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Does This Patient Have Hip Osteoarthritis?:

The Rational Clinical Examination Systematic Review

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Abstract

IMPORTANCE—Hip osteoarthritis (OA) is a common cause of pain and disability.

OBJECTIVE—To identify the clinical findings that are most strongly associated with hip OA.

DATA SOURCES—Systematic search of MEDLINE, PubMed, EMBASE, and CINAHL from inception until November 2019.

STUDY SELECTION—Included studies (1) quantified the accuracy of clinical findings (history, physical examination, or simple tests) and (2) used plain radiographs as the reference standard for diagnosing hip OA.

DATA EXTRACTION AND SYNTHESIS—Studies were assigned levels of evidence using the Rational Clinical Examination scale and assessed for risk of bias using the Quality Assessment of

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Diagnostic Accuracy Studies tool. Data were extracted using individual hips as the unit of analysis and only pooled when findings were reported in 3 or more studies.

MAIN OUTCOMES AND MEASURES—Sensitivity, specificity, and likelihood ratios (LRs).

RESULTS—Six studies were included, with data from 1110 patients and 1324 hips, of which 509 (38%) showed radiographic evidence of OA. Among patients presenting to primary care physicians with hip or groin pain, the affected hip showed radiographic evidence of OA in 34% of cases. A family history of OA, personal history of knee OA, or pain on climbing stairs or walking up slopes all had LRs of 2.1 (sensitivity range, 33%−68%; specificity range, 68%−84%; broadest LR range: 95% CI, 1.1–3.8). To identify patients most likely to have OA, the most useful findings were squat causing posterior pain (sensitivity, 24%; specificity, 96%; LR, 6.1 [95% CI, 1.3–29]), groin pain on passive abduction or adduction (sensitivity, 33%; specificity, 94%; LR, 5.7 [95% CI, 1.6–20]), abductor weakness (sensitivity, 44%; specificity, 90%; LR, 4.5 [95% CI, 2.4–8.4]), and decreased passive hip adduction (sensitivity, 80%; specificity, 81%; LR, 4.2 [95% CI, 3.0–6.0]) or internal rotation (sensitivity, 66%; specificity, 79%; LR, 3.2 [95% CI, 1.7–6.0]) as measured by a goniometer or compared with the contralateral leg. The presence of normal passive hip adduction was most useful for suggesting the absence of OA (negative LR, 0.25 [95% CI, 0.11–0.54]).

CONCLUSIONS AND RELEVANCE—Simple tests of hip motion and observing for pain during that motion were helpful in distinguishing patients most likely to have OA on plain radiography from those who will not. A combination of findings efficiently detects those most likely to have severe hip OA.

Clinical Scenarios

In the following cases, the clinician wants to determine whether the patient's symptoms are caused by hip osteoarthritis (OA).

Case 1

A58-year-old woman was experiencing pain in her right groin, which had not changed over the last 6 months. She is a school teacher and the pain was worse on climbing up staircases, which made it difficult for her to get to her classroom. You do not have a goniometer for precise range-of-motion measurement but, compared with the left side, the right hip had decreased passive hip adduction and internal rotation.

Case 2

A 60-year-old man presented to his primary care clinician with a 9-month history of left hip pain, which had remained stable until it worsened over the last 3 weeks and was exacerbated by walking. There was no pain on internal rotation and passive movements on clinical examination were not different to the right side.

Background

OA is a disabling disease that affects multiple components of joints, including articular cartilage, subchondralbone, and the synovial joint lining. OA commonly affects the hips and knees.[1] The prevalence of symptomatic hip OA among people aged 60 years and older is

6.2%.[2] Population studies suggest that hip OA is twice as common in women as in men, and there is evidence to suggest a strong heritable component.[3] Obesity, injury, malalignment, and anatomical abnormalities have also been associated with onset and progression of lower limb OA, possibly due to increased or altered load across articular surfaces.[1]The pain and restricted motion of hip OA can be debilitating but there is good evidence of benefit for a range of interventions, including weight loss, physiotherapy that includes strengthening of periarticular muscles, intra-articular injections, and total hip replacement.[3]

The main symptom of hip OA is pain (Figure 1).[3–5] A number of structures around the hip are richly innervated by sensory nerve fibers, including the periosteum,[6] subchondral bone,[6] synovium,[7] and surrounding soft tissues. Chronic joint pain is also associated with central sensitization at the spinal and cortical levels, which can lead to referred pain and even tenderness remote from the affected joint.[8,9] Long-standing hip OA may also affect gait and so lead to secondary symptoms such as pain in the knees and lumbar spine.[10,11]

Why Is This an Important Question to Answer With a Clinical Evaluation?

The differential diagnosis of hip pain includes greater trochanteric pain syndrome, piriformis syndrome, stress fracture, inflammatory arthropathies (eg, rheumatoid arthritis), lumbar radiculopathy, pelvis bone tumors, osteonecrosis, pelvic insufficiency fractures, and meralgia parasthetica.[3,12] Nonmusculoskeletal conditions (eg, groin hernia, intrapelvic pathology, and leaking abdominal aortic aneurysms) may also present with hip and/or groin pain.[13]

Plain radiographs are the most commonly used method for diagnosing hip OA.[3] This modality does not directly visualize articular cartilage but can reveal features of disease, such as joint space narrowing, osteophytes, subchondral sclerosis, and subchondral cysts,[14] as well as excluding alternative causes of pain.[14] Although an anterior-posterior pelvis radiograph is inexpensive and simple, intra-articular hip pathology can sometimes be diagnosed by clinical examination alone (Figure 2).[3,15] Early radiographs may only be needed when the diagnosis is uncertain or requires confirmation before invasive treatments are undertaken. The evidence-based UK National Institute for Health and Care Excellence recommends diagnosing OA without imaging in persons aged older than 45 years with activity-related joint pain and without prolonged (≥30 minutes) morning stiffness.[15] Prolonged morning stiffness may point toward an inflammatory cause for pain such as rheumatoid arthritis.[16]

Radiographic hip OA is common in the general population and is often asymptomatic: the presence of x-ray findings suggestive of hip OA does not always correlate with symptoms. One large population cohort study reported that only 21% of patients with radiographic hip OA experienced pain.[17] Therefore, it is particularly important to establish a pretest probability before ordering radiographs. Inadequate clinical assessment risks overdiagnosis of hip OA in patients with symptoms attributable to another cause (eg, lumbar radiculopathy) but with incidental radiographic findings. Such patients might undergo unnecessary treatment that would not improve their symptoms.

