Systematic Review With Video Illustration

Diagnostics of Femoroacetabular Impingement and Labral Pathology of the Hip: A Systematic Review of the Accuracy and Validity of Physical Tests

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Purpose: Femoroacetabular impingement (FAI) and labral pathology have been recognized as causative factors for hip pain. The clinical diagnosis is now based on MRI-A (magnetic resonance imaging-arthrogram) because the physical diagnostic tests available are diverse and information on diagnostic accuracy and validity is lacking. The purpose of this systematic review was to identify the diagnostic accuracy and validity of physical tests that are used to assess FAI and labral pathology of the hip joint. **Methods:** We performed a computerized literature search using PubMed, Medline, Web of Science, PEDro, the Cochrane Library, and CINAHL (Cumulative Index to Nursing and Allied Health Literature) (through EBSCO). Studies describing tests and diagnostic accuracy studies were included. All included studies were assessed by the Levels of Evidence for Primary Research Questions list. All diagnostic accuracy studies were assessed by the QUADAS (Quality Assessment of Diagnostic Accuracy Studies) score. **Results:** We included 21 studies in which 18 different tests were described. For 11 of these tests, diagnostic accuracy figures were presented. Sensitivity was examined for all tests. Other diagnostic accuracy figures were often lacking, and when available, these were low. All articles describing tests had Level IV or V evidence. All diagnostic accuracy studies, except 1, had Level II or III evidence. Three articles had a good QUADAS score. **Conclusions:** In previous studies a wide range of physical diagnostic tests have been described. Little is known about the diagnostic accuracy and validity of these tests, and if available, these figures were low. The quality of the studies investigating these tests is too low to provide a conclusive recommendation for the clinician. Thus, currently, no physical tests are available that can reliably confirm or discard the diagnoses of FAI and/or labral pathology of the hip in clinical practice. **Level of Evidence:** Level III, systematic review of Level III studies.

Femoroacetabular impingement (FAI) and acetabular labral pathology have been recognized as common causes of hip pain and dysfunction.[1-3] The exact prevalence of acetabular labral pathology and FAI in the general population is unknown.[4] Figures in the symptomatic population vary considerably.[5,6] However, FAI is increasingly recognized as a causative factor of many intra-articular hip lesions.[7] It is foremost associated with labral pathology.[5,6,8,9] Both FAI (i.e., cam or pincer impingement) and labral pathology are associated with the development of osteoarthritis of the hip.[5,7-9] Through the development of hip arthroscopy, FAI and labral pathology can now be better treated with fewer complications and a faster rehabilitation rate.[10,11] Recent studies have shown that this treatment is effective.[6,7,11] It leads to improvements in symptoms and range of motion, as well as a

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full return to sport activity.[5,7,11] Furthermore, it is expected that this treatment will delay the progression of osteoarthritis.[9,12] An adequate and timely diagnosis is important, but studies have shown that the mean time to diagnosis of hip joint pathology is greater than 2 years.[2,6,8,13] Patients often see multiple health care providers before the definitive diagnosis is obtained and sometimes even undergo unnecessary surgery. As Martin et al.[2] and Tibor and Sekiya[3] described, an important part of recognizing intra-articular hip pain is the patient's history and physical examination. Furthermore, it is necessary for the clinician to recognize the need for additional investigations such as MRI-A (magnetic resonance imaging-arthrogram).[1-3,8,14]

Several studies on the clinical presentation of FAI and labral pathology have been conducted, and most of these focused on the patient's history and symptoms.[5,9,15,16] There is less evidence regarding the physical tests that are used for examination of the hip joint.[3,17-20] Many different tests are used to diagnose FAI and labral pathology.[18,20] Frequently, these tests have different names but are similar or have the same name but are conducted in different manners. There is also a lack of information regarding the diagnostic accuracy of these tests, such as sensitivity, specificity, likelihood ratios, and predictive values.[2,14,17,18] Therefore the purpose of this study was to identify the diagnostic accuracy and validity of physical tests that are used to assess FAI and labral pathology of the hip joint.

METHODS

The objective of this study was to identify (1) which physical diagnostic tests are used to assess intra-articular hip pathology, especially FAI and labral pathology; (2) the diagnostic accuracy and validity of these tests; and (3) the quality of the diagnostic accuracy studies describing these tests.

