CLINICAL GUIDELINES

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Non-arthritic Hip Joint Pain
Clinical Practice Guidelines
Linked to the International Classification
of Functioning, Disability, and Health
from the Orthopaedic Section of the
American Physical Therapy Association


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Non-arthritic Hip Joint Pain: Clinical Practice Guidelines

**Recommendations***

**Risk Factors**
Clinicians should consider the presence of osseous abnormalities, local or global ligamentous laxity, connective tissue disorders, and nature of the patient’s activity and participation as risk factors for hip joint pathology. (Recommendation based on weak evidence)

**Diagnosis/Classification – Non-arthritic Hip Joint Pain:** Clinicians should use the clinical findings of anterior groin pain or generalized hip joint pain that is reproduced with the FAIR or FABER test, along with collaborative imaging findings, to classifying a patient with hip pain into the International Statistical Classification of Diseases and Related Health Problems (ICD) categories of M25.5 Pain in joint, M24.7 Protrusio acetabula, M24.0 Loose body in joint, and M24.2 Disorder of ligament, and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of hip pain (b28016 Pain in joints) and mobility impairments (b7100 Mobility of a single joint; b7150 Stability of a single joint). (Recommendation based on weak evidence)

**Examination – Outcome Measures**
Clinicians should utilize the Hip Outcome Score, the Copenhagen Hip and Groin Outcome Score, the International Hip Outcome Tool for individuals with higher levels of function, and may use the use of the Modified Harris Hip Score and the Western Ontario and McMaster Universities Osteoarthritis Index with individuals with lower levels of function, before and after interventions intended to alleviate the impairments of body function and structure, activity limitations, and participation restrictions associated with hip joint pathology. (Recommendation based on moderate evidence)

**Examination – Physical Impairment Measures:** When evaluating a patient with suspected or confirmed hip pathology over an episode of care, assessment of impairment of body function should include objective and reproducible measures of hip pain, mobility, muscle power, and movement coordination. (Recommendation based on moderate evidence)

**Differential Diagnosis**
Clinicians should consider diagnostic categories other than non-arthritic joint pain when the patient’s history, reported activity limitations, or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline or when the patient’s symptoms are not diminishing with interventions aimed at normalization of the impairments of body function. (Recommendation based on expert opinion)

**Intervention – Patient Education and Counseling**
Patient education should be linked to the clinical presentation. In the presence of femoracetabular impingement, activities that involve end ranges hip flexion and hip internal rotation should be avoided. In the presence of structural instability, activities that involve end ranges of hip extension and external rotation should be limited. In the presence of intra-articular injury, activities that involve end ranges of all motions or that produce or increase pain should be
avoided. Instruction in use of assistive devices, such as a cane, should be provided when pain interferes with normal gait. (Recommendation based on expert opinion)

**Intervention – Manual Therapy**
In the absence of contraindications, joint mobilization procedures are indicated when capsular restrictions are suspected to impair hip mobility and soft tissue mobilization procedures are indicated when muscles and their related fascia are suspected to impair hip mobility. (Recommendation based on expert opinion)

**Intervention – Therapeutic Exercises**
Therapeutic exercises should be utilized to address joint mobility, muscle flexibility, muscle strength, and muscle power deficits identified during the physical examination of patients with hip joint pain. Cardiorespiratory/aerobic endurance exercise that involves minimal stress to the hip should be utilized to promote optimal health and prevent or remediate metabolic disorders. (Recommendation based on theoretical/foundational evidence)

**Intervention – Neuromuscular Reeducation**
Neuromuscular reeducation procedures should be offered to diminish movement coordination impairments identified in patients with non-arthritic hip pain. (Recommendation based on expert opinion)

*These recommendations and clinical practice guidelines are based on the scientific literature accepted for publication prior to January 2012.*
INTRODUCTION

AIM OF THE GUIDELINES
The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based practice guidelines for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization’s International Classification of Functioning, Disability, and Health.1

The purposes of these clinical guidelines are to:
- Describe evidence-based physical therapy practice including diagnosis, prognosis, intervention, and assessment of outcome for musculoskeletal disorders commonly managed by orthopaedic physical therapists
- Classify and define common musculoskeletal conditions using the World Health Organization’s terminology related to impairments of body function and body structure, activity limitations, and participation restrictions
- Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
- Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure as well as in activity and participation of the individual
- Provide a description to policy makers, using internationally accepted terminology, of the practice of orthopaedic physical therapists
- Provide information for payers and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

STATEMENT OF INTENT
This guideline is not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made in light of the clinical data presented by the patient, the diagnostic and treatment options available, and the patient’s values, expectations, and preferences. However, we suggest significant departures from accepted guidelines should be documented in the patient’s medical records at the time the relevant clinical decision is made.

METHODS
Content experts were appointed by the Orthopaedic Section, APTA as developers and authors of clinical practice guidelines for musculoskeletal conditions of the hip that are commonly treated by physical therapists. These content experts were given the task to identify impairments of body
function and structure, activity limitations, and participation restrictions, described using ICF terminology, that could (1) categorize patients into mutually exclusive impairment patterns upon which to base intervention strategies, and (2) serve as measures of changes in function over the course of an episode of care. The second task given to the content experts was to describe the supporting evidence for the identified impairment pattern classification as well as interventions for patients with activity limitations and impairments of body function and structure consistent with the identified impairment pattern classification. It was also acknowledged by the Orthopaedic Section, APTA a systematic search and review of the evidence related to diagnostic categories based on International Statistical Classification of Diseases and Health Related Problems (ICD) terminology would not be sufficient for these ICF-based clinical practice guidelines as most of the evidence associated with changes in levels of impairment or function in homogeneous populations is not readily searchable using the current ICD terminology. For this reason, the content experts were directed to also search the scientific literature related to classification, outcome measures, and intervention strategies for musculoskeletal conditions commonly treated by physical therapists. Thus, the authors of this guideline independently performed a systematic search of the MEDLINE, CINAHL, and the Cochrane Database of Systematic Reviews (1967 through December 2011) for any relevant articles related to classification, outcome measures, and intervention for musculoskeletal conditions related to non-arthritic hip joint pain. Additionally, when relevant articles were identified their reference lists were hand-searched in an attempt to identify additional articles that might contribute to the outcome of this guideline. Articles from the searches were compiled and reviewed for accuracy by the authors. Articles with the highest levels of evidence that were most relevant to classification, examination, and intervention for patients with musculoskeletal conditions related to non-arthritic hip joint pain were included in this guideline.

This guideline was issued in 2012, based upon publications in the scientific literature prior to January 2012. This guideline will be considered for review in 2017 or sooner if new evidence becomes available. Any updates to the guideline in the interim period will be noted on the Orthopaedic Section of the APTA website: www.orthopt.org

**LEVELS OF EVIDENCE**

Individual clinical research articles will be graded according to criteria described by the Center for Evidence-Based Medicine, Oxford, United Kingdom (for diagnostic, prospective, and therapeutic studies. If 2 content experts did not agree on a grade of evidence for a particular article, a third content expert was used to resolve the issue.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tr>
<td>I</td>
<td>Evidence obtained from high quality randomized controlled trials, prospective studies, or diagnostic studies</td>
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<tr>
<td>II</td>
<td>Evidence obtained from lesser quality randomized controlled trials, prospective studies or diagnostic studies (e.g., improper randomization, no blinding, &lt; 80% follow-up)</td>
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<tr>
<td>III</td>
<td>Case controlled studies or retrospective studies</td>
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<td>IV</td>
<td>Case series</td>
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<td>V</td>
<td>Expert opinion</td>
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**GRADES OF EVIDENCE**
The overall strength of the evidence supporting recommendations made in this guideline will be graded according to guidelines described by Guyatt et al, as modified by MacDermid and adopted by the coordinator and reviewers of this project. In this modified system, the typical A, B, C and D grades of evidence have been modified to include the role of consensus expert opinion and basic science research to demonstrate biological or biomechanical plausibility.