We conducted a systematic review to evaluate the diagnostic accuracy of clinical findings in determining the prevalence of radiographic OA among those presenting to primary care clinicians with hip or groin pain and the likelihood of hip OA based on symptoms and signs.

Methods

Search Strategy

Literature searches (eTable 1 in the Supplement) were performed by a specialist information librarian using PubMed, Ovid MEDLINE (1946 to November 2019), Embase (1974 to November 2019), and EBSCO CINAHL (1982 to November 2019). Further items were sought from the reference lists of previous studies and review articles. Once duplicates were removed, all unique database items were downloaded into specialist software for screening abstracts (Rayyan, Qatar Computing Research Institute).

Study Selection

We included all studies that described clinical finding sin patients with hip or groin pain and used plain radiographs as a diagnostic standard. It was also necessary for researchers to prespecify the criteria used to identify patients with radiographic hip OA. Studies were excluded if they were not designed in such a way (eg, uncontrolled case series) that they could determine sensitivity and specificity of clinical findings for abnormalities on plain radiographs. Titles and abstracts were independently screened by 2 authors (D.M. and H.A.C.). If either author promoted an item to the next stage, full texts were retrieved and screened at a single sitting, with disagreements resolved by consensus.

Data Extraction and Quality Assessment

Two authors extracted data from included studies (D.M. and H.A.C.), which were then independently checked by a third author (D.C.P.). Original data were sought from corresponding authors of studies where appropriate. Study quality was summarized using a checklist designed for the Rational Clinical Examination series.[18] Level 1 studies require that clinical findings be assessed and categorized independently of the radiographic findings in 200 or more consecutive patients; level 2 studies have the same requirement but include fewer than 200 patients; and level 3 studies include nonconsecutive patients. We excluded level 4 and level 5 studies because they use nonindependent assessment of predictors and outcomes.

The Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) criteria[19] were used to assess individual included studies for risk of bias. This process was undertaken by 2 authors (DM and HAC) and disagreements resolved by a third author (DCP). For included studies, we recorded the study design, setting, population, age of patients, radiographic criteria for defining hip OA, diagnostic accuracy, and whether the denominator for measures of accuracy (sensitivity and specificity) was based on unique patients or number of hips examined. When authors presented data for “any OA” and “severe OA,” these were extracted and separately analyzed. We pragmatically accepted diagnoses of hip OA based on any radiographic criteria prespecified by study authors. “Severe OA” was defined by the 2

studies that reported patients in this category as hips with radiographic joint space less than or equal to 1.5 mm.[20,21]

Statistical Methods

Sensitivity, specificity, and likelihood ratios (LRs) were calculated using data extracted from each study together with their 95% CIs. The unit of analysis was individual hips. The positive LR is defined as the ratio between probability of a positive clinical finding when the disease is present and the probability of a positive finding when the disease is absent (LR = sensitivity/[1-specificity]). The negative LR (LR–) is the ratio between the probability of a negative clinical finding when the disease is present and the probability of a negative finding when the disease is absent (LR– = [1-sensitivity]/specificity).[22]

Clinical tests reported by only 1 study were presented as individual data points. Those reported by 2 studies were presented as ranges. Data for clinical tests reported by 3 studies were pooled using univariate random-effects models and data reported by more than 4 studies were pooled by fitting a multilevel mixed-effects logistic regression model. All analyses were undertaken using StataSE version 15 (StataCorp) together with its *metan*[23] and *metandi*[24] modules.

We highlighted features with a point estimate positive LR of greater than or equal to 2.0 or a negative LR of less than 0.5, and a confidence interval that excludes 1.0, as being most likely to be useful in routine clinical practice.[25] Given an initial pretest probability of 10%, the presence of a feature with a positive LR of 2.0 would increase the probability to 18%. The absence of a feature with a negative LR of 0.5 would conversely reduce a pretest probability of 10% to 5.3%.

Results

There were 2985 unique items retrieved by the online database search, which were reduced to 6 studies by the screening process (Figure 3). The 6 included studies reported data from 1110 patients and 1324 hips, 509 (38%) of which were found to have radiographic evidence of OA (eTable 2 in the Supplement). There were 5 prospective cohort studies and 1 case-control study. Five studies were judged to be Rational Clinical Examination[25] level 1,none were level2, and 1 was level 3 (eTable 3 in the Supplement).

Prevalence

The population prevalence of symptomatic hip OA in those aged older than 60 years is around 6.2%.[2] Two consistent studies included in this review found that, among patients presenting to a primary care practitioner (mean age, 63–66 years) with hip and/or groin pain, just over a third (34%–35%) had at least mild to moderate OA and 11% to 14% had severe OA.[20,21]

Risk Factors and Symptoms

Four studies[4,20,26,27] evaluated features in the patient history (Table 1). Three findings were associated with the presence of hip OA: a family history of OA (sensitivity, 34%; specificity,

84%; LR, 2.1 [95% CI, 1.2–3.6]), a personal history of knee OA (sensitivity, 33%; specificity, 84%; LR, 2.1 [95% CI, 1.1–3.8]), and pain on climbing stairs or walking down slopes (sensitivity, 68%; specificity, 68%; LR, 2.1 [95% CI, 1.6–2.8]). While the worst pain located in the medial thigh was infrequently found (2.7% of patients), this location of the worst pain had the highest LR (sensitivity, 12%; specificity, 98%; LR, 7.8 [95% CI, 1.7–37]).