TABLE 1. *Overview of Search Strategy for Systematic Review*

	Search Terms	PubMed	PEDro	Cochrane Library	Web of Science	CINAHL	Medline	Total
1.	hip*	95,518					79,943	
2.	groin*	7,870					6,913	
3.	1 or 2	102,886	6	9,611	83.157	20,767	86,577	
4.	exam*	1,914,696					56,531	
5.	test*	1,347,475					57,687	
6.	diagnos*	2,414,400					75,408	
7.	asses*	1,529,078					62,512	
8.	arthromet*	494					491	
9.	4 or 5 or 6 or 7 or 8	5,750,915	0	277,825	96.867	735,185	99,994	
10.	acetabul*	12,852					10,934	
11.	labr*	11,406					5,093	
12.	intra-articular	10,539					8,621	
13.	impingement	4,433					4,263	
14.	femoro-acetabular impingement	337					40	
15.	10 or 11 or 12 or 13 or 14	37,514	0	1,906	23,340	3,553	27,269	
16.	disorder*	1,199,468					80,938	
17.	patholog*	2,301,141					85,804	
18.	injur*	398,152					80,785	
19.	pain*	416,900					85,619	
20.	lesion*	541,230					82,515	
21.	tear*	28,722					25,112	
22.	16 or 17 or 18 or 19 or 20 or 21	4,147,258	0	148,578	96.162	394,507	99,489	
23.	reliab*	242,893					73,281	
24.	valid*	305,724					67,588	
25.	accur*	367,036					62,386	
26.	23 or 24 or 25	800,664	0	40,082	97.647	111,485	100,000	
27.	3 and 9 and 15 and 22 and 26	306	0	46	13	65	15	
	27 and limits	169	0	46	12	65	15	307

NOTE. Search terms and combinations of search terms are presented in the left column. "Limits" used in the last search term were based on inclusion and exclusion criteria of the study. The number of results per database is presented in the other columns.

Table 2. *Inclusion and Exclusion Criteria Used for Systematic Review*

Inclusion Criteria	Exclusion Criteria
Article published in English, German, or Dutch and available as full-text article	Asymptomatic study population
All study designs	Intra-articular hip pathology other than FAI and/or labral pathology
Study population aged between 10 and 80 yr	Studies reporting no separate findings for population with FAI and/or labral pathology *v* none or other pathology
Study with (among others) goal to specifically investigate which clinical diagnostic tests are available for diagnosis of FAI and/or labral pathology	Studies with research solely into agreement and inter-rater and intrarater reliability
Study with (among others) goal to specifically investigate diagnostic accuracy or validity of clinical diagnostic tests for diagnosis of FAI and/or labral pathology	Diagnostic accuracy study using no new data but using data extracted from other research (e.g., systematic reviews)

Search Strategy

We performed a computerized literature search (Table 1) using PubMed, Medline, Web of Science, PEDro, the Cochrane Library, and CINAHL (Cumulative Index to Nursing and Allied Health Literature) (through EBSCO). All relevant articles published between January 1980 and April 1, 2011, were identified. The search was conducted by 2 reviewers (M.T. and L.W.). The following terms or a combination of terms was used: hip*, groin*, exam*, test*, asses*, diagnos*, arthromet*, acetabul*, labr*, intra-articular, impingement, femoro-acetabular impingement, disorder*, patholog*, pain*, injur*, lesion*, tear*, reliab*, valid*, and accur*. Terms were searched as key words or "free-text" terms in all databases. The reference lists of the retrieved articles were checked for additional references.

Study Selection

The 2 reviewers (M.T. and L.W.) independently screened all publications by title and abstract for possible inclusion in the study. All identified publications were then retrieved in full and independently assessed by the 2 reviewers for inclusion in the study. Inclusion and exclusion criteria are presented in Table 2. Disagreements between reviewers were resolved by consensus. If consensus was not reached, the final decision was made by a third reviewer (R.v.C.). The reviewers were not blinded to the authors, journal of publication, or date of publication.

Quality Assessment

General Quality Assessment: The Levels of Evidence for Primary Research Questions list was used to determine the level of evidence of all included studies.[21] This list was developed to define and compare the levels of evidence of studies with different study designs to recommend a clinical advice. It contains 5 levels, Level I being the best and Level V being the worst level of evidence. Each study is scored based on research question, content, and design.

Quality Assessment of Diagnostic Accuracy Studies: The QUADAS (Quality Assessment of Diagnostic Accuracy Studies) tool was used for the quality assessment of the diagnostic accuracy studies.[22,23] It consists of 14 items that can be scored yes, no, or unclear. The inter-rater agreement has been reported to be 90% between 2 reviewers.[22] The Cochrane Collaboration recommends this tool for the assessment of the quality of primary studies on diagnostic accuracy.[24] If half of the items or fewer scored yes, a study was graded "poor." Studies that scored yes for three-fourths of items or more were graded "good." All studies in between were graded "moderate." Before the start of the review process, a pilot study was performed in which the QUADAS tool was used to score 5 articles, achieving an overall agreement of 91% between the 2 reviewers (M.T. and L.W.).

