver variability was resolved by consensus. Univariate statistical analysis was performed.

Results

Overall 470 THR cases were identified and assigned a numeric identifier (ID) using a random number generator; 82 subjects were then selected from a ranked list of these randomly assigned IDs. Seven of the 82 subjects were excluded due to the lack of preoperative radiographs (N 03), duplication (N 03), suspected secondary OA (N02), or poor quality radiographs (N01). Of 75 subjects, 49 (65 %) were male. The mean age was 49.5 ±4.7 years. Preoperative AP radiographs were available for all 75 subjects, but only 52 subjects (69 %) had lateral films available.

Definite FAI was present in 27 (36 %) subjects and no FAI in 25 (33 %) subjects. In 23 (31 %) subjects, FAI could not be excluded due to advanced osteoarthritis. Thus, of those that could be adjudicated clearly, 27 of 52 (52 %) had FAI and 25 of 52 (48 %) did not. Of the 27 subjects with FAI, 5 cam-type-, 13 pincer-type-, and 9 mixed-type cases were identified. There was a male predominance in cam-type features (70 % males vs. 0 % females) and a female predominance in pincer-type features (100 % of females vs. 75 % of males).

Discussion

Results of this study of younger adults who underwent THR suggest that FAI is common in this patient group. These findings add to the limited epidemiologic data available on the burden of FAI. The prevalence rates reported to date span a wide range, reflecting differences in the populations sampled, imaging modality used, and the criteria used to define FAI [5, 12–14].

Ochoa et al. [15] studied subjects (mean age 32 years) who presented to an army medical center with hip-related complaints. At least one radiographic FAI finding was present for 135 of 155 subjects (87 %), with radiographic signs of FAI including herniation pits, pistol grip deformity, center-edge angle, alpha angle, and crossover sign. Unlike in the study of Ochoa et al., where 60 % of the sample population were Tönnis grade 0 and 28 % were Tönnis grade 1, our study evaluated subjects with end-stage OA undergoing THR. Given the joint degeneration seen in advanced OA, some of the radiographic signs were not as apparent, which may explain our lower numbers of subjects with FAI. Tanzer and Noiseux [17] conducted a prospective study involving 200 consecutive patients under-going THR. Of the 200 patients, 125 (62 %) had PHOA, and all patients in this subset had a pistol grip deformity detected radiographically. Tanzer and Noiseux's population was similar to that of our study, but our prevalence of FAI was lower. This may be explained by presence of osteophytes in advanced OA that appear like pistol grip deformities. Furthermore, our careful assignment of subjects with osteophytes and questionable FAI to the “not possible to exclude FAI” group, may have contributed to lower numbers in the “definite FAI” group.

In another study, Kim et al. [16] assessed FAI in two groups who previously had hip arthroscopy for early OA. Group I consisted of patients with no radiographic OA but with degenerative changes of the labrum and cartilage on magnetic resonance (MR) arthrograms, while group II was composed of patients with early radiographic OA. Six of 21 (29 %) subjects in group I and 12 of 22 (56 %) subjects in group II showed radiographic evidence of FAI. The findings of Kim et al. are comparable to our figures. Our sampled populations were similar in that the subjects had hip OA that required a surgical procedure. They too used preoperative radiographs but had additional imaging from MR arthrography. More recently, in a cross-sectional population-based study that included 3,620 subjects (36.7 % male, 63.2 % female), Gosvig et al. reported the prevalence of hip OA to be 9.5 % in men and 11.2 % in women [13]. Among these subjects with hip OA, 71 % of males and 36.6 % of females had a concomitant hip malformation associated with FAI [13]. Of interest, new data are also emerging on the prevalence of cam-type deformities in asymptomatic individuals. Reichenbach et al. obtained MRI studies for 244 asymptomatic males (mean age 19.9 years) and found an overall prevalence of cam-type deformities to be 24 % [12]. The authors attributed this high prevalence of FAI in asymptomatic males to MRI imaging for its ability to better detect FAI signs. The heterogeneity—including patient populations evaluated, imaging modalities used, and definitions for FAI—of the studies described above makes it challenging to compare prevalence figures [12–17]. From the radiographs that we could accurately assess, 27 of 52 subjects (52 %) had FAI, a number lower than that reported by Ochoa et al. [15] and Tanzer and Noiseux [17] but closer to the findings of Gosvig et al. [13] and Kim et al. [16]. Our sample of 52 subjects with both AP and lateral films available is one of the limitations of our study. For example, sample size precludes comparative analyses between different FAI types or patient subgroups. However as described, the substantial heterogeneity in patient populations where FAI prevalence has been estimated as well as differences in imaging modalities used and definitions for FAI warrants ongoing epidemiologic studies of FAI. One limitation of our study’s retrospective design was the inability to assure standardized technique and views for the radiographs assessed. This is important since incorrect positioning or radiographic technique may affect the accuracy of interpretation [6]. In addition, the lack of lateral view radiographs for 23 of the 75 (31 %) eligible subjects made it difficult to discern cam impingement features. This may explain why we observed more pincer cases despite reports that mixed-type impingement is the most common. Our gender distribution for impingement type, however, was consistent with previous literature [5, 12–14]. Moreover, many of the subjects had radiographic end-stage OA, which made it difficult to exclude FAI (e.g., it was challenging to distinguish an osteophyte from a pistol grip deformity). The high frequency of FAI in PHOA has resulted in the interest in FAI as a primary cause and as a potentially surgically remediable condition. Further epidemiological studies including longitudinal studies given the cross-sectional nature of many previous studies, as well as the development of standardized radiologic criteria for identifying presence of bony abnormalities, are required to clarify the relationship between hip impingement and PHOA. Longitudinal studies would also be valuable in elucidating the percentage of asymptomatic individuals showing FAI radiographic signs who develop symptomatic hip OA and require THR in the future.