Several features were best at identifying patients unaffected by hip OA. Younger patients (age <60 years) compared with older patients are less likely to have hip OA (sensitivity, 96%; specificity, 25%; LR–, 0.11 [95% CI, 0.02–0.78]). While the presence of morning stiffness (sensitivity range, 56%−91%; specificity range, 41%–67%), pain on walking (sensitivity range, 80%−97%; specificity range, 12%−34%), or relief of pain on sitting (sensitivity, 92%; specificity, 33%) did not help identify hip OA in patients (all with LR <2.0), the absence of these features identified patients less likely to have hip OA (absence of morning stiffness <60 minutes: LR– range, 0.22–0.65; absence of pain on walking: LR– range, 0.25–0.58; absence of pain improved on sitting: LR–, 0.24 [95% CI, 0.06–0.92]).

Clinical Signs

Six studies[4,20,21,26–28] evaluated physical examination findings and reported on the physical examination findings most likely to be associated with hip OA (Table 2). In general, physical examination findings were more useful than historical features for identifying the presence of OA. The most strongly associated physical findings were (in descending order) as follows: posterior hip pain caused by squatting (sensitivity, 24%; specificity, 96%; LR, 6.1 [95% CI, 1.3–29]), groin pain on hip abduction or adduction (sensitivity, 33%; specificity, 94%; LR, 5.7 [95% CI, 1.6–20]), abductor weakness (sensitivity, 44%; specificity, 90%; LR, 4.5 [95% CI, 2.4–8.4]), decreased hip adduction (sensitivity, 80%; specificity, 81%; LR, 4.2 [95% CI, 3.0–6.0]), and decreased internal rotation (sensitivity, 66%; specificity, 79%; LR, 3.2 [95% CI, 1.7–6.0]) as measured by a goniometer or compared with the contralateral leg.

While the presence of pain during the range-of-motion test was useful for identifying affected patients, decreased range-of-motion findings were more useful than those that simply recorded pain provoked by movement (Figure 4).The presence of normal hip passive adduction (sensitivity, 80%; specificity, 81%; LR–,0.25 [95% CI, 0.11–0.54]) or abduction (sensitivity, 88%; specificity, 46%; LR–, 0.26 [95% CI, 0.09–0.77]) were most useful for identifying patients with hip pain who were less likely to have OA.

Simple Laboratory Tests

Only a single study evaluated the role of 2 blood tests in the evaluation of hip OA: rheumatoid factor and erythrocyte sedimentation rate.[26] The presence of rheumatoid factor at a titer of 1:80 or greater was present in 34% of patients and significantly decreased the likelihood of OA (sensitivity, 96%; specificity, 62%; LR, 0.06 [95% CI, 0.01–0.23]). The absence of a rheumatoid factor titer less than 1:80 increased the likelihood of OA as the cause of the patient's hip discomfort (LR, 2.6 [95% CI, 1.8–3.6]). In those with an erythrocyte sedimentation rate of 40 mm/h or greater, an alternative diagnosis was more likely to be the cause of pain (LR, 0.42 [95% CI, 0.21–0.83]).

Combination of Findings

In one study, factors found to be associated with OA were age older than 60 years, pain lasting longer than 3 months, groin tenderness, decreased external rotation, and absence of pain aggravation by sitting (Table 3).[20] Hip OA was strongly associated with the presence of 4 or more findings (LR, 4.9 [95% CI, 2.8–8.7]) while no or 1 finding indicated a reduced likelihood of hip OA (LR, 0.24 [95% CI, 0.09–0.64]).

This same study evaluated a combination of 7 findings for severe OA (minimal joint space ≤1.5 mm): patient age older than 60 years, inguinal ligament tenderness, decreased external rotation, decreased internal rotation, and decreased adduction, bony restriction using passive hip movement, and hip abductor weakness (Table 3).[20] The presence of 5 or more findings was highly suggestive of severe OA (LR, 35 [95% CI, 13–95]) while those with 3 or fewer findings were much less likely to have severe OA (LR, 0.05 [95% CI, 0.01–0.32]). However, the authors noted that inguinal ligament tenderness has not previously been identified as a clinical sign of hip OA and that this finding should by tested in further studies.[20]

Discussion

The studies included in this review showed that a small number of clinical findings can help estimate the likelihood of hip OA among patients presenting with hip and/or groin pain. These data are consistent with the pragmatic approach recommended by some national organizations.[15]

Hip OA can be diagnosed in patients that present with typical features, such as posterior hip pain with squatting, reduced range of movement of the affected hip, or groin pain on abduction or adduction. These findings may be sufficient for a clinical diagnosis of OA (without need for imaging) in a patient with mild symptoms. With features that are atypical for hip OA, such as normal range of motion and painless internal rotation, plain radiographs may be unhelpful and even confuse the diagnostic picture by identifying incidental hip OA. Alternatively, patients with severe pain lasting more than 3 months, extended morning stiffness, weight loss, or extreme pain with range-of-motion testing may require further investigation. Patients with OA features whose symptoms are sufficiently limiting that they might consider surgery may also require radiographic confirmation of the diagnosis before referral to an orthopedic surgeon. A combination of clinical findings (≥5 findings from age >60 years, inguinal ligament tenderness, decreased external rotation, decreased internal rotation, bony restriction on passive hip movement, and hip abductor weakness) may provide the most useful clinical means of predicting severe radiographic hip OA. However, further studies may be necessary to confirm the association between inguinal ligament tenderness and hip OA.[20] Figure 5 summarizes one approach that clinicians might adopt when evaluating a patient with atraumatic hip or groin pain, although this has not been independently validated.

Our findings suggest that clinicians should focus on ensuring that they are confident in the examination of hip movements. Although affected hips may be examined with reference to the unaffected side in many patients, OA often occurs bilaterally.[29] Clinicians should, therefore, aim to recognize “normal” hip movement so that they can become proficient at

eliciting signs in patients with bilateral disease. This is particularly true as most primary care offices do not have a goniometer.