The 2 reviewers (M.T. and L.W.) independently assessed all included articles with the relevant quality-assessment tools. For all quality assessments, any disagreements between reviewers were resolved by consensus. If consensus was not reached, a decision was made by a third reviewer (R.v.C.).

RESULTS

The search identified a total of 307 studies. Based on the title and abstract, 245 studies were excluded. There were 16 doubles, and 25 studies were excluded based on full-text assessment, which left a total of 21

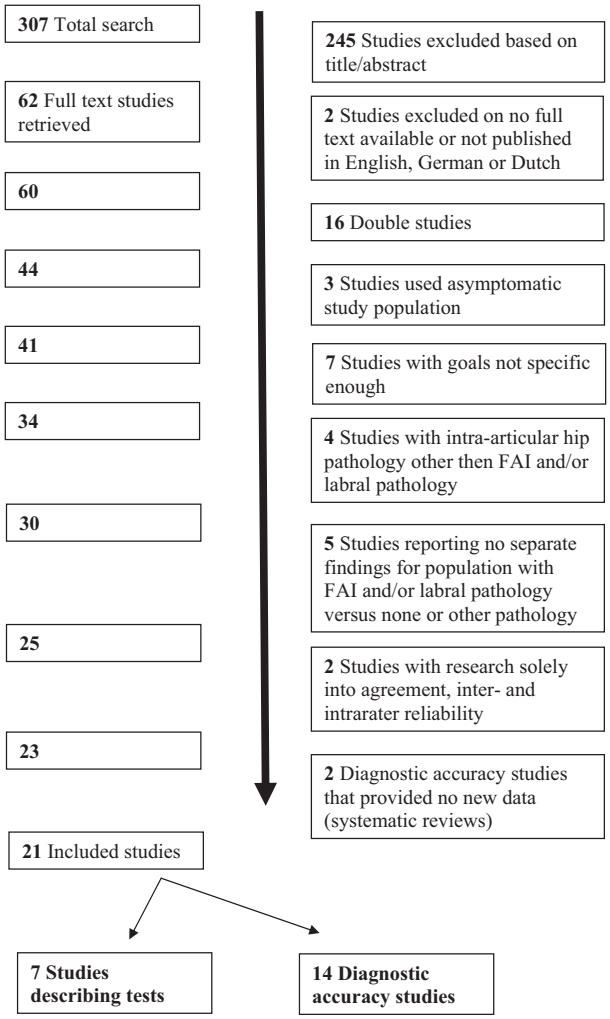

FIGURE 1. Overview of selection procedure for inclusion of studies in systematic review. The number of studies excluded per criteria is presented in the right column. The total search led to 307 studies, of which 21 were included.

studies to be included (Fig 1). Of these studies, 7 described tests for diagnosing FAI and/or labral pathology and 14 focused on diagnostic accuracy. There were minor disagreements between reviewers regarding inclusion of studies, but consensus was reached in all cases.

Clinical Diagnostic Tests

In the 21 included studies, a total of 18 different physical tests were described (Table 3). Ten tests appeared under multiple names or test executions.

Twenty studies described a combined flexion, adduction, and internal rotation maneuver of the hip. The anterior hip impingement test, in which the leg was specifically moved into 90° of flexion, adduction, and internal rotation simultaneously, was described most.

The FABER (flexion-abduction-exorotation) test, also called the Patrick sign, was described in 12 studies. This test is a combination of flexion, abduction, and external rotation of the hip. Because this test was originally designed to diagnose sacroiliac pathology, authors have stated that it is important to distinguish between pain posterior or anterior to the hip.[20,32,33]

Flexion-extension maneuvers were described in 9 studies. These maneuvers often had several different names and executions. Common factors were the movement from flexion to extension with several rotations and abductions/adductions. These tests can be compared with the McMurray tests of the knee.[20,32]

The resisted straight-leg raise (RSLR) test was described in 8 studies. This test consisted of hip flexion against resistance of the examiner with the fully extended leg in 30° or 45° of hip flexion while the patient lay supine.

Several other tests were sporadically described. Most of these tests were derived from existing hip maneuvers, such as the Thomas test.

Diagnostic Accuracy of Clinical Tests

A total of 14 studies examined 11 physical tests (Table 4). For the anterior hip impingement test, the impingement sign, the flexion–adduction–axial compression test, the FABER test, the Fitzgerald test, and the hip quadrant position, a high sensitivity was reported (0.9 to 1.0). For the other tests, the sensitivity was low to moderate.

The specificity was described for 7 physical tests and was not available for the flexion–adduction–axial compression test, the Fitzgerald test, the log-roll test, and the posterior impingement test. A specificity of 0.9 to 1.0 was reported for the anterior hip impingement test, the FABER test, the RSLR test, and the Thomas test.