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<tr>
<th>Grades of Recommendation</th>
<th>Strength of Evidence</th>
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<tr>
<td>A</td>
<td>Strong evidence</td>
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<td></td>
<td>A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study</td>
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<td>B</td>
<td>Moderate evidence</td>
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<td>A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation</td>
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<td>C</td>
<td>Weak evidence</td>
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<td>A single level II study or a preponderance of level III and IV studies including statements of consensus by content experts support the recommendation</td>
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<td>D</td>
<td>Conflicting evidence</td>
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<td>Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies</td>
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<td>E</td>
<td>Theoretical/foundational evidence</td>
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<tr>
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<td>A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic sciences/bench research support this conclusion</td>
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<tr>
<td>F</td>
<td>Expert opinion</td>
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<td></td>
<td>Best practice based on the clinical experience of the guidelines development team</td>
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REVIEW PROCESS
The Orthopaedic Section, APTA also selected consultants from the following areas to serve as reviewers of the early drafts of this clinical practice guideline:
- Claims review
- Coding
- Epidemiology
- Hip pain rehabilitation
- Medical practice guidelines
- Movement science
- Orthopaedic physical therapy residency education
- Outcomes research
- Physical therapy academic education
- Sports physical therapy residency education
- Sports rehabilitation

Comments from these reviewers were utilized by the authors to edit this clinical practice guideline prior to submitting it for publication to the Journal of Orthopaedic & Sports Physical Therapy. In addition, several physical therapists practicing in orthopaedic and sports physical
therapy settings were sent initial drafts of this clinical practice guideline, along with feedback forms to determine its usefulness, validity, and impact.

CLASSIFICATION

The primary International Statistical Classification Of Diseases and Related Health Problems (ICD)-10th revision code associated with non-arthritic hip pain are M25.5 Pain in joint, M24.7 Protrusio acetabula, M24.0 Loose body in joint, and M24.2 Disorder of ligament.

The corresponding ICD-9th revision CM code and conditions, which are used in the USA, are: 719.45 Joint pain, 718.65 Unspecified intrapelvic protrusion of acetabulum, 718.15 Loose body in joint, 718.5, and Other derangement of joint pelvic region and thigh.

Other ICD-10 codes that may be associated with non-arthritic hip joint pain are:
- M21.0 Valgus deformity, not elsewhere classified
- M21.1 Varus deformity, not elsewhere classified
- M21.2 Flexion deformity
- M24.3 Pathological dislocation and subluxation of joint, not elsewhere classified
- M24.4 Recurrent dislocation and subluxation of joint
- M24.5 Contracture of joint
- M24.6 Ankylosis of joint
- M24.9 Joint derangement, unspecified
- M25.0 Hemarthrosis
- M25.3 Other instability of joint
- M25.4 Effusion of joint
- M25.6 Stiffness of joint, not elsewhere classified
- M25.7 Osteophyte
- M25.8 Other specified joint disorders
- M25.9 Joint disorder, unspecified
- Q65.6 Unstable hip
- R29.4 Clicking hip
- S73 Dislocation, sprain and strain of joint ligaments of hip

The primary ICF body function codes associated with non-arthritic hip joint pain are b28016 Pain in joints, b7100 Mobility of a single joint, and b7150 Stability of a single joint. Other ICF body functions codes that may be associated with this condition are b7300 Power of isolated muscles and muscle groups, b7400 Endurance of muscle groups, b7603 Supportive functions of arm and leg, b770 Gait functions, and b7800 Sensation of muscle stiffness.

The primary ICF body structure code associated with non-arthritic hip joint pain is s750001 hip joint. Other ICF body structure codes associated with this condition are s7402 Muscles of the pelvic region, and s7403 Ligaments and fasciae of the pelvic region.

The primary ICF activities and participation codes associated with non-arthritic hip joint pain are d4103 Sitting, d4104 Standing, d4151 Maintaining a squatting position, d4153 Maintaining
a sitting position, d4552 Running, d4500 Walking short distances, and d4501 Walking long distances.

Other ICF Activities and Participation codes that may be associated with non-arthritic hip joint pain are:

d2303 Completing daily routine
d4101 Squatting
d4154 Maintaining a standing position
d4302 Carrying in arms (object)
d4303 Carrying on shoulders, hip, and back
d4351 Kicking
d4500 Walking short distances
d4501 Walking long distances
d4502 Walking on different slopes
d4551 Climbing
d4553 Jumping
d5701 Maintaining diet and fitness
d4600 Moving around within the home
d4601 Moving around within buildings other than home
d4602 Moving around outside the home or other building
d4650 Moving around using equipment
d5204 Caring for toenails
d5400 Putting on clothes
d5401 Taking off clothes
d5402 Putting on footwear
d5403 Taking off footwear
d920 Recreation and Leisure
d9201 Sports
IMPAIRMENT/FUNCTION-BASED DIAGNOSIS

PATHOANATOMICAL FEATURES

Understanding the complex relationship among the labrum, the bony architecture of the acetabulum and femur, as well as the proximate soft tissues such as the ligaments and muscles, is important for diagnosis and optimal treatment of individuals with mechanical hip pain.

The proximal femur articulates with the acetabulum to form the hip joint. The femoral head is two thirds of a sphere covered with hyaline cartilage and enclosed in a fibrous capsule. The femoral head is connected to the femoral shaft via the femoral neck. In the frontal plane the femoral neck lies at an angle to the shaft of the femur. This “angle of inclination” is normally 120° to 125° in the adult population. In the transverse plane the proximal femur is oriented anterior to the distal femoral condyles as a result of a medial torsion of the femur with a normal range between 14° to 18° of anteversion. The hip joint is a “ball and socket” synovial joint with articular cartilage and a fully developed joint capsule allowing movement in all 3 body planes.

The articular cartilage of the femoral head is thickest in the anterior-superior region except where it is absent at the fovea capitis. In normal volunteers, the cartilage is thickest in the central portion around the ligamentum teres. This corresponds to the area of maximum weight bearing forces. The articular cartilage of the acetabulum is horseshoe-shaped and thickest superiorly. It is continuous with the cartilage that lines the acetabular labrum. The articular cartilage of the hip joint is avascular and aneural.

The joint capsule attaches around the acetabular rim proximally and distally at the intertrochanteric line. Along with the labrum, the capsule provides passive stability to the hip joint. The capsule attaches proximally to the acetabular rim and extends to the base of the femoral neck. The iliofemoral, ischiofemoral, and pubofemoral ligaments assist the capsule in providing stability to the joint. These three strong ligaments reinforce the joint capsule, the iliofemoral and pubofemoral ligaments anteriorly and ischiofemoral ligament posteriorly.