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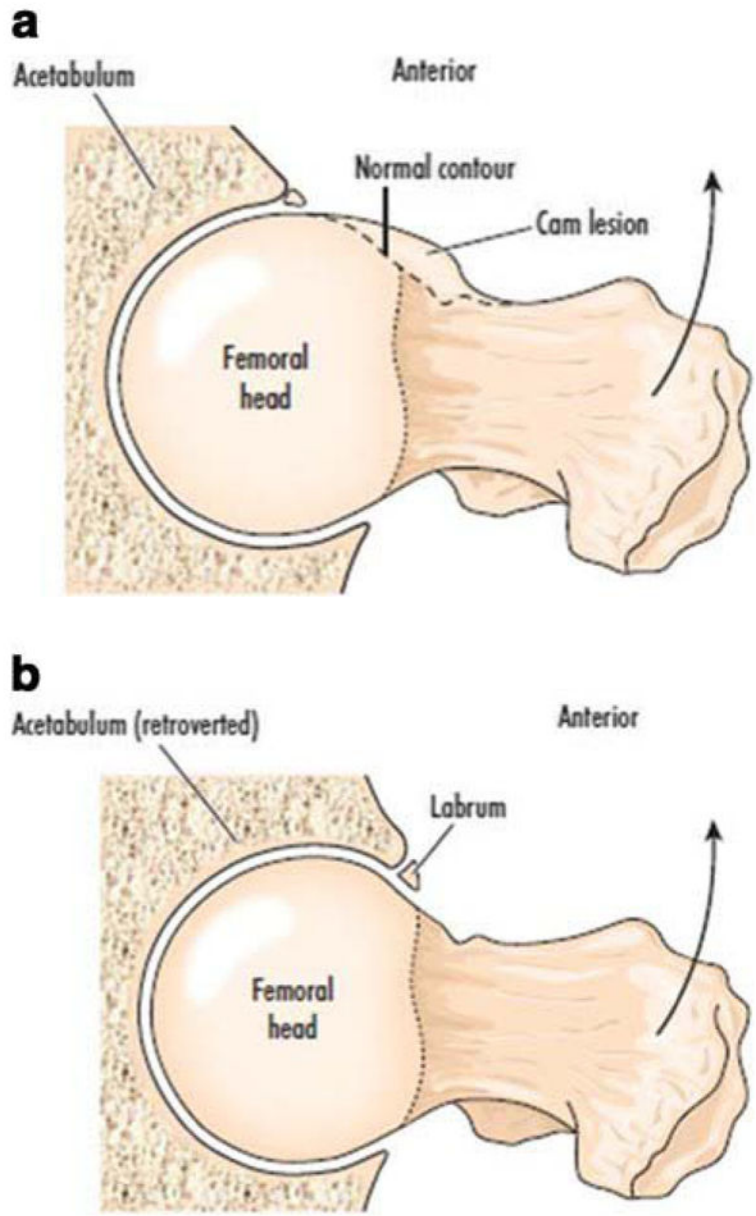

Fig. 1.

a). Cam impingement; b). pincer impingement. Reproduced with permission from Stafford and Witt [4]. The anatomy, diagnosis, and pathology of femoroacetabular impingement

Table 1

Radiographic signs in cam impingement [6, 11]

Radiographic sign	**Definition**	**Value in cam FAI**
Pistol grip deformity	Osseous bump located on lateral part of femoral head–neck junction	Present on AP Radiograph
Alpha angle	Angle formed by the axis of the femoral neck and a line connecting the center of the femoral head to the point where the contour begins to stray from a spherical radius	>50° on cross-table Radiograph
Femoral head-neck offset	Distance between the widest diameter of the femoral head and the most prominent part of femoral neck	<8 mm on cross-table radiograph
Offset ratio	Ratio between femoral head-neck offset and diameter of femoral head	<0.18 on cross-table radiograph

Table 2

Radiographic signs in pincer impingement [6, 9–11]

Radiographic sign	Definition	Value in pincer FAI
Coxa profunda	Floor of fossa acetabuli touching or overlapping ilioischial line medially	Present on AP radiograph
Protrusio acetabuli	Femoral head overlaps ilioischial line medially	Present on AP radiograph
Reduced femoral head extrusion index	Percentage of femoral head uncovered when horizontal line is drawn parallel to interteardrop line	Reduced extrusion index on AP radiograph
Posterior wall sign	Posterior rim of acetabulum lies lateral to the femoral center	Present on AP radiograph
Crossover sign	Anterior acetabular rim lies lateral to posterior rim in the cranial part of acetabulum, then crosses the posterior rim in the distal part of acetabulum (“figure-8 configuration”)	Present on AP radiograph
Reduced Tönnis angle	Angle between a line connecting the two ends of the acetabular sourcil and the horizontal line of the pelvis	Angle ≤0° on AP radiograph