A high positive predictive value (PPV) of 0.9 to 1.0 was reported for all tests except for the internal rotation–flexion–axial compression maneuver, the log-roll test, and the posterior impingement test.

Only Maslowski et al.[34] described the FABER test and the hip quadrant position and provided a negative predictive value (NPV) of 0.90 and higher. All other values were low to moderate or not calculable.

The positive likelihood ratio (LOR+) was considered large if values above 10 were produced.[35] Only McCarthy et al.[13] showed an LOR+ of 11.125 for the Thomas test. All other authors' values varied between

Table 3. *Clinical Diagnostic Tests With Test Executions and Corresponding Diagnoses*

Test	Test Execution	Diagnoses
Flexion–adduction–internal rotation tests		
Anterior hip impingement test	Patient lies supine while the examiner moves the affected leg into 90° of flexion, adduction, and internal rotation until end range is achieved. Pain in any location marks a positive result.[1,2,14,16,32,38-40]	FAI/labral pathology
Impingement sign/flexion–internal rotation test	Patient lies supine while the researcher brings the involved leg into flexion/internal rotation. Pain predominating in flexion/internal rotation, pain exclusively in flexion/internal rotation, and reduced pain-free flexion amplitude under internal rotation all are positive results.[25,26,37]	FAI/labral pathology
Internal rotation–flexion–axial compression maneuver/internal rotation over pressure test (IROP)	Patient lies supine while the researcher brings the affected leg into internal rotation and flexion, followed by axial compression through the knee. Pain is a positive result.[34,36]	FAI/labral pathology
Flexion–adduction–axial compression test	Patient lies supine while the researcher brings the affected leg into 90° of flexion and slight adduction. Then, axial compression on the joint is performed. Pain is a positive result.[25]	Labral pathology
Flexion–adduction–internal rotation test (FADDIR)	The patient lies in the lateral recumbent position. The examiner stands behind the patient. The leg is positioned into the FADDIR position. Reproduction of the patient's pain is a positive result for FAI. Freehill and Safran[27] described the same test but using in a supine position. The point where the combination of flexion/adduction and internal rotation causes pain should be noted.[20,27-29,32]	FAI/labral pathology
Abduction–external rotation tests		
FABER test/Patrick sign	The patient lies supine. The affected leg is simultaneously flexed, abducted, and externally rotated so that the patient's lateral ankle rests on the contralateral leg just proximal to the knee. While the SIAS is being stabilized, the knee is lowered toward the table. A positive test result may be indicated by either a decrease in ROM compared with the nonaffected leg or reproduction of pain.[1,2,13,14,20,29,30,32-34,38]	FAI/labral pathology
Flexion-extension maneuvers		
Fitzgerald test/labral stress test	The hip is brought into acute flexion, external rotation, and full abduction and is then extended with internal rotation and adduction. The patient lies supine. Extension with abduction and external rotation from the fully flexed, adducted, and internally rotated position completes the test. Pain or a click is a positive result.[27,31]	Labral pathology
Dynamic external rotatory impingement test (DEXRIT)/supine abduction–external rotation test	The patient is in the supine position and is instructed to hold the contralateral leg in flexion beyond 90°. The examined hip is brought into 90° of flexion or beyond and is passively taken through a wide arc of abduction and external rotation. A positive test will re-create the patient's pain.[20,28,32]	FAI/labral pathology
Dynamic internal rotatory impingement test (DIRIT/DIRI)	The patient is in the supine position and is instructed to hold the contralateral leg in flexion beyond 90°. The examined hip is brought into 90° of flexion or beyond and is passively taken through a wide arc of adduction and internal rotation. A positive test will re-create the patient's pain.[20,28,33]	FAI/labral pathology
Hip quadrant position/scour test	The patient lies supine while the examiner brings the affected leg into flexion and adduction. The leg is then rotated. A positive test will re-create the patient's pain or shows a restriction in ROM. Maslowski et al.[34] described the same test only with axial compression through the joint.[29,30,32]	FAI/labral pathology