Control of the hip during movement involves complex interactions between the nervous, muscular, and skeletal systems. The twenty-seven muscles that cross the hip joint act as primary movers and dynamic stabilizers of the hip and leg. The gluteus medius is the primary source of dynamic stabilization for the hip joint in the frontal plane. Weakness of this muscle has been traditionally implicated as playing a role in functional impairments. The iliopsoas complex is the primary hip flexor and may play a role in stabilizing the femoral head anteriorly given its location across the anterior hip joint. The gluteus maximus is the most powerful hip extensor. The hip external and internal rotators’ role in stabilization may become more crucial when the acetabular labrum is torn secondary to the subsequent loss of passive rotational stability.

Non-arthritis hip joint pain may be related to numerous underlying causes such as femoroacetabular impingement, structural instability, acetabular labral tears, osteochondral lesions, loose bodies, ligamentum teres injury, and septic conditions. Recently, an increased focus has been placed on identifying acetabular labral tears as
one cause of hip pain and understanding the underlying mechanisms in the development of labral tears. These underlying mechanisms may be related to variations in joint anatomy combined with specific activities or of traumatic onset. Two anatomical variants have been described, femoroacetabular impingement, and structural instability.

**Femoroacetabular Impingement**

Structural variations of the proximal femur or acetabulum may result in a femoroacetabular impingement, which is described as abnormal contact between the femoral head/neck and the acetabular margin and has been associated with labral and chondral damage. Osseous abnormalities proposed to contribute to labral tears due to femoroacetabular impingement, include bony malformations in the proximal femur or the acetabulum resulting in premature abutment of the femoral neck into the acetabulum during the motion of hip flexion with internal rotation. The presence of a slipped capital femoral epiphysis (SCFE) has also been noted to cause femoroacetabular impingement. With repetitive motions into the position of impingement, the acetabular labrum will undergo excessive shear and compressive forces which may lead to eventual injury. Femoroacetabular impingement has been further classified into three categories, based on the specific osseous abnormality present. Cam impingement is the result of asphericity of the femoral head which is often related to a slipped capital femoral epiphysis or other epiphyseal injury, or protrusion of the head-neck junction occurring at the proximal femur. Pincer impingement is the result of acetabular abnormalities, such as general (protrusia) and localized anterosuperior acetabular overcoverage of the femur (acetabular retroversion). When the angle of anteversion is decreased (retroversion) the anterosuperior head-neck junction will be closer to the anterior rim of the acetabulum. Therefore the anterosuperior labral may be at risk for compression from the femoral head-neck junction with movements that incorporate hip internal rotation in 30-60° of flexion. Likewise, when anteversion is greater than 30° the posterior head-neck junction is closer to the posterior rim of the acetabulum. Therefore the posterior-superior labrum is at risk for impingement with movements that incorporate external rotation in extension. Impingement may be more pronounced when relative femoral retroversion and anteversion are respectively combined with acetabular retroversion and anteversion. The third category is a combination of the cam and pincer impingement, likely the most common. Radiographic evidence of femoroacetabular impingement is common in active patients with hip complaints. Several studies have suggested abnormal movement at the hip joint occurs secondary to femoral acetabular impingement may lead to labral lesions and cartilage damage. The end-stage of this process may lead to the development of secondary hip joint osteoarthritis.

Gender differences have been described in individuals with labral tears secondary to associated with osseous abnormalities. Cam impingement morphology appear to be twice as prevalent in males than females. Pincer lesions are more common in middle aged, active females. In the North American population, the most common area of labral tears occurs in the anterior-superior (weight-bearing) region of the labrum. In two small sample studies (n ≤ 8), labral tears in the Japanese population have been reported at a greater frequency in the posterior region.

**Structural Instability**

Hip instability may be defined as extraphysiologic hip motion that causes pain with or without the symptom of hip joint unsteadiness. Hip instability may be traumatic, atraumatic, or
secondary to bony or soft tissue abnormality. Factors related to structural instability of the joint include a shallow acetabulum, a neck shaft angle greater than 140° and an excessive (anteversion) 60°. Determination of femoral version is further described in the “imaging” section of this guideline. These conditions, particularly when combined with repetitive forceful activities, have been associated with the development of labral tears.

A shallow acetabulum (acetabular dysplasia) has been associated with labral tears due to structural instability. Excessive acetabular anteversion or retroversion and inferior acetabulum insufficiency may also be a component of structural instability. 90 In a hip with structural instability insufficient coverage of the femoral head, with anteversion decreased posterior coverage while in retroversion decreased anterior coverage, which may result in repetitive shear stresses to the acetabular labrum as it attempts to maintain the congruent relationship between the femur and the acetabulum. Continued repetitive stresses may result in further instability of the hip joint. Structural instability due to dysplasia is thought to be more common in females. 7

The presence of dysplasia in adult individuals with hip pain has been discussed. In a cross-sectional study by Jacobsen and Sonne-Holm 76 hip joint dysplasia ranged from 5.4 – 12.8%. Birrell et al 14 found the prevalence of dysplasia in new presenters with hip pain to be 32%. They also found no difference in the prevalence of acetabular dysplasia between men and women in the symptomatic population. In a prospective multicenter study utilizing clinical and radiographic examination of the hip joint for 292 patients between the ages of 16 and 50 years, the rate of dysplasia was 35%. 139

Excessive anteversion of the femur is characterized by an increased amount of femoral internal rotation and a limitation in femoral external rotation. Excessive retroversion of the femur will result in the opposite limitation, increased femoral external rotation and decreased femoral internal rotation. A significant limitation in femoral rotation due to abnormal femoral ante or retroversion may place an individual at risk for labral injury, 7, and increase their risk for developing hip OA. 185

Acetabular Labral Tears

The acetabular labrum is a fibrocartilagenous structure, which extends from the osseous rim of the acetabulum and serves multiple functions. The labrum structure deepens the socket of the hip joint 178 and acts as a buffer, decreasing forces transmitted to the articular cartilage. 49, 50 In addition to deepening the socket component of the hip joint, the acetabular labrum also creates an environment of negative intra-articular pressure, creating a seal. 177 The labrum also contains free nerve endings that have been suggested to play a potential role in proprioception and potential sources of pain. 87

Acetabular labral tears may occur as the result of acute trauma or of insidious onset. The diagnosis of a labral tear is often delayed and is often misdiagnosed. 19, 81 Recent advances in imaging have resulted better identification of labral tears and additional treatment options for this population of patients has followed suit. 83 Acetabular labral tears have been noted to occur in association with trauma, with conditions resulting in femoroacetabular impingement and in those with structural instability.
Acetabular labral tears have recently been identified as a major source of pain\textsuperscript{19, 81, 131} and a possible precursor to osteoarthritis.\textsuperscript{121, 122, 166} True estimates of the prevalence of labral tears are not currently available. In studies specific to patients with mechanical hip pain, the prevalence of labral tears has been reported to be as high as 90%.\textsuperscript{52, 120, 137} In their review of studies examining individuals with hip or groin pain, Groh and Herrera\textsuperscript{60} found prevalence to be 22-55%. Labral tears may be seen in individuals throughout the age span.\textsuperscript{121} Groh and Herrera\textsuperscript{60} found that up to 74.1% of labral tears are not associated with any specific event.

An increased incidence of acetabular labral tears has been described in a number of specific populations, in particular those individuals who subject the hip joint to specific repetitive stress. Narvani et al\textsuperscript{131} found acetabular labral tears to be the cause of hip and groin pain in 20% of athletes presenting with groin pain.