The competent clinical evaluation of patients with hip pain is necessary because overinvestigation is likely to lead to erroneous diagnoses of significant hip OA in patients with incidental radiographic findings[17] but who have an alternative cause for their symptoms. Overuse of imaging may also expose patients unnecessarily to ionizing radiation.[3,30] The LRs provided in this study should be used to rationally identify the patients whose pretest probability for hip OA is sufficient to justify radiographic imaging. They may also be sufficient to clinically diagnose hip OA in patients with mild symptoms that do not yet warrant surgical referral.[3,15]

Limitations

The certainty of these recommendations is reduced by the small evidence base. In particular, there is a lack of data from patients presenting with pain in primary care. Only 2 studies[20,21] reported on the factors associated with hip OA among patients presenting initially to a generalist physician. As some of the clinical tests performed by specialists are likely to be unfamiliar to generalists (eg, the Scour test), it is possible that the test would either not be performed or be performed differently. It is reassuring that the features that were most associated with OA were either found on the clinical history (eg, pain on climbing stairs or walking down slopes) or physical examination (eg, decreased hip movements and pain on internal/external rotation) that should be familiar to, and readily elicited by, most clinicians. Previous studies have found that there is good inter-rater reliability for interpreting simple hip clinical signs among clinicians from different disciplines.[31,32] However, there were differences in terms of how clinical signs were elicited even between studies included within this review. It is also uncertain whether these signs would be interpreted exactly the same by generalists as by specialists.

The lack of primary care studies also challenges the external validity of our findings. The LRs of each clinical sign were based largely on hospital outpatients and may not be generalizable to the population presenting within primary care. For example, the prevalence of radiographic hip OA in the 3 studies[4,26,28] from consecutive patients referred to specialists was higher than the 2 studies[20,21] of consecutive patients seen in primary care (42% vs 28%). Such a difference occurs because patients whose symptoms improve are less likely to be referred. This selection bias increases disease prevalence in secondary care populations but also leads to verification bias because only those with persistent hip symptoms are referred and so undergo radiographic imaging. The effect of verification bias is usually to produce a specificity estimate that is too low and a sensitivity estimate that is too high.[18] It is, therefore, possible that clinical findings in primary care settings will have higher specificity (positive findings have a greater LR in primary care than in specialty care) but lower sensitivity than the estimates reported in this study (negative findings are not as useful at ruling out hip OA in primary care compared with specialty care).

The quality of the underlying evidence was mixed. We did not include data from studies with the lowest QUADAS-2 scores (ie, nonindependent comparisons of clinical signs) but one included study was assigned QUADAS-2 level 3. Although our study reported data on

62 different clinical findings, only 20 (32%) were evaluated by more than a single study. The factors most strongly associated with hip OA were generally evaluated by multiple studies and so few of our recommendations were based on single point estimates. It is, therefore, likely that the findings of future studies would fall within our estimated confidence intervals. Larger studies would be helpful to narrow the confidence intervals, particularly for those clinical findings that were only evaluated by single studies. There is a clear need for prospective diagnostic studies in primary care (where patients with hip pain are likely to initially present), particularly aimed at validating the predictive properties of combinations of clinical signs. It is nevertheless possible that other clinical signs would have proven useful if evaluated in larger, better-quality, or multiple studies.

Scenario Resolution

Before taking the individual characteristics of the presented cases, there is a pretest probability of 35% for hip OA, as this is the prevalence among patients with hip and/or groin pain presenting to a primary care practitioner for initial assessment. This pretest probability will increase or decrease as outlined below based on the features of the clinical assessment.

Case 1

The 58-year-old woman experienced groin pain (sensitivity, 39%; specificity, 74%; LR, 1.7), which persisted for more than 3 months (sensitivity, 80%; specificity, 38%; LR, 1.3). It was worse on walking up steps (sensitivity, 68%; specificity, 68%; LR, 2.1). She had decreased hip adduction (sensitivity, 80%; specificity, 81%; LR, 4.2) and internal rotation (sensitivity, 66%; specificity, 79%; LR, 3.2).The single best test (ie, decreased hip adduction) alone would convert the pretest probability of 35% to 69%.There have not been any studies to evaluate these tests in combination but the pretest likelihood for hip OA is clearly high.

Case 2

The 60-year-old man presented with hip pain that persisted for more than 3 months (sensitivity, 80%; specificity, 38%; LR, 1.3). This might have been interpreted as increasing pretest probability from 35% to 41%. However, the findings on physical examination did not support a diagnosis of hip OA. If these features were independent of each other, the absence of pain on internal rotation (LR, 0.31) and the unrestricted hip movement (LR, 0.34) would have reduced his pretest probability of hip OA to only 5.3%. If radiographs were obtained, it is possible that these would have revealed incidental hip OA, which might have confused the clinical picture. This man required careful consideration of alternative causes for his hip pain, which should include an examination for referred pain.

Clinical Bottom Line

Simple tests of hip motion and elicitation of pain during those movements can help identify patients who have radiographic evidence of hip OA. The best overall physical examination findings are squat causing posterior hip pain, pain on abduction or adduction, adductor weakness, and decreased adduction. These are strongly associated with hip OA when present

and of an alternative diagnosis when absent. Patients at high likelihood of severe hip OA may be best identified initially using a combination of clinical signs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key Points

Question

How can physicians identify patients who are most likely to have hip osteoarthritis (OA)?

Findings

The most useful findings for identifying patients with hip OA are squat causing posterior pain, groin pain on passive abduction or adduction, abductor weakness, and decreased passive hip adduction or internal rotation. Hip OA is unlikely in the presence of normal passive hip adduction.

Meaning

A number of simple range-of-motion tests can be used to identify patients with hip or groin pain that are most likely to have evidence of OA on hip radiographs.