TABLE 3. *Continued*

Test	Test Execution	Diagnoses
McCarthy test	The patient lies supine while the examiner rolls the affected hip in a wide arc of internal and external rotation from flexion to extension. A positive sign re-creates the patient's pain in a specific position. Plante et al.[28] described the same test but with internal rotation and adduction combined and with external rotation and abduction combined. This test is also described by Martin et al.[20] but with axial compression during the whole movement and is called the scour test.[14,20,28,29,32]	FAI/labral pathology
Lateral rim impingement test	The patient lies in the lateral position while the examiner brings the affected leg from flexion to extension in continuous abduction while externally rotating the hip. A reproduction of the patient's pain is a positive result.[20,29]	FAI
Remaining tests		
Thomas test	Patient lies supine with the legs pulled to the chest. The affected leg is lowered off the edge of the table (from flexion to extension). A click (as perceived by patient/researcher) or recognizable pain marks a positive result.[13,29,36]	Labral pathology
Hyperextension–external rotation test	The patient lies in the end position of the Thomas test (1 leg bent and 1 leg free of the table). The examiner externally rotates the leg in neutral abduction-adduction and in adduction. Pain reproduction is a positive result.[27]	FAI/labral pathology
RSLR test/Stinchfield test	The patient lies supine and is asked to raise the straight leg to 45° of hip flexion. The patient is asked to resist manual force applied just proximal to the knee by the researcher. Recognizable pain or weakness is a positive result. Troelsen et al.[38] and Maslowski et al.[34] performed the same test but only raised the leg until 30°.[1,14,20,27,32,33]	FAI/labral pathology
Log-roll test/passive supine rotation test	The patient lies supine while the examiner places both hands on the upper leg. The involved leg is then rolled inward and outward. Pain or a restriction during this maneuver is a positive result.[1,14,20,33]	FAI/labral pathology
Posterior hip impingement test/posterior rim impingement	The patient lies at the edge of the examining table and the legs hang freely at the hip. Both legs are drawn up to the chest and then the affected leg is lowered off the table, fully abducted, and externally rotated. Pain is a positive result.[1,14,20,33]	FAI/labral pathology
Foveal distraction	The patient lies in the supine position with the affected leg 30° abducted. Axial traction is placed on the leg. A relief of pain or pain reduction is a positive result.[20,28,29]	FAI/labral pathology

NOTE. Tests are divided into categories based on similarities in execution. Tests with several names but the same execution are presented in 1 row, and the names are divided by virgules.
Abbreviations: ROM, range of motion; SIAS, spina iliaca anterior inferior.

0.73 and 1.55, presenting no or minimal changes in the positive likelihood of the disease.[35] McCarthy et al.[13] also produced a moderate negative likelihood ratio (LOR–) of 0.12, whereas all other studies showed small or minimal decreases in the likelihood of the disease.

For the log-roll test and the posterior impingement test, no PPV, NPV, LOR+, or LOR–values were provided. Overall, 6 studies examining 7 tests provided information for all diagnostic accuracy figures.[2,34-38] With the exception of the studies by Troelsen et al.,[38] McCarthy et al.,[13] and Maslowski et al.,[34] the reported values were moderate to low.

General Quality Assessment

The general quality assessment performed by the levels of evidence list[21] showed that all studies describing physical diagnostic tests were rated Level IV or V (Table 5). All diagnostic accuracy studies were

TABLE 4. *Clinical Diagnostic Tests for FAI and/or Labral Pathology With Diagnostic Accuracy and Validity*

Author (Year of Publication)	Study Population	Diagnoses Made by Authors	Reference Standard Used to Confirm or Discard Diagnosis	Sensitivity	Specificity	LOR+	LOR–	PPV	NPV
Anterior hip impingement test									
Martin et al.[2] (2008)	N = 49 (24 women/25 men); mean age, 42 yr (range, 18-68 yr; SD, 15)	Acetabular labral tear	50% improvement of VAS after intra-articular injection and MRI-A	0.78	0.10	0.86	2.3	0.53	0.25
Sink et al.[16] (2008)	N = 35 (30 female patients/5 male patients); mean age, 16 yr (range, 13-18 yr)	FAI in combination with labral pathology	Radiography (35), MRI (4), and MRI-A (24)	1.0	NA	NA	NA	1.0	NA
Clohisy et al.[1] (2009)	N = 51 (53 hips); mean age, 35 yr (range, 15-61 yr)	Symptomatic FAI in combination with labral pathology	Clinical diagnosis with radiography	0.88	NA	NA	NA	1.0	0
Burnett et al.[39] (2006)	N = 66 (47 female patients/19 male patients); mean age, 38 yr (range, 15-64 yr)	Acetabular labral tear	Arthroscopy	0.95	NA	NA	NA	1.0	0
Troelsen et al.[38] (2009)	N = 18 (16 women/2 men); median age, 43 yr (range, 32-56 yr)	Labral pathology	MRI-A	0.59	1.0	0	0.41	1.0	0.13
Philippon et al.[40] (2009)	N = 301 (153 male patients/148 female patients); mean age, 39.9 yr (range, 11-72 yr)	FAI	Arthroscopy	0.99	NA	NA	NA	NA	NA
Impingement sign									
Nogier et al.[37] (2010)	N = 292 (111 women/181 men); mean age, 35 yr (SD, 10)	FAI	Complete physical examination with radiography	0.2-0.7	0.44-0.86	1.25-1.55	0.68-0.93	0.63-0.67	0.44-0.53
Santori and Villar[26] (2000)	N = 58 (33 female patients/25 male patients); mean age, 36.7 (range, 10-70 yr)	Acetabular labral tear	Arthroscopy	1.0	NA	NA	NA	1.0	NA
Hase and Ueo[25] (1999)	N = 10 (7 female patients/10 male patients); mean age, 28.7 yr (range, 13-67 yr)	Acetabular labral tear	Arthroscopy	0.7	NA	NA	NA	1.0	NA
Internal rotation–flexion–axial compression maneuver/internal rotation over pressure test									
Narvani et al.[36] (2003)	N = 18 (5 female patients/13 male patients); mean age, 30.5 yr (range, 17-48 yr; SD, 8.45)	Acetabular labral tear	MRI-A	0.75	0.43	1.32	0.58	0.27	0.86
Maslowski et al.[34] (2010)	N = 50; mean age, 60.2 yr (range, 22-84 yr)	Labral tear, FAI	80% improvement of pain on 10-cm VAS after intra-articular hip injection or 80% pain relief	0.89	0.15	1.05	0.73	0.19	0.86