Age appears to influence prevalence of labral tears. Tears have been observed in up to 96% of older individuals.\textsuperscript{118, 166} In another study, 88% of patients older than 30 years were found to have labral detachment from the articular cartilage.\textsuperscript{20}

Various mechanisms of injury have been described for acetabular labral tears. Common traumatic mechanisms described involve rapid twisting, pivoting, or falling motions.\textsuperscript{40, 52} Specifically, a common mechanism includes forceful rotation with the hip in a hyperextended position.\textsuperscript{117} This is a common traumatic mechanism in the athletic population. Other mechanisms of injury consist of a combination of anatomical variants with repetitive forces.

Lage et al\textsuperscript{94} described a system of classifying acetabular labral tears. The four classifications are: radial flap, radial fibrillated, longitudinal peripheral, and abnormally mobile (partially detached). Radial flap tears, where the free margin of the labrum is disrupted, are the most commonly observed.\textsuperscript{94} Radial fibrillated tears involve characteristic fraying of the free margin of the labrum.\textsuperscript{94, 118} The least common noted were longitudinal peripheral tears.\textsuperscript{94}

Optimal recognition and treatment of acetabular labral tears of the hip has a theoretical basis for prevention of future hip osteoarthritis\textsuperscript{82} and researchers have proposed that acetabular labral tears may be a precursor to articular cartilage degeneration.\textsuperscript{121, 122} However, definitive causality have not been published. The primary indication for definitive identification and treatment of labral tear is to provide pain relief and restoration of function.

**Ruptured Ligamentum Teres**

The ligamentum teres originates from the edges of the acetabular notch and transverse acetabular ligament and attaches onto the fovea capitis of the femoral head. Though traditionally thought to play a minimal role in joint function, more recent findings suggest this structure may play a role in stabilization.\textsuperscript{24, 156} The ligamentum teres may be a strong intrinsic stabilizer that resists hip joint subluxation forces.\textsuperscript{9, 27} It is a strong intra-articular ligament and an important stabilizer of the hip, particularly when the hip is externally rotated in flexion and internally rotated in extension.\textsuperscript{111} Several different theories have been proposed to describe the exact function of the ligamentum teres including a role in providing a “sling-like” stabilization of the hip joint as it wraps around the femoral head.\textsuperscript{26, 89, 110, 112} Patients with tears of the ligamentum teres develop hip microinstability and when combined with recreational and sports activities, results in damage
to the labrum and cartilage, possibly explaining the high association rate between tears of the ligamentum teres, labral tears, and cartilage. Injuries to the ligamentum teres are generally considered rare. Rao et al found ligamentum teres injury in less than 8% of arthroscopy cases. Orthopaedic surgeons have reported a ruptured ligamentum teres as the primary arthroscopic finding in individuals with report of hip pain and dysfunction. Acute tearing of this structure has been described, however, the correlation between injuries to the ligamentum teres and clinical presentation is not well understood.

Chondral Lesions

Little is known about the prevalence of isolated chondral lesion, however McCarthy found that 73% of patients with fraying or tearing of the labrum also had chondral damage. Anterior-superior cartilage lesions have been associated with dysplasia, anterior joint laxity, and the presence of femoroacetabular impingement. The combination of labral tears present greater than 5 years and full-thickness chondral lesions have been associated with the progression of osteoarthritis.

Chondral lesions have been reported in younger, more active individuals as a source of hip pain. A traumatic injury pattern involving acute overloading through impact sustained by a blow to the greater trochanteric region has been described. This clinical scenario has been reinforced by arthroscopic findings.

Loose Bodies

The presence of loose bodies has been implicated as a disruptor of joint function in individuals presenting with hip pain. Numerous underlying mechanisms have been described. Though the specific mechanisms underlying their presence may vary, their potential for being a cause of pain and/or mechanical disruption should be considered. Loose bodies, ossified and non-ossified, may be present in the joint secondary to a number of factors. Single fragments typically occur in the case of dislocation or osteochondritis dissecans. Multiple fragments are more common in conditions such as synovial chondromatosis.
RISK FACTORS

With the exception of traumatic injury, the specific cause of non-arthritic hip disorders is not clearly understood. Potential risk factors have been proposed. However, there is only minimal evidence to substantiate the relationship of these potential risk factors to non-arthritic hip joint disorders.

Femoroacetabular impingement

Genetics: Previous investigation has established the genetic influence on severe osseous abnormalities, such as slipped capital femoral epiphysis (SCFE) and acetabula protrusio, however, limited evidence exists specific to milder abnormalities. In one study, Pollard et al compared the radiographs of patients with symptomatic femoroacetabular impingement to two groups, one group included the patient’s siblings and the second group included spouses of the patients and the siblings. Compared to the spouse controls, the siblings demonstrated a greater relative risk for cam and pincer deformity respectively, suggesting genetics is a possible risk factor for femoroacetabular impingement.

Sex: The individual’s sex may influence the type of osseous abnormality. Hack et al studied 200 asymptomatic volunteers and found the prevalence of cam deformities was higher in men (24.7%) than women (5.4%). In a cross-sectional, population-based study, a sub-study of the Copenhagen City Heart Study I-III, Gosvig et al reports the prevalence estimates of osseous abnormalities by sex. More women (19%) demonstrated a deep acetabular socket (Pincer) than men (15%). More men (20%) demonstrated a pistol grip (cam) deformity than women (5%).

Structural instability

Genetics: Genetic factors have long been recognized in the etiology of dysplasia, particularly in the more severe cases such as congenital hip dislocation. Although studies are not available to demonstrate the genetic influence on milder forms of acetabular dysplasia thought to contribute to structural instability, it is likely that genetic factors play a role in structural instability.

Intra-articular injury (acetabular labral tear, ruptured ligamentum teres, loose bodies) chondral lesions)

Osseous Abnormalities. While osseous abnormalities of the femur or acetabulum have been proposed to contribute to intra-articular hip disorders causation has not been demonstrated. Many believe osseous abnormalities precede intra-articular pathology. Others hypothesize intra-articular pathology precedes osseous abnormalities. Studies to demonstrate the temporal relationship between osseous abnormalities and intra-articular lesions are not available; however, there is evidence to suggest a relationship between osseous abnormalities and intra-articular lesions. Descriptive studies based on retrospective observations report osseous abnormalities were present in up to 87% of patients presenting with labral tears. Guevara et al assessed the radiographs of people with labral tear and compared the bony morphology of the involved hip to
the uninvolved hip. They reported compared to the uninvolved side, the hips with labral tears had a higher prevalence of osseous abnormalities associated either with dysplasia (structural instability) or femoroacetabular impingement.

**Osseous abnormalities associated with femoroacetabular impingement**

Visual assessment and computer modeling have been implemented to assess location of injury and femoroacetabular impingement. Through intra-operative visual assessment, labral and articular cartilage damage has been shown to be located at the site of impingement, where the femoral neck abuts the acetabular rim. In a retrospective study, Tannast et al used computer simulation to predict the impingement zone in 15 subjects and compared their predicted impingement zone to the location of labral and cartilage damage in 40 different subjects. They found the computer-predicted impingement zone to be similar to the location of labral and cartilage damage in the sample of 40 subjects. The most severe damage was located in the zone with the highest probability of impact related to femoroacetabular impingement, the anterosuperior area of the acetabulum. Sink et al used visual inspection of hip motion intra-operatively and determined that the anterosuperior cartilage damage coincided with the area of impingement when the hip was positioned into flexion and internal rotation.