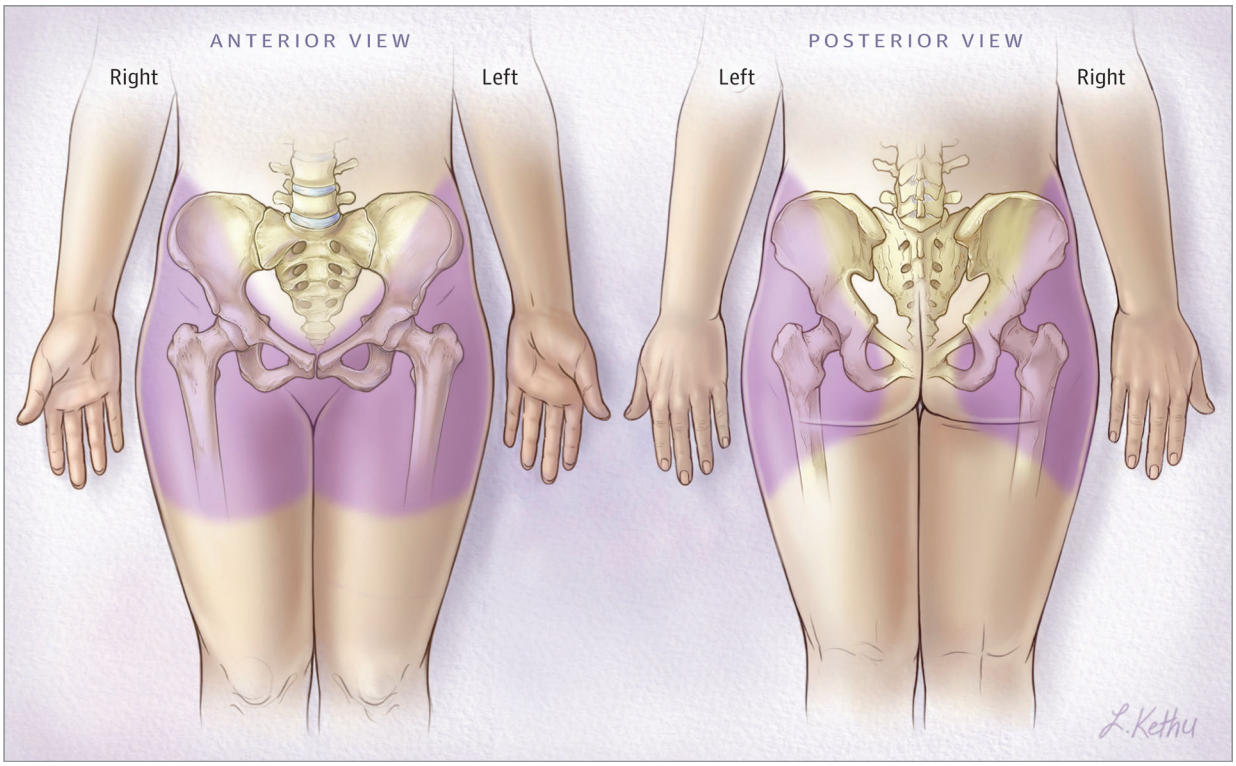

Figure 1.
Distribution of Pain Typically Arising From Hip Osteoarthritis

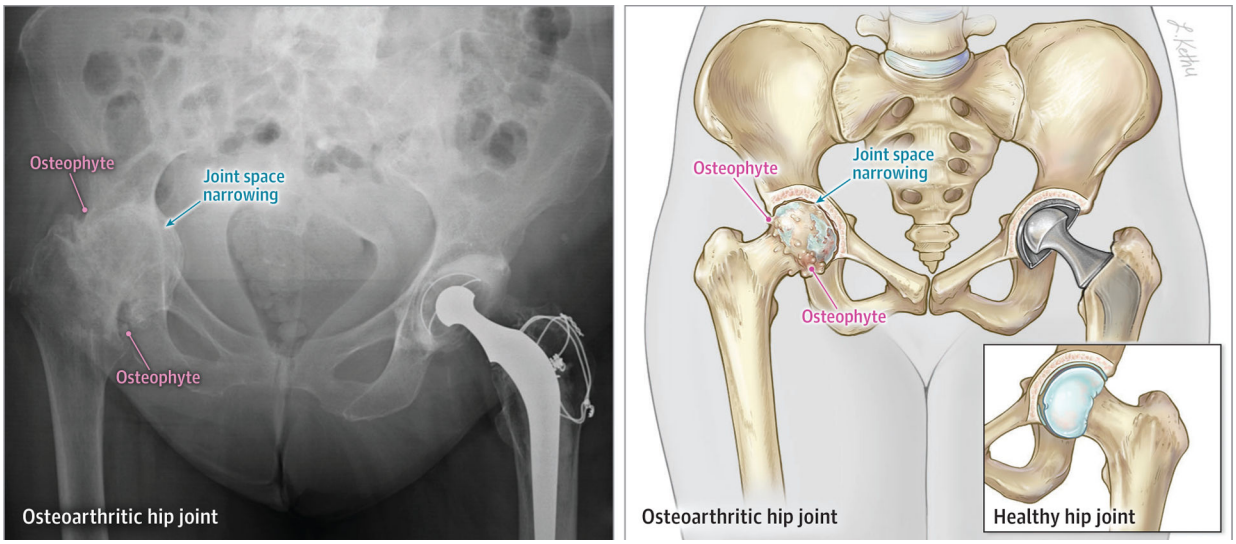

Figure 2.
A Plain Radiograph and Illustration Showing Features of Right Hip Osteoarthritis