TABLE 4. *Continued*

Author (Year of Publication)	Study Population	Diagnoses Made by Authors	Reference Standard Used to Confirm or Discard Diagnosis	Sensitivity	Specificity	LOR+	LOR–	PPV	NPV
Flexion–adduction–axial compression test									
Hase and Ueo[25] (1999)	N = 10 (7 female patients/10 male patients); mean age, 28.7 yr (range, 13-67 yr)	Acetabular labral tear	Arthroscopy	1.0	NA	NA	NA	1.0	NA
FABER test/Patrick sign									
Martin et al.[2] (2008)	N = 49 (24 women/25 men); mean age, 42 yr (range, 18-68 yr; SD, 15)	Acetabular labral tear	50% improvement of VAS after intra-articular injection and MRI-A	0.6	0.18	0.73	2.2	0.45	0.29
Clohisy et al.[1] (2009)	N = 51 (53 hips); mean age, 35 yr (range, 15-61 yr)	Symptomatic FAI in combination with labral pathology	Clinical diagnosis with radiography	0.69	NA	NA	NA	1.0	0
Mitchell et al.[30] (2003)	N = 25 (9 female patients/16 male patients); mean age, 30.9 yr (range, 16-56 yr)	Labral tear, rim lesion	Arthroscopy	0.88	NA	NA	NA	1.0	0
Troelsen et al.[38] (2009)	N = 18 (16 women/2 men); median age, 43 yr (range, 32-56 yr)	Labral pathology	MRI-A	0.41	1.0	0	0.59	1.0	0.09
Philippon et al.[40] (2009)	N = 301 (153 male patients/ 148 female patients); mean age, 39.9 yr (range, 11-72 yr)	FAI	Arthroscopy	0.97	NA	NA	NA	NA	NA
Maslowski et al.[34] (2010)	N = 50; mean age, 60.2 yr (range, 22-84 yr)	Labral tear, FAI	80% improvement of pain on 10-cm VAS after intra-articular hip injection or 80% pain relief	0.88	0.24	1.16	0.5	0.18	0.91
Fitzgerald test									
Fitzgerald[31] (1995)	N = 56; mean age, 36.5 yr (range, 18-75 yr)	Labral tear	Hip joint surgery (marcainisation in 7 subjects)	0.96	NA	NA	NA	1.0	0
Hip quadrant position/ scour test									
Mitchell et al.[30] (2003)	N = 25 (9 female patients/16 male patients); mean age, 30.9 yr (range, 16-56 yr)	Labral tear, rim lesion	Arthroscopy	1.0	NA	NA	NA	1.0	NA
Maslowski et al.[34] (2010)	N = 50; mean age, 60.2 yr (range, 22-84 yr)	Labral tear, FAI	80% improvement of pain on 10-cm VAS after intra-articular hip injection or 80% pain relief	0.88	0.43	1.54	0.28	0.23	0.95
Thomas test									
McCarthy et al.[13] (1995)	N = 59 (32 female patients/ 27 male patients); mean age, 37 yr (range, 17-69 yr)	Acetabular labral tear	Arthroscopy	0.89	0.92	11.125	0.12	0.94	0.86