Other observational studies suggest a relationship between intra-articular lesions and cam impingement specifically. Anderson et al performed a multivariable logistic regression to assess the correlation between radiographic findings and articular cartilage delamination. The study sample included 62 patients with the pre-operative diagnosis of femoroacetabular impingement or related disorder. Delamination was found to be associated with femoral side (cam) findings (odds ratio = 11.87), however, delamination was not associated with acetabular overcoverage (pincer) findings (odds ratio = 0.16). These findings suggest that cam impingement increases the risk of articular cartilage delamination, however, pincer impingement may be protective of the cartilage. This study however did not assess the association of the bony morphology to the other intra-articular lesions, such as labral tears. Ito et al also showed a link between femoral side findings and intra-articular lesions. In their study, patients with the clinical presentation of femoroacetabular impingement and a labral tear demonstrated a reduced head-neck offset anteriorly compared to asymptomatic controls.

**Osseous abnormalities associated with structural instability**

There are no known studies to demonstrate an association between structural instability and non-arthritic or intra-articular hip disorders; however, the presence of acetabular retroversion in a person with dysplasia may place the hip joint structures at risk. Fujii et al demonstrated the acetabular retroversion, defined in their study as localized anterosuperior acetabular over-coverage of the femur, was associated with an earlier onset of hip pain in people with dysplasia.

**Other osseous abnormalities**

While femoral version has been studied extensively in the pediatric population, little research has been performed in the adult population. Abnormal version of the femur, either excessive anteversion or retroversion, may result in abnormal stresses on the hip joint. Ito et al reported that patients with the clinical presentation of femoroacetabular impingement and confirmed labral tears demonstrated a significantly reduced femoral version (retroversion) compared to asymptomatic control subjects.
Ligamentous laxity

Ligamentous laxity of the hip joint, global or focal, has been proposed as a risk factor for the development of acetabular labral tears. Global ligamentous laxity due to connective tissue disorders, such as Ehlers-Danlos, Down, and Marfan syndromes, have been implicated as a risk factor in the development of acetabular labral tears.

A correlation between acetabular labral tears and focal rotational laxity has been suggested. The focal laxity most commonly occurs as anterior capsular laxity secondary to repetitive movements involving external rotation and/or extension, possibly resulting in iliofemoral ligament insufficiency. Although uncommon, repeated, forced hip internal rotation in flexion may also be a harmful repetitive movement. When insufficiency is present, the ligament’s ability to absorb stress is compromised, potentially subjecting the labrum to abnormal stress and pathology.

Activity and Participation

Activities such as distance running, ballet, golf, ice hockey and soccer have been implicated in acetabular labral tears. Some authors have proposed a specific direction of hip motion related to the suspected activities may be responsible for the increased risk; these directions include rotational stresses, hyperextension, and hyperflexion.

Clinicians should consider the presence of osseous abnormalities, local or global ligamentous laxity, connective tissue disorders, and nature of the patient’s activity and participation as risk factors for hip joint pathology.
DIAGNOSIS/CLASSIFICATION
The diagnostic criteria to determine clinical diagnosis of femoroacetabular impingement, structural instability, and intra-articular pathology have not yet been standardized resulting in low agreement with intra-operative findings of intra-articular lesions. Therefore careful attention to ruling out differential diagnoses is necessary. The following criteria are based on the best available evidence to date.

III
The diagnosis of femoroacetabular impingement and the associated ICF diagnosis of joint pain and mobility impairment is suspected when the patient presents with the following clinical and radiographic findings:

- Anterior groin pain
- Pain is reproduced with the hip flexion, adduction, internal rotation (FADIR) test
- Hip internal rotation with the hip flexed to 90° is less than 20°
- Hip flexion and abduction may also be decreased
- Mechanical symptoms such as popping, locking or snapping of the hip
- Conflicting clinical findings are not present
- Radiographic findings:
  - Cam impingement
    - Increased femoral neck diameter that approaches the size of the femoral head diameter
      - Alpha angle greater than 60°
      - Head-neck offset ratio less than 0.14
  - Pincer impingement
    - Increased acetabular depth
      - Coxa profunda (lateral center-edge angle >35°)
      - Acetabular protrusion
    - Decreased acetabular inclination
      - Tönnis angle less than 0°
    - Acetabular retroversion
      - Cross-over sign indicating localized anterosuperior overcoverage
      - Ischial spine projection into the pelvis

III
The diagnosis of structural instability and the associated ICF diagnosis of joint pain and stability impairment is suspected when the patient presents with the following clinical and radiographic findings:

- Anterior groin pain, lateral hip pain or generalized hip joint pain
- Pain is reproduced with the FADIR test or the hip flexion, abduction, external rotation (FABER) test
- Positive hip apprehension sign may be present
- Hip internal rotation is greater than 30° when the hip is at 90° flexion
- Mechanical symptoms such as popping, locking or snapping of the hip
Conflicting clinical findings are not present

Radiographic findings:

- Increased acetabular inclination
  - Tönnis angle greater than 10°
  - Decreased femoral head coverage
    - Lateral center-edge of Wiberg less than 25°
    - Anterior center-edge angle <20°

III

The diagnosis of intra-articular injury (labral tear, osteochondral lesion, loose bodies and ligamentum teres rupture) and the associated ICF diagnosis of joint pain are provided when the patient presents with the following clinical and imaging findings:

- Anterior groin pain or generalized hip joint pain
- Pain is reproduced with the FADIR test or the FABER test
- Mechanical symptoms such as popping, locking or snapping of the hip
- May report feelings of instability (ligamentum teres)
- Conflicting clinical findings are not present
- Imaging findings
  - Labral tear
    - Magnetic resonance arthrography (MRA)

C

Clinicians should use the clinical findings of anterior groin pain or generalized hip joint pain that is reproduced with the hip flexion, adduction, internal rotation test or the hip flexion, abduction external rotation test, along with collaborative imaging findings, to classifying a patient with hip pain into the International Statistical Classification of Diseases and Related Health Problems (ICD) categories of M25.5 Pain in joint, M24.7 Protrusio acetabula, M24.0 Loose body in joint, or M24.2 Disorder of ligament, and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of hip pain (b28016 Pain in joints) and mobility impairments (b7100 Mobility of a single joint; b7150 Stability of a single joint).

DIFFERENTIAL DIAGNOSIS

Potential differential diagnoses for non-arthritic joint hip pain are:

- Referred pain from lumbar facet disorders
- Referred pain from lumbar disc disorders
- Sacroiliac joint dysfunction
- Pubic symphysis dysfunction
- Lumbar spinal stenosis
- Nerve entrapment (lateral femoral cutaneous, obturator)
- Hip osteoarthritis
- Iliopsoas tendinitis/bursitis
- Adductor strain
Clinicians should consider diagnostic categories other than non-arthritic joint pain when the patient’s history, reported activity limitations, or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline or when the patient’s symptoms are not diminishing with interventions aimed at normalization of the impairments of body function.

**IMAGING STUDIES**

Imaging studies are used when clinical management considerations indicate a need to confirm the clinical diagnosis associated with the non-arthritic hip joint pain and rule out other pathologies such as osteoarthritis, osteonecrosis and stress fractures. Imaging may not add value to the early management of non-arthritic hip joint pain provided differential conditions can be adequately ruled-out without imaging. Imaging is particularly helpful in this population when initial therapies do not resolve symptoms. Plain radiographs are the first imaging study in the differential diagnostic procedures. Radiographs are useful in detecting femoral and acetabular abnormalities associated with non-arthritic hip joint pain. Plain radiographs do not provide adequate detail regarding soft tissue morphology. Non-contrast magnetic resonance imaging (MRI) provides better detail with assessing soft tissue integrity, however, it has not been used extensively to assess intra-articular structures. Magnetic resonance arthrography (MRA) is commonly used to detect changes of the intra-articular structures. Techniques such as computed tomography and delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) have recently been implemented to assess articular cartilage integrity and assist with pre-surgical planning.