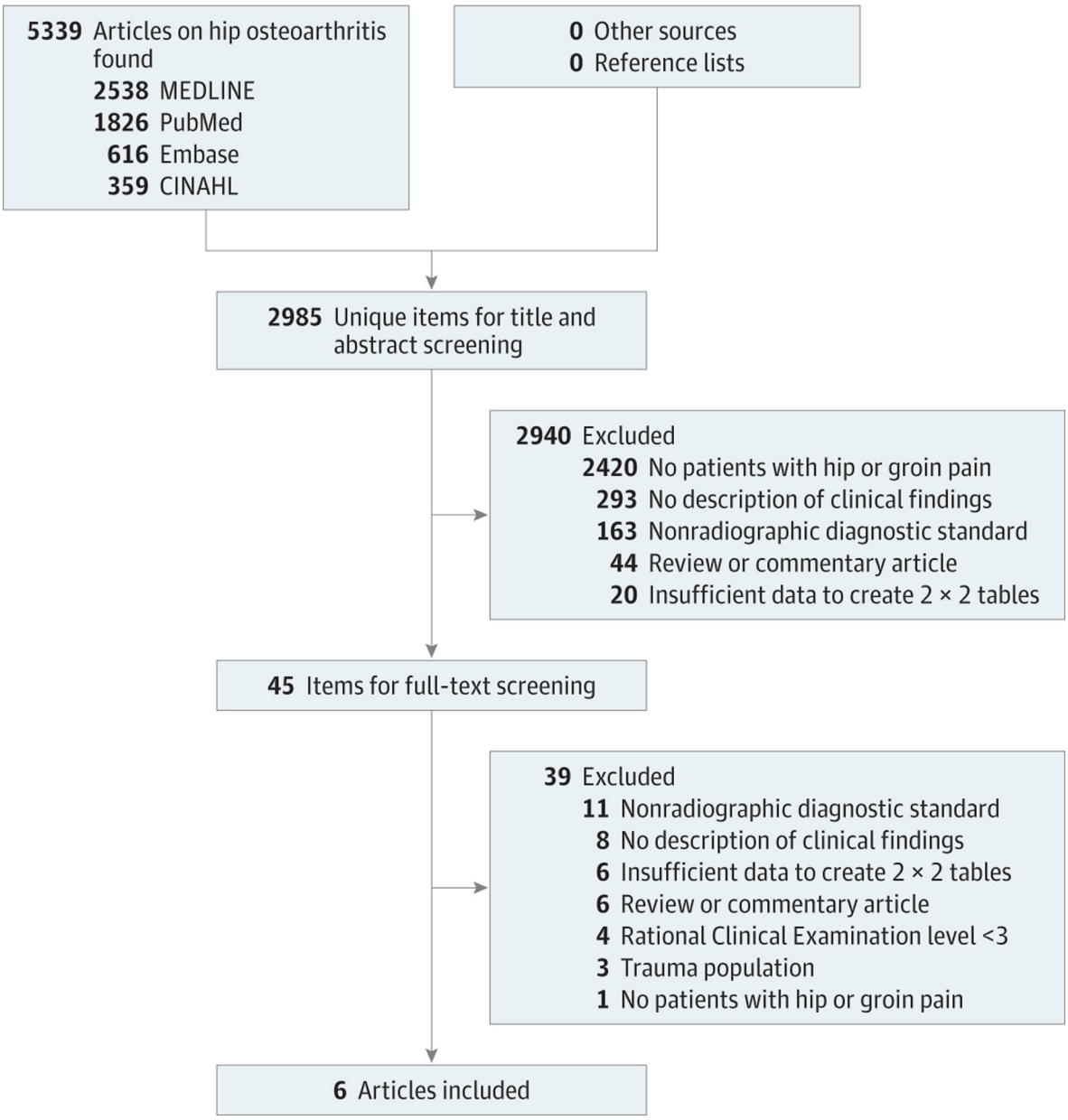

Figure 3.
Flow Diagram Showing Inclusion and Exclusion of Studies

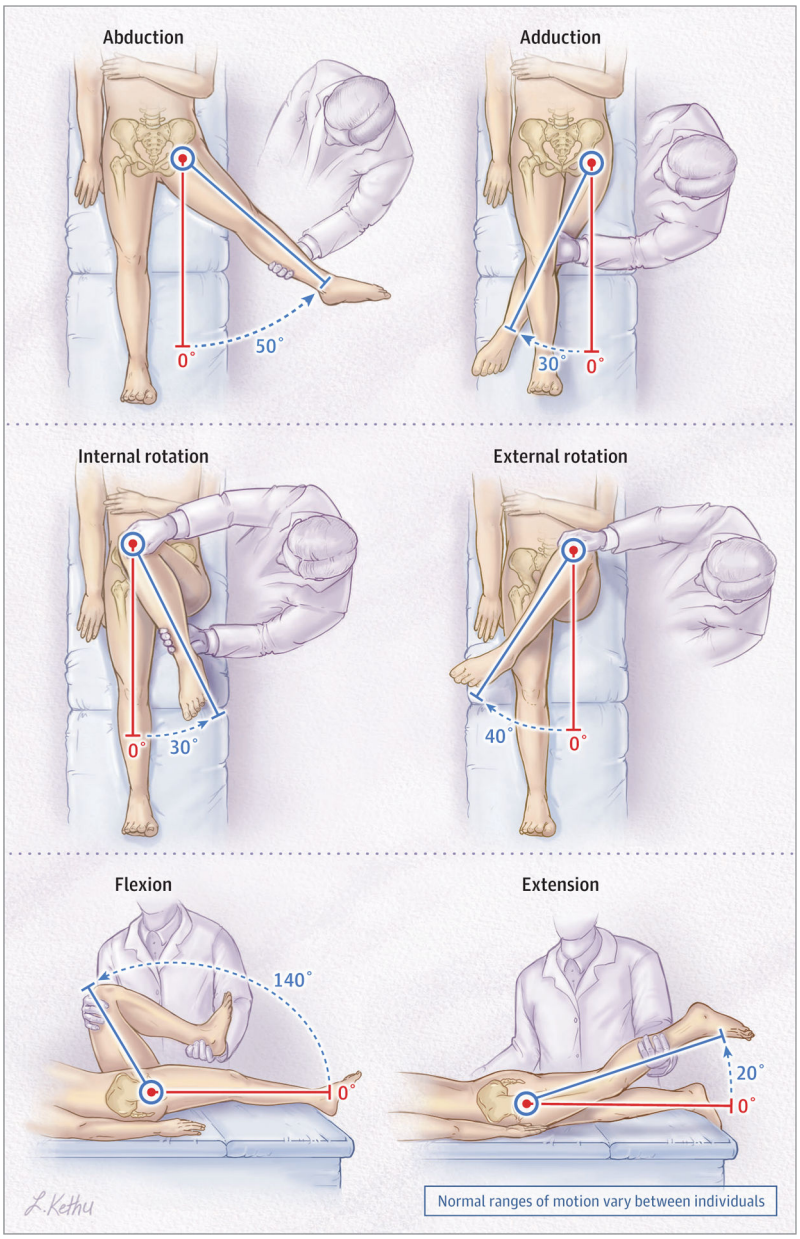

Figure 4.
Normal Hip Ranges of Motion

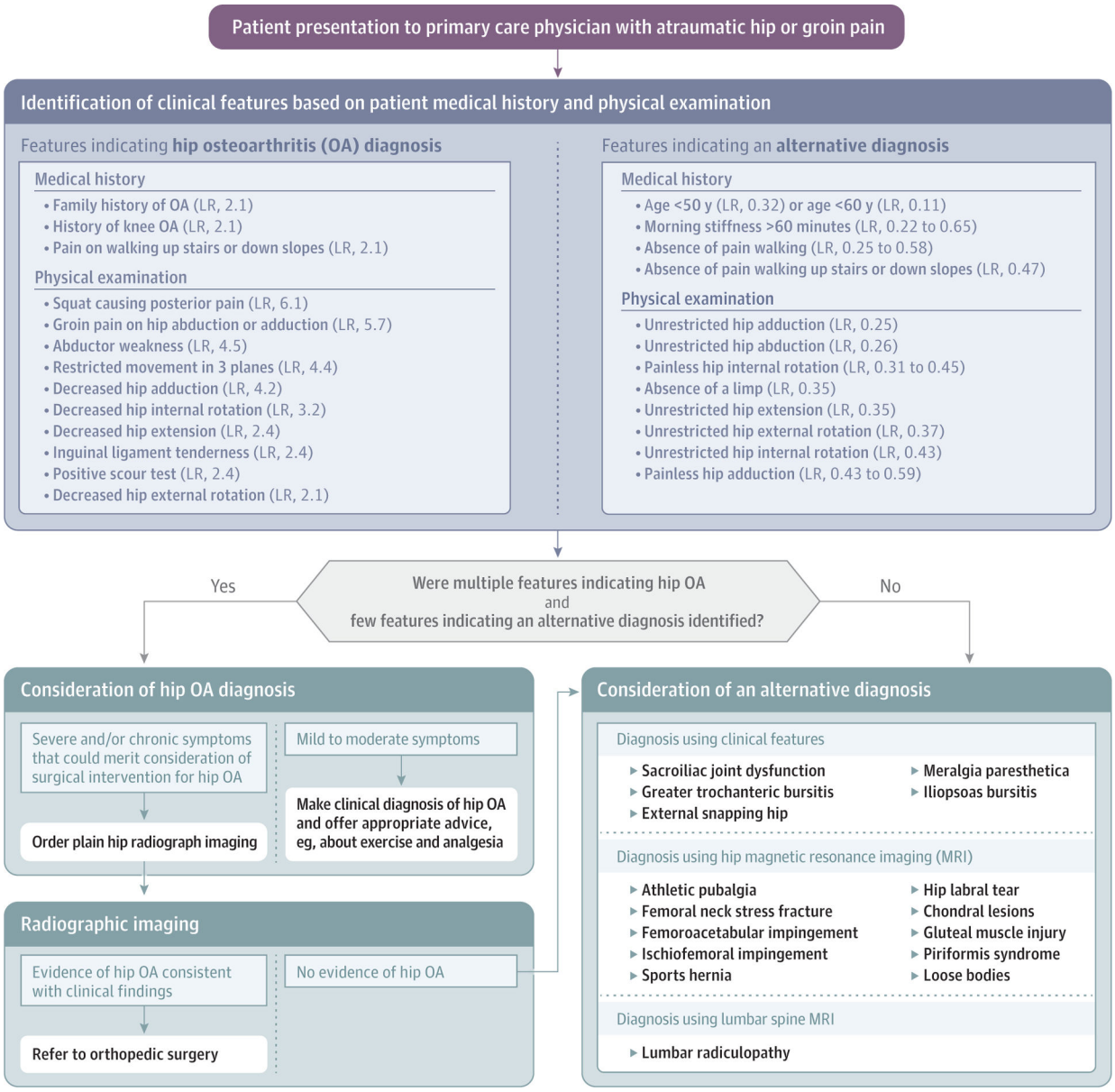

Figure 5. Algorithm for Rationalizing Use of Imaging in Adults Presenting With Atraumatic Hip or Groin Pain

This approach shown has not been independently validated. LR indicates likelihood ratio.

Table 1.

History Findings and Likelihood of Hip Osteoarthritis With Positive Likelihood Ratio of 2.0 or Greater or Negative Likelihood Ratio of 0.5 or Less[a]

		% (95% CI) or % Range			
Feature	**No. (%)[b]**	**Sensitivity**	**Specificity**	**Positive Likelihood Ratio**	**Negative Likelihood Ratio**
General Features					
Family history of osteoarthritis[26]	191 (21)	34 (25–44)	84 (74–91)	2.1 (1.2–3.6)	0.79 (0.67–0.93)
History of knee osteoarthritis[26]	173 (26)	33 (24–43)	84 (73–92)	2.1 (1.1–3.8)	0.80 (0.68–0.95)
