



Prevalence of Femoroacetabular Impingement Imaging Findings in Asymptomatic Volunteers: A Systematic Review

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Purpose: The aim of this study was to determine the prevalence of radiographic findings suggestive of femoroacetabular impingement (FAI) in asymptomatic individuals. **Methods:** A systematic review was performed using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Studies reporting radiographic, computed tomographic, or magnetic resonance imaging (MRI) findings that were suggestive of FAI in asymptomatic volunteers were included. Cam, pincer, and combined pathologic conditions were investigated. **Results:** We identified 26 studies for inclusion, comprising 2,114 asymptomatic hips (57.2% men; 42.8% women). The mean participant age was 25.3 ± 1.5 years. The mean alpha angle in asymptomatic hips was $54.1^\circ \pm 5.1^\circ$. The prevalence of an asymptomatic cam deformity was 37% (range, 7% to 100% between studies)—54.8% in athletes versus 23.1% in the general population. Of the 17 studies that measured alpha angles, 9 used MRI and 9 used radiography (1 study used both). The mean lateral and anterior center edge angles (CEAs) were 31.2° and 30° , respectively. The prevalence of asymptomatic hips with pincer deformity was 67% (range 61% to 76% between studies). Pincer deformity was poorly defined (4 studies [15%]; focal anterior overcoverage, acetabular retroversion, abnormal CEA or acetabular index, coxa profunda, acetabular protrusion, ischial spine sign, crossover sign, and posterior wall sign). Only 7 studies reported on labral injury, which was found on MRI without intra-articular contrast in 68.1% of hips. **Conclusions:** FAI morphologic features and labral injuries are common in asymptomatic patients. Clinical decision making should carefully analyze the association of patient history and physical examination with radiographic imaging. **Level of Evidence:** Level IV, systematic review if Level II-IV studies.

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A common cause of hip pain is femoroacetabular impingement (FAI). In this condition, abnormal bony morphologic features of the acetabulum or femoral head, or both, lead to abnormal joint contact

and stresses with deep flexion and rotation motion.^{1,2} FAI is frequently associated with labral injury. In fact, some studies have shown that nearly all participants with labral tears have variable degrees of FAI morphologic features.³⁻⁶ A variety of radiographic measures and findings have been reported in the literature to aid in the diagnosis of FAI.^{4,7}

In patients with symptomatic FAI that has failed conservative treatment, either open or arthroscopic hip preservation surgery may be indicated. These techniques address both bony (FAI) and soft tissue (labrum) pathologic conditions. It is thought that FAI may be the precursor to idiopathic hip osteoarthritis. Thus, elimination of FAI may slow or prevent the progression of degenerative changes. Currently, there is no role for prophylactic hip preservation surgery to prevent this progression in asymptomatic individuals with radiographic evidence of FAI.⁸ It is unknown what the radiographic prevalence of FAI is in asymptomatic individuals.

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The authors report the following potential conflict of interest or source of funding: S.N. receives support from Össur, Stryker, AlloSource, Arthrex, Athletico, DJ Orthopaedics, Linvatec, Miomed, and Smith & Nephew and M.S. receives support from Smith & Nephew and Linvatec.

Received July 2, 2014; accepted November 26, 2014.

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0749-8063/14551/\$36.00

<http://dx.doi.org/10.1016/j.arthro.2014.11.042>

Several studies have reported the presence of radiographic findings suggestive of FAI in select cohorts of asymptomatic patients. The goal of this study was to systematically review the literature for studies that reported the prevalence of radiographic findings suggestive of FAI and labral injuries in asymptomatic volunteers. The authors hypothesized that the prevalence of FAI and labral injuries would be less than 50%.