To detect osseous abnormalities, specific radiographic views are needed in addition to the standard hip protocol. Specific images to consider include: 1) cross-table lateral view, 2) 45°
or 90° Dunn view, or 90° Dunn view, 3) “frog” lateral view, and 4) false profile view. These specific views allow the diagnosis of osseous abnormalities, such as femoroacetabular impingement and structural instability, proposed to be associated with non-arthritic hip joint pain. The osseous abnormalities are described below. The clinician is encouraged to refer to Clohisy et al for a thorough description of the measurement methods and representative figures. An alternative view has recently been introduced to measure the distance between the femoral neck and the acetabular rim when the hip is in 90 degrees of flexion. It should be noted that variations of suggested normal measurements exist within the literature. In addition, the relationship between pain and bony abnormalities has not been fully established.

Measurements may be taken to evaluate for hip dysplasia including the Tönnis angle (abnormal > 10 degrees), the lateral center-edge angle of Wiberg (abnormal < 25 degrees), and the anterior center-edge angle of Lequesne (abnormal < 25 degrees) as measured on a false-profile radiograph. The neck shaft angle of the proximal femur is considered normal between 120 and 140 degrees. Radiographic images for hip femoroacetabular impingement, structural instability have been published.

Radiographic findings that support the clinical diagnosis of Pincer FAI include increased acetabular depth, decreased acetabular inclination and acetabular retroversion. Acetabular depth, inclination and retroversion are all assessed on the anterior posterior (AP) view. Acetabular depth is determined by observing the relationship of the floor of the acetabulum and femoral head. Acetabular protrusion represent a deep acetabulum and suggestive of Pincer femoroacetabular impingement. Acetabular inclination is assessed using the Tönnis angle. Acetabuli having a Tönnis angle of 0° to 10° are considered normal, whereas those having an angle greater than 10° or less than 0° are considered increased and decreased, respectively. Hips with an increased Tönnis angle were considered to be at risk for structural instability, whereas those having a decreased inclination were considered at risk for pincer impingement. Pincer-type femoroacetabular impingement (acetabular retroversion or protrusio) is identified using the presence of a crossover sign, lateral center edge angle >39°, or an acetabular index ≤ 0.

Acetabular retroversion may also contribute to pincer impingement. Acetabular retroversion has been described as either local or general retroversion. Local retroversion results in overcoverage of femoral head in the anterosuperior region of the acetabulum. On the AP radiograph, this appears as the crossover sign or the figure of eight sign. The crossover sign occurs if the line representing the anterior acetabular wall crosses the line representing the posterior acetabular wall, resulting in an “X” appearance. Radiographic assessment of ischial spine projection into the pelvis has been suggested as another method of identifying acetabular retroversion. The general type of retroversion occurs results in a more generalized overcoverage of the femoral head anteriorly. This type of retroversion is best assessed with 3D imaging using either MRI or CT.

The radiographic finding to support cam impingement is an increased thickness of the femoral head-neck junction. The most commonly reported measure to represent the femoral head-neck junction is the alpha angle, which may be measured on the frog-leg lateral view, or the 90 degree Dunn view. A large alpha angle, greater than 60° is suggestive of a cam impingement. Head-neck offset ratio, measured on the cross table lateral view is another measure to
represent the femoral head-neck junction. \textsuperscript{43} A head-neck offset ratio less than 0.14 is suggestive of femoroacetabular impingement. \textsuperscript{151}

The radiographic finding to support the clinical diagnosis of structural instability is an increased acetabular inclination. Acetabular inclination may be assessed using the Tönnis angle \textsuperscript{184} or the lateral center-edge angle of Wiberg, \textsuperscript{190} both assessed from the AP view. A Tönnis angle greater than 10 degrees or a lateral center edge angle less than 25 degrees may indicate inadequate acetabular coverage of the femoral head. \textsuperscript{10, 39}

Magnetic resonance imaging is useful in detecting musculotendinous pathology, such as iliopsoas tendinopathy. Although MRI is not used widely to detect intra-articular injury, some investigators report high accuracy (89-95\%) in detecting labral tears. \textsuperscript{77, 125} Currently, the most common imaging procedure used to confirm the diagnosis of intra-articular pathology, such as labral tears or chondral lesions is magnetic resonance arthrography (MRA). \textsuperscript{70, 197} Contrast is injected into the hip joint to allow better visualization of the intra-articular structures. Compared to the gold standard of arthroscopic visual inspection, MRA has the sensitivity of 71\% - 100\% \textsuperscript{19, 37, 54, 81} and the specificity of 44\%-71\% \textsuperscript{37, 81} in detecting a labral tear. All study subjects in these studies had a clinically suspected labral tear. In a small cadaveric study, MRA demonstrated 60\% sensitivity, 100\% specificity and 70\% accuracy. \textsuperscript{149} In the same study conventional MRI with a large field of view was 8\% sensitive in detecting labral tears compared with findings at the time of arthroscopy. Diagnostic sensitivity was improved to 25\% with a small field of view. MRA with a small field of view was 92\% sensitive in detecting labral tears. In addition to soft tissue integrity, MRI or MRA may be used to detect osseous abnormalities previously described, such as the alpha angle \textsuperscript{155} or acetabular retroversion. \textsuperscript{141, 186}

Computed tomography may be used to determine the osseous architecture of the hip. Current technologies allow for three dimensional reconstruction of the hip anatomy and thus provide additional information that is useful in pre-surgical planning. Due to radiation exposure CT has not been widely used in the diagnosis of non-arthritic hip joint pain and is most often reserved for pre-surgical planning. \textsuperscript{180, 91}

The use of image-guided injection for purposed of diagnosis has been described. The injection would consist of a local anesthetic and possibly a corticosteroid. Pre-injection and post-injection levels of pain are examined, with a notable and immediate decrease of pain considered indicative of chondral damage within the hip joint. Kivlan and Martin \textsuperscript{88} found that individuals with chondral damage displayed a greater relief of pain compared to their counterparts without chondral damage. This was found to be independent of the presence of extra-articular pathology.

**CLINICAL COURSE**

The clinical course of non-arthritic hip disorders has not been described. However, recent interest has been placed on the presence of these disorders and their association with the development of osteoarthritis (OA). Femoroacetabular impingement \textsuperscript{10} and labral tears \textsuperscript{121} are both proposed to contribute to OA. A shallow acetabulum and resulting dysplasia has been shown to be associated with OA of the hip joint in relatively younger patients. \textsuperscript{66, 128}
CLINICAL MANAGEMENT

The management of non-arthritic hip disorders non-surgically or surgically is highly variable and practitioner-dependent. Recent advances in imaging and surgical techniques have led to an increase in surgical management for non-arthritic hip disorders. While evidence related to surgical outcomes is growing, the literature is limited to observational studies with small samples and short-term outcomes.

A period of non-surgical management is recommended of at least 8 - 12 weeks, prior to surgical intervention. Non-surgical management may include physical therapy, medication and ultrasound/fluoroscopic guided therapeutic injections. If symptoms do not improve with non-surgical care, surgical intervention may be considered.