TABLE 4. *Continued*

Author (Year of Publication)	Study Population	Diagnoses Made by Authors	Reference Standard Used to Confirm or Discard Diagnosis	Sensitivity	Specificity	LOR+	LOR–	PPV	NPV
RSLR test/Stinchfield test									
Clohisy et al.[1] (2009)	N = 51 (53 hips); mean age, 35 yr (range, 15-61 yr)	Symptomatic FAI in combination with labral pathology	Clinical diagnosis with radiography	0.56	NA	NA	NA	1.0	0
Troelsen et al.[38] (2009)	N = 18 (16 women/2 men); median age, 43 yr (range, 32-56 yr)	Labral pathology	MRI-A	0.06	1.0	0	0.94	1.0	0.06
Maslowski et al.[34] (2010)	N = 50; mean age, 60.2 yr (range, 22-84 yr)	Labral tear, FAI	80% improvement of pain on 10-cm VAS after intra-articular hip injection or 80% pain relief	0.75	0.38	1.21	0.66	0.19	0.89
Log-roll test									
Clohisy et al.[1] (2009)	N = 51 (53 hips); mean age, 35 yr (range, 15-61 yr)	Symptomatic FAI in combination with labral pathology	Clinical diagnosis with radiography	0.30	NA	NA	NA	NA	NA
Posterior impingement test									
Clohisy et al.[1] (2009)	N = 51 (53 hips); mean age, 35 yr (range, 15-61 yr)	Symptomatic FAI in combination with labral pathology	Clinical diagnosis with radiography	0.21	NA	NA	NA	NA	NA

NOTE. Data are arranged per test and then per study. Therefore some studies are cited more than once. Tests with several names but the same execution are presented in 1 row; the names are divided by virgules.

Abbreviations: MRI, magnetic resonance imaging; MRI-A, magnetic resonance imaging-arthrogram; NA, not applicable (data were not calculated in study and/or could not be calculated based on available figures); VAS, visual analog scale.

TABLE 5. *Overview of Included Studies With Corresponding Level of Evidence*

Author (Year of Publication)	Test Description or Diagnostic Accuracy Study	Level of Evidence
Braly et al.[29] (2006)	Test description	V
Domb et al.[32] (2009)	Test description	V
Freehill and Safran[27] (2011)	Test description	V
Martin et al.[14] (2006)	Test description	V
Martin et al.[33] (2010)	Test description	V
Martin et al.[20] (2010)	Test description	IV
Plante et al.[28] (2011)	Test description	V
Burnett et al.[39] (2006)	Accuracy	II
Clohisy et al.[1] (2009)	Accuracy	II
Fitzgerald[31] (1995)	Accuracy	II
Hase and Ueo[25] (1999)	Accuracy	III
Martin et al.[2] (2008)	Accuracy	III
Maslowski et al.[34] (2010)	Accuracy	III
McCarthy et al.[13] (1995)	Accuracy	III
Mitchell et al.[30] (2003)	Accuracy	III
Narvani et al.[36] (2003)	Accuracy	III
Nogier et al.[37] (2010)	Accuracy	IV
Philippon et al.[40] (2009)	Accuracy	II
Santori and Villar[26] (2000)	Accuracy	III
Sink et al.[16] (2008)	Accuracy	III
Troelsen et al.[38] (2009)	Accuracy	III

NOTE. The second column describes whether the research described tests (test description) and, if so, investigated the diagnostic accuracy and validity of the tests (accuracy).

rated Level II or III except for the study by Nogier et al.,[37] which was rated Level IV.

Quality of Diagnostic Accuracy Studies

All included diagnostic accuracy studies were cohort studies or cross-sectional studies, and the QUADAS score was used for quality assessment. Based on the overall score, 4 articles were graded as poor, 7 as moderate, and 3 as good (Table 6). With the exception of the study by Narvani et al.,[36] a disadvantage of all studies was the use of a study population in which there was a high suspicion or confirmation of intra-articular hip pathology.

DISCUSSION

This review identified 21 studies describing 18 physical diagnostic tests for the assessment of FAI and/or labral pathology of the hip joint. Of the studies, 7 gave a description of these tests and 14 were diagnostic accuracy studies. Many physical tests were the objective of previous studies, but results show that there was a lack of diagnostic accuracy parameters or these parameters had poor values. This was supported by our finding that based on the QUADAS score, only 3 of 14 diagnostic accuracy studies were of good quality. These 3 studies investigated the anterior hip impingement test, the FABER test, and the RSLR test (Video 1, available at www.arthroscopyjournal.org).[38-40] However, because of several methodologic problems, none of these tests are appropriate to reliably confirm or discard the diagnosis of FAI and/or labral pathology.