Methods

A systematic review was performed using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines with a PRISMA checklist.⁹ Three independent reviewers (one board-eligible orthopaedic surgeon in sports medicine fellowship training and 2 orthopaedic surgery residents) completed the search. The search was performed on April 13, 2013 using an explicit search algorithm: (((hip[Title/Abstract])) AND (asymptomatic[Title/Abstract])) AND (((radiograph[Title/Abstract]) OR radiographic[Title/Abstract]) OR imaging[Title/Abstract]) OR x-ray[Title/Abstract]) AND (English[lang])) NOT arthroplasty[Title/Abstract] AND (English[lang]). The following databases were queried: MEDLINE, SPORTDiscus, CINAHL, and Cochrane Central Register of Controlled Trials. Studies that reported radiographic, computed tomographic, or magnetic resonance imaging (MRI) findings (or findings from a combination of these modalities) that were suggestive of FAI in asymptomatic volunteers were included. Cam, pincer, and combined pathologic conditions were investigated. Exclusion criteria included non-English language articles; participants who had undergone total joint arthroplasty or those who were symptomatic; participants with hip osteoarthritis, hip dysplasia, slipped capital femoral epiphysis, or Legg-Calve-Perthes disease; studies using ultrasonographic or bone scan imaging modalities; articles investigating joints other than the hip; systematic reviews or meta-analyses; letters to the editor; topic reviews; and articles dealing with hip pathologic conditions other than impingement. Both electronically published and print journal articles were acceptable. However, meeting abstracts and proceedings were disallowed. All references within included studies were cross-referenced for potential inclusion if omitted from the initial search. **Figure 1** shows the search algorithm used to generate the final studies for inclusion and analysis.

Each study was analyzed for several radiographic variables suggestive of FAI—specifically the alpha angle and the lateral and anterior center edge angles (CEAs), head-neck offset, ischial spine sign, crossover sign, posterior wall sign, coxa profunda, and acetabular protrusio. In addition, radiographic signs of hip arthritis were also investigated, including joint space narrowing (distance), subchondral sclerosis, subchondral cysts,

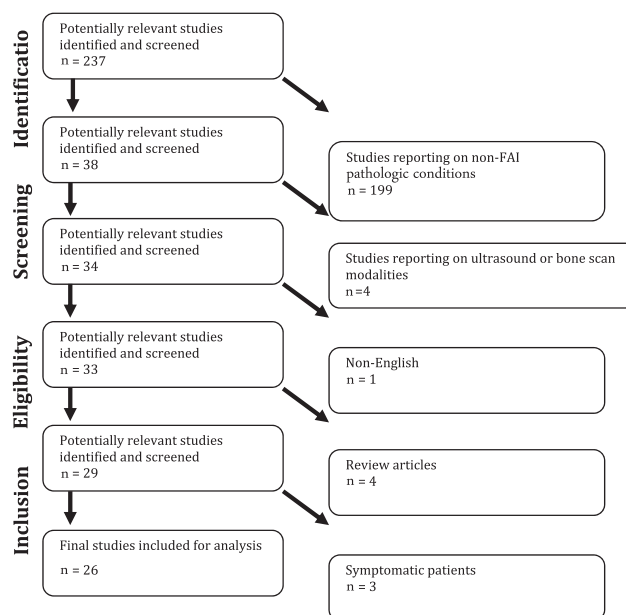


Fig 1. Systematic review search algorithm within MEDLINE database according to Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. After application of all exclusion criteria, 26 studies were identified for inclusion and further analysis.

osteophytes, Tonnis classification, and Kellgren-Lawrence classification. Studies were also analyzed for the number of overall participants who were diagnosed with a cam or pincer deformity or labral injury (according to each study's criteria). Demographic data recorded included sex and age.

Descriptive statistics were calculated for each study and parameter or variable analyzed. Continuous variable data were reported as mean \pm standard deviation (weighted means when applicable). Categorical data was reported as frequencies with percentages. For all statistical analysis, $P < .05$ was deemed statistically significant.

Results

Before screening, 237 studies were identified. After applying inclusion and exclusion criteria, 26 studies remained (**Table 1**). These comprised 2,114 asymptomatic hips (57.2% in men and 42.8% in women) with a mean overall age of 25.3 ± 1.5 years. Of the 2,114 asymptomatic hips analyzed, approximately 33% were in athletes (most commonly collegiate football players; $n = 298$), army recruits ($n = 244$), and hockey players ($n = 127$). The mean alpha angle (measured on MRI and radiography) in asymptomatic hips was $54.1^\circ \pm 5.1^\circ$. The overall prevalence of an asymptomatic cam deformity was 37% (range, 7% to 100% between studies). Comparing the athletic group to the general population, there was an almost 3:1 prevalence of cam deformity (54.8% v 23.1%) (**Fig 2**). Of the 17 studies that measured alpha angles, 9 used MRI without

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