Anti-inflammatory agents are often recommended for pain relief and inflammation, however evidence to support this intervention in patients with a non-arthritic hip pain is lacking. Both over-the-counter and prescribed anti-inflammatory agents including NSAIDs, Cox-2 inhibitors, may be prescribed as part of a treatment program. However, it should be noted that this class of drugs is not without risk for serious adverse events including increased gastrointestinal bleeding.

Common surgical options include arthroscopic procedures such as: labral tear resection or repair, capsular modification, osteoplasty to address femoroacetabular impingement, ligamentum teres tear debridement, and loose body removal. In addition a periacetabular osteotomy (PAO) procedure may be performed to address acetabular dysplasia. The purpose of this open procedure is to surgically separate the acetabulum from the innominate, then re-attach the structure in a position that provides ideal coverage of the femoral head providing closer to normal stability of the hip joint.

Of the available arthroscopic procedures, labral tear resection has the most supporting evidence. This procedure is typically utilized for fraying or peripheral tears of the labrum. Studies have shown clinical improvement following labral resection. Intrasubstance tears of the labrum may be repaired. More recently, labral repair in combination with osteoplasty of the acetabular rim and/or the femoral head-neck junction has become a common surgical procedure for treating FAI and its associated intra-articular abnormalities.

Limited evidence is available to support favorable outcomes in individuals undergoing resection of labral tears and capsular modification. An osteoplasty procedure may be performed to remove the excessive bone present in the case of impingement. Early results for this procedure have been promising. A systematic review by Ng et al. found that surgical treatment of femoroacetabular impingement reliably improved patients’ symptoms.

Arthroscopic debridement of ligamentum teres tears has been described. The goal of the surgery is to resect the tear to a stable remnant preventing potential painful disruption of joint mechanics. Promising results have been reported in patients with isolated injury that do not have other concurrent conditions such as osteochondral defects. Microfracture techniques have been described for medium-sized, full-thickness chondral defects. No current studies exist examining the outcomes for microfracture procedures of the hip joint.
EXAMINATION – OUTCOME MEASURES

I
The Hip Outcome Score
The Hip Outcome Score (HOS) is a self-report measurement tool consisting of two separate subscales for activities of daily living (ADLs) and sports. The HOS was developed specifically to assess the ability of young individuals with acetabular labral tears and address the ceiling effect of the Harris Hip Score (HHS) and the Western Ontario and McMaster Universities Osteoarthritis Index. The ADL subscale contains 17 items; examples include walking on level surfaces, hills, stairs, getting in and out of a car, deep squat, heavy work and recreational activities. The sports subscale contains 9 items examples include running, jumping, cutting, and swinging a golf club. Each item is scored from 4 to 0, with 4 being “no difficulty” and 0 being “unable to do”. There is a N/A option that is not counted in scoring. The total number of items with a response is multiplied by 4 to get the highest potential score. An individual’s score is divided by the highest potential score then multiplied by 100 to get a percentage. A higher score is representative of a higher level of physical function for each subscale.

The HOS subscales have high test-retest reliability, ICC = 0.98 and 0.92 for the ADL and Sports subscale respectively. The minimal detectable change (MDC) is an increase or decrease of 3 points and the minimum clinically important difference (MCID) is 9 points on the ADL subscale, 6 points the sports scale.

Each subscale of the HOS demonstrated construct validity when compared to the SF-36 questionnaire. In patients with labral tears, the correlation coefficients between the ADL subscale and SF-36 physical function and physical component score were .76 and .74 respectively. The correlation coefficients between the sports subscale and SF-36 physical function and physical component score were .72 and .68 respectively.

I
Copenhagen Hip and Groin Outcome Score (HAGOS)
The Copenhagen Hip and Groin Outcome Score (HAGOS) was developed in 2011 to assess a patient’s hip and groin disability in a young, active patient. The HAGOS is a disease-specific self-report questionnaire with following six separately scored subscales; pain, other symptoms, physical function in daily living, function in sport and recreation, participation in physical activities, and hip related quality of life. Each item is score using standardized answer options scored from 0 to 4. A normalized score with 100 indicating no symptoms is calculated for each subscale.

The HAGOS has substantial test-retest reliability, ICCs ranging from 0.82 to 0.91 for the 6 subscales. The smallest detectable change for the subscales range from 2.7 to 5.2, indicating changes greater than 5.2 in any scale would be detectable. Construct validity and
responsiveness were confirmed with statistically significant correlation coefficients (0.37–0.73, p < 0.01) for convergent construct validity and for responsiveness from 0.56 to 0.69, p < 0.01.

I
International Hip Outcome Tool (iHOT-33)
The International Hip Outcome Tool (iHOT-33) was developed in 2012 by the Multicenter Arthroscopy of the Hip Outcomes Research Network specifically for young, active adults with symptomatic hip disease. The iHOT-33 is a disease-specific self-report questionnaire with questions related to the following domains; symptoms and functional limitations, sports and recreational physical activities, job-related concerns, social, emotional, and lifestyle concerns. Each item on the iHOT-33 is scored using a 100-point Visual Analog Scale, where 100 indicates the best possible score.

The iHOT-33 has moderate-good test-retest reliability, ICC = 0.78 for the overall score. Convergent construct validity was confirmed with statistically significant correlation coefficient of 0.81 compared to the Nonarthritic Hip Score. The MCID after hip arthroscopy is 6 points. The properties of the subscales have not been assessed.

V
Modified Harris Hip Score
The Modified Harris Hip Score (MHHS) is a disease-specific self-report questionnaire with questions related to pain and functional ability. The original Harris Hip Score, developed to assess patient function after total hip arthroplasty, was modified by excluding the clinician’s judgment of deformity and range of motion. The MHHS, therefore allows the patient to complete the questionnaire independently. A single score is calculated ranging from 0-100 where higher scores indicate better function. Approximately 48% of the MHHS score is based on the patient’s description of their pain and the remaining 52% is based on the ability to complete basic activities including walking, stairs, and donning/doffing shoes and socks. The MHHS does not capture the patient’s ability to perform higher-level tasks, such as heavy work or exercise activities. Although the MHHS is the most commonly reported outcome measure in the current literature related to patients with non-arthritic hip joint pain, no studies have been reported on the reliability or validity of the measure in non-arthritic hip joint pain.

V
Western Ontario and McMaster Universities Osteoarthritis Index
The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is another a self-report functional outcome questionnaire reported in the literature. A total score (score range 0-96) and three scale scores representing pain (score range 0-20), stiffness (score range 0-8), and physical function (score range 0-68) are generated. Lower scores represent better health or function. Scores for the scales and the total score may be normalized as a percentage. The WOMAC was originally developed to assess outcomes in patients after a total joint replacement and has limited validity for use in the individual with non-arthritic hip joint disease. A modified version with improved validity has been recently introduced, with further study needed to determine the reliability and responsiveness of the questionnaire.
Clinicians should consider using the Hip Outcome Score, the Copenhagen Hip and Groin Outcome Score, the International Hip Outcome Tool for individuals with relative high levels of function. Clinicians may consider the use of the Modified Harris Hip Score, and the Western Ontario and McMaster Universities Osteoarthritis Index before and after interventions intended to alleviate the impairments of body function and structure, activity limitations, and participation restrictions associated with hip joint pathology. Clinicians should be aware the MHHS and WOMAC do not capture high level function (manual labor occupations, athletic activity, etc.) (Recommendation based on moderate evidence)
EXAMINATION – PHYSICAL IMPAIRMENT MEASURES

TRENDELENBURG SIGN

ICF Category:
Measurement of impairment of body function – power of isolated muscles and muscle groups; and control of complex voluntary movements

Description: The purpose is to assess ability of the hip abductors to stabilize the pelvis during single limb stance.