Age, y					
>60[20]	220 (68)	96 (80–99.9)	25 (29–42)	1.5 (1.3–1.7)	0.11 (0.02–0.78)
>50[26]	199 (83)	91 (84–96)	28 (19–39)	1.3 (1.1–1.5)	0.32 (0.16–0.62)
Morning stiffness <60 min[20,26]	415 (55)	56–91	41–67	1.5–1.7	0.22–0.65
Location of Pain					
Worst pain in medial thigh[20]	220 (2.7)	12 (2.5–31)	98 (96–99.7)	7.8 (1.7–37)	0.89 (0.77–1.0)
Worst pain in buttock[20,27]	292 (34)	12–67	57–69	0.38–2.0	0.38–0.76
Activity Effect on Pain					
Climbing stairs or walking down slopes[4]	230 (47)	68 (59–76)	68 (58–76)	2.1 (1.6–2.8)	0.47 (0.35–0.63)
Pain on initial steps after rest[20]	220 (76)	92 (74–99)	26 (20–32)	1.2 (1.1–1.4)	0.31 (0.08–1.2)
Pain on walking[20,26]	415 (80)	80–97	12–34	1.1–1.2	0.25–0.58
Pain relieved by sitting[20]	220 (30)	92 (1.0–26)	33 (60–73)	1.4 (0.2–1.6)	0.24 (0.06–0.92)

[a] eTable 4 provides results from individual studies and findings not meeting the likelihood ratio thresholds.