The first methodologic issue is that in each of the 3 studies, there were some flaws that resulted in a lower strength of evidence. The number of subjects per study differed from 18 to 301.[38-40] Because variation among subjects can be expected, a group of 18 subjects is too small to reliably interpret diagnostic accuracy figures. Furthermore, all 3 studies used a study population in which there was a high suspicion of intra-articular hip pathology, increasing the risk of spectrum bias. These 2 flaws led to difficulties in interpretation of the diagnostic accuracy figures. This was confirmed by the fact that the sensitivity ranged from 0.59 to 0.99 for the anterior hip impingement test and from 0.41 to 0.97 for the FABER test.[38-40] In addition, only Troelsen et al.[38] provided the specificity, resulting in an LOR+ and LOR–. However, the usefulness of these figures is questionable because these were based on 18 subjects only. Two studies reported high PPV values of 1.0 for all 3 investigated tests.[38,39] Yet, the PPV and NPV were of limited use because the disease prevalence figures in these studies were not comparable to those in clinical practice. This was because of study populations in which there was a high suspicion or even confirmation of the disease but also because general prevalence figures for FAI and/or labral pathology are unknown.[2,4]

The second methodologic issue is that the results of these 3 studies could not be combined because of slight differences in test executions. For example, a positive FABER test described by Philippon et al.[40] consisted of a decreased range of motion, whereas Troelsen et al.[38] described pain as a positive result (Video 1). This was seen more often in the literature, where many tests have different names but are similar or have the same name but are conducted in different manners.[20,33]

To a certain extent, the results of this systematic review are comparable to those presented in 2 previous systematic reviews concerning labral pathology. Burgess et al.[17] studied the validity and accuracy of clinical diagnostic tests for labral pathology and concluded that there is too little information to draw a conclusion for clinical practice. They included only 5 articles with an equal number of tests,

TABLE 6. *Quality Assessment of Diagnostic Accuracy Studies for FAI and/or Labral Pathology by Means of QUADAS Tool*

Author (Year of Publication)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Final Score
Burnett et al.[39] (2006)	N	Y	Y	U	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Good
Clohisy et al.[1] (2009)	N	U	Y	Y	Y	U	N	N	N	U	U	Y	Y	Y	Poor
Fitzgerald[31] (1995)	N	N	Y	U	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Moderate
Hase and Ueo[25] (1999)	N	N	Y	U	Y	Y	Y	U	N	N	N	Y	Y	Y	Poor
Martin et al.[2] (2008)	N	Y	N	U	Y	Y	Y	N	Y	U	U	Y	Y	Y	Moderate
Maslowski et al.[34] (2010)	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Moderate
McCarthy et al.[13] (1995)	N	Y	Y	U	Y	Y	Y	N	Y	U	N	Y	Y	Y	Moderate
Mitchell et al.[30] (2003)	N	N	Y	U	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Moderate
Narvani et al.[36] (2003)	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	Y	Moderate
Nogier et al.[37] (2010)	N	Y	N	Y	Y	Y	N	N	N	N	N	Y	N	N	Poor
Philippon et al.[40] (2009)	N	Y	Y	U	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Good
Santori and Villar[26] (2000)	N	N	Y	U	Y	U	Y	U	Y	N	N	Y	Y	Y	Poor
Sink et al.[16] (2008)	N	Y	N	U	Y	U	Y	Y	Y	U	U	Y	Y	Y	Moderate
Troelsen et al.[38] (2009)	N	Y	N	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good

NOTE. The final score was deemed poor if there were 7 yes answers or fewer; moderate, 8 to 10 yes answers; and good, 11 yes answers or more.

Abbreviations: N, no (information is not provided or adequate); U, unclear (insufficient information available to make a judgment); Q, questions from QUADAS score according to Whiting et al.[22] (2003); Y, yes (information is provided and correct).

for which only the sensitivity and specificity values were reported. Moreover, the tests were not described as they were originally developed. Leibold et al.[18] investigated the concurrent criterion-related validity of physical examination tests for hip labral lesions. They found that a negative result on the flexion–adduction–internal rotation test, the impingement provocation test, the flexion–internal rotation test, the flexion–adduction–axial compression test, the Fitzgerald test, or a combination of these provided the clinician with the greatest confidence that labral pathology was absent. However, this conclusion was premature because it was based on sensitivity data and a narrative discussion only. Both reviews included labral pathology only.[17,18] In the absence of major trauma, isolated labral pathology is uncommon.[6] Therefore other causative factors of hip pain should be considered and investigated. FAI is increasingly recognized as a causative factor for many intra-articular hip lesions, and FAI and labral pathology are the most common indications for hip arthroscopy.[8,41] Therefore we included studies investigating physical diagnostic tests for these 2 pathologies. To our knowledge, this is the first systematic review that addresses the accuracy and validity of physical diagnostic tests for FAI and/or labral pathology. A possible limitation of this study was that other intra-articular pathology and radiographic investigations were not included.

CONCLUSIONS

There exists a wide range of physical diagnostic tests for FAI and/or labral pathology and little information on the diagnostic accuracy and validity. The methodologic quality of the diagnostic accuracy studies is moderate to poor. Uniformity in test executions is warranted, and these should be thoroughly investigated for diagnostic accuracy and validity. For now, no (combination of) physical diagnostic tests are available that can reliably confirm or discard the diagnoses of FAI and/or labral pathology in clinical practice.

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