[b] With proportion (%) of hips with each clinical finding.

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Table 2.

Physical Examination Findings and Likelihood of Hip Osteoarthritis With Positive Likelihood Ratio of 2.0 or Greater or Negative Likelihood Ratio of 0.5 or Less[a]

		% (95 % CI) or % Range			
Feature	**No. (%)[b]**	**Sensitivity**	**Specificity**	**Positive Likelihood Ratio**	**Negative Likelihood Ratio**
General Findings					
Abductor weakness[20]	220 (14)	44 (24–65)	90 (85–94)	4.5 (2.4–8.4)	0.62 (0.43–0.88)
Limp[26]	165 (73)	85 (76–92)	43 (31–55)	1.5 (1.2–1.9)	0.35 (0.20–0.61)
Pain on Palpation					
Inguinal ligament tenderness[20]	220 (29)	60 (39–79)	75 (68–81)	2.4 (1.6–3.8)	0.53 (0.33–0.87)
Tensor fascia lata tenderness[20]	220 (23)	40 (21–61)	80 (73–85)	2.0 (1.1–3.4)	0.75 (0.54–1.1)
Pain on Movement and Provocation Tests					
Squat causing posterior pain[27]	72 (53)	24 (8.2–47)	96 (86–99.5)	6.1 (1.3–29)	0.79 (0.62–1.0)
Groin pain on abduction or adduction[27]	72 (14)	33 (15–57)	94 (84–99)	5.7 (1.6–20)	0.71 (0.52–0.97)
Scour test[27][c]	72 (36)	62 (42–82)	74 (60–86)	2.4 (1.4–4.3)	0.51 (0.29–0.90)
Pain on hip adduction[20,26]	410 (58)	68–80	46–54	1.5–1.5	0.43–0.59
Pain on hip internal rotation[20,26]	412 (68)	82–88	38–39	1.4–1.4	0.31–0.45
Tests of Motion					
Restricted movement[21]					
3 planes	39 (16)	NA[d]	NA[d]	4.4 (2.4–8.3)	NA[d]
2 planes	46 (18)	NA[d]	NA[d]	1.5 (0.90–2.6)	NA[d]
1 plane	63 (25)	NA[d]	NA[d]	1.3 (0.85–2.0)	NA[d]
0 planes	102 (41)	NA[d]	NA[d]	0.91 (0.78–1.1)	NA[d]
Decreased hip adduction[20][e]	220 (26)	80 (59–93)	81 (75–86)	4.2 (3.0–6.0)	0.25 (0.11–0.54)
Decreased hip internal rotation[20,26–28][e]	788 (30)	66 (47–81)	79 (57–92)	3.2 (1.7–6.0)	0.43 (0.31–0.60)
Decreased range of movement[4][e]	230 (51)	75 (66–82)	74 (65–82)	2.9 (2.1–4.0)	0.34 (0.25–0.47)

		% (95 % CI) or % Range			
Feature	**No. (%)[b]**	**Sensitivity**	**Specificity**	**Positive Likelihood Ratio**	**Negative Likelihood Ratio**
Decreased hip extension[20][e]	220 (37)	76 (55–91)	68 (61–75)	2.4 (1.8–3.2)	0.35 (0.17–0.71)
Decreased hip extension[20][e]	220 (40)	76 (55–91)	64 (57–71)	2.1 (1.6–2.8)	0.37 (0.19–0.76)
Decreased hip abduction[20][e]	220 (58)	88 (69–98)	46 (38–53)	1.6 (1.3–2.1)	0.26 (0.09–0.77)

Abbreviation: NA, not applicable.

[a] eTable 5 provides results from individual studies and findings not meeting likelihood ratio thresholds.

[b] With proportion (%) of hips with each clinical finding.

[c] The Scour test is an impingement test where the examiner compresses the femoral neck against the acetabulum while the femur is at maximal flexion and while applying axial pressure, the knee is moved in an arc toward the shoulders. A positive test consists of “bumps” in movement, pain, or patient apprehension with the motion.

[d] For ordinal data shown from 0 planes to 3 planes, sensitivity and specificity do not apply. Results shown as serial likelihood ratios to show the increasing likelihood of restricted movements from 0 to 3 different affected planes.

[e] Measured with goniometer and/or comparison with contralateral hip.

Table 3.

Combinations of Clinical Signs and Likelihood of Hip Osteoarthritis[a]

Feature	Threshold[b]	No. (%)[c]	Positive Likelihood Ratio[d]
Any Hip Osteoarthritis			
No. of signs[20]	≥4 Present	48 (22)	4.9 (2.8–8.7)
• Age >60 y	2–3	137 (62)	0.72 (0.57–0.93)
• Pain lasting >3 mo	≤1	35 (16)	0.24 (0.09–0.64)
• No pain aggravation by sitting			
• Groin tenderness			
• Decreased external rotation			
Severe Hip Osteoarthritis			
No. of signs[20]	≥5 Present	22 (10)	35 (13–95)
• Age >60 y	4	30 (14)	2.0 (0.88–4.3)
• Inguinal ligament tenderness	≤3	168 (76)	0.05 (0.01–0.32)
• Decreased external rotation			
• Decreased internal rotation			
• Decreased adduction			
• Bony restriction in one of the directions using passive hip movement			
• Hip abductor weakness			

[a] eTable 6 provides the results at each threshold value.

[b] Number of clinical signs that were present.

[c] Number of hips and proportion (%) with each clinical finding.

[d] Results are serial likelihood ratios (so sensitivity and specificity do not apply). As the number of findings increase, the likelihood of any hip osteoarthritis or severe hip osteoarthritis increases. Serial likelihood ratios were derived from the study by Bierma-Zeinstra et al.[20]