Measurement Method: 65
From standing, the patient performs single limb stance by flexing the opposite hip to 30° and holding for 30 seconds. Once balanced, the patient is asked to raise the non-stance pelvis as high as they can. From the posterior view, the examiner observes the angle formed by a line that connects the iliac crest and a line vertical to the testing surface.

Observation:
The test is negative if the pelvis on the non-stance side can be elevated and maintained for 30 seconds. The test is positive if one of the following criteria are met.
1) the patient is unable to hold the elevated pelvic position for 30 seconds
2) no elevation is noted on the non-stance side
3) the stance hip adducts allowing the pelvis on the non-stance side to drop downwardly below the level of the stance side pelvis.

A false negative may occur if the patient is allowed to shift their trunk too far laterally over the stance limb. The patient may use light touch using the ipsilateral upper extremity or the examiner may provide gentle manual pressure to maintain balance and reduce the trunk shift.

Objective measurement: A goniometer may be used to quantify the amount of pelvic movement. The axis of the goniometer is placed on the anterior superior iliac spine (ASIS), the stationary arm along an imaginary line between the two ASIS landmarks and the moving arm along the anterior midline of the femur. 196

Nature of Variable: Observation: Nominal (positive/negative)
Objective measurement: Continuous

Units of Measurement: Observation: None
Objective measurement: Degrees

Measurement Properties:
Objective measurement:
Youdas et al 196 measured intratester reliability in healthy subjects. The reported the intratester reliability for measurement of the hip adduction angle is 0.58 and standard error of measurement (SEM) is 2°. The minimal detectable change (MDC95) is 4°. 196
FLEXION ABDUCTION EXTERNAL ROTATION (FABER) TEST

ICF Category:
Measurement of impairment of body function – pain in joints; and mobility of a single joint

Description:
A test to determine the irritability of the hip joint and motion at the hip joint.

Measurement Method:
Position and Motion: The patient is positioned in supine with the heel of the lower extremity to be tested placed over the opposite knee. The hip joint is passively externally rotated and abducted while stabilizing the contralateral anterior superior iliac spine (ASIS). The patient is asked what effect the motion has on their symptoms. The test is considered positive if the patient reports the production of, or increase in, the anterior groin, posterior buttock, or lateral hip pain, which is consistent with the patient’s presenting pain complaint. If no increase in pain is produced, pressure may be placed over the ipsilateral knee to determine the limit/end-range of passive ROM and again assess for pain provocation.

Measurement: After being zeroed against a wall, the inclinometer is placed on the medial aspect of the tibia of the tested lower extremity, just distal to the medial tibial condyle. The range of motion measurement is taken at the point of maximal passive resistance or at the point where the patient stopped the test secondary to pain.30

1. Provocative: A positive test for hip pathology reproduces groin pain.
2. ROM: Side to side comparison is made.

Nature of Variable: 1. Provocative: Nominal
2. ROM: Continuous

Units of Measurement: 1. Provocative: None
2. ROM: Degrees

Measurement Properties:
Specific to pathology or pain relief
Martin et al115 assessed the intertester reliability of the FABER test in people seeking care for intra-articular, non-arthritic hip joint pain. The examiners demonstrated 84% agreement and a kappa value of 0.63 (95% CI = 0.43-0.83) indicating substantial95 reliability. In a separate study, Martin et al107 assessed the diagnostic accuracy of the FABER test. Using pain relief with a diagnostic injection as the comparison, the sensitivity and specificity of the FABER test was reported to be 0.60 (95% CI = 0.41-0.77) and 0.18 (95% CI = 0.07-0.39) respectively. The positive likelihood ratio was 0.73 (95% CI = 0.50-1.1) and the negative likelihood ratio was 2.2 (95% CI = 0.8-6).107

In their study to detect intra--articular hip pathology, including osteoarthritis, Maslowski et al116 also assessed the diagnostic accuracy of the FABER test. Using pain relief with a diagnostic injection as the comparison, the sensitivity and specificity of the FABER test was reported to be 0.82 (95% CI = 0.34-0.82) and 0.25 (95% CI = 0.09-0.48) respectively.107 The positive predictive value was 0.46 (95% CI = 0.28-0.65) and the negative predictive value was 0.64(95% CI = 0.27-0.91).107
Mitchell et al\textsuperscript{126} reported hip a slightly higher sensitivity (88\%) when compared to intra-operative findings, however there was no correlation to a specific hip joint pathology, eg labral lesion or chondral lesion.

Specific to ROM
No studies were located reporting the measurement properties of the FABER for ROM in people with non-arthritic hip joint pain. In a study of people with knee OA, Cliborne et al\textsuperscript{30} reported the reliability of ROM measurements to be excellent, ICC = 0.87 (95\% CI= 0.78-0.94).
FLEXION-ADDUCTION INTERNAL ROTATION IMPINGEMENT TEST (FADIR)

ICF Category:
Measurement of impairment of body function – pain in joints; and mobility of a single joint

Description:
A test to assess for painful impingement between the femoral neck and acetabulum in the anterosuperior region. The FADIR test has also been used to assess for specific pathology of the acetabular labrum.

Measurement Method:
The patient is positioned in supine. The hip and knee is flexed to 90°. Maintaining the hip at 90° of flexion, the hip is then internally rotated and adducted as far as possible. The patient is asked what effect the motion has on their symptoms. The test is considered positive if the patient reports a production of, or increase in, the anterior groin, posterior buttock, or lateral hip pain consistent with the patient’s presenting pain complaint. If the test is negative, the test is repeated with the hip placed in full flexion.

Nature of Variable: Nominal (positive/negative)

Units of Measurement: None

Measurement Properties:
Martin et al. assessed the intertester reliability of the FADIR test in people seeking care for intra-articular, non-arthritic hip joint pain. The examiners demonstrated 91% agreement, however due to the high proportion of positive to negative test agreements, the kappa value was low at 0.58 (95% CI = 0.29-0.87), indicating only moderate95 reliability.

Specific to pathology or pain relief
Two studies report the FADIR test characteristics specific to pain provocation. In both studies, the subjects were patients who reported pain consistent with intra-articular, non-arthritic hip joint pain. Compared to diagnostic injection, the sensitivity and specificity of the FAIR test was reported to be 0.78 (95% CI = 0.59-0.89) and 0.10 (95% CI = 0.03-0.29) respectively. The positive likelihood ratio was 0.86 (95% CI = 0.67-1.1) and the negative likelihood ratio was 2.3 (95% CI = 0.52-10.4). Compared to MRA finding of labral lesion, the sensitivity and specificity of the FADIR test was 0.75 (95% CI = 0.19-0.99) and 0.43 (95% CI = 0.18-0.72). In their study to detect intra-articular hip pathology, including osteoarthritis, Maslowski et al. also assessed the diagnostic accuracy of a test that is similar to the FADIR test, called the internal rotation with overpressure (IROP). Using pain relief with a diagnostic injection as the comparison, the sensitivity and specificity of the IROP test was reported to be 0.91 (95% CI = 0.68-0.99) and 0.18 (95% CI = 0.05-0.40) respectively. The positive predictive value was 0.88 (95% CI = 0.67-0.98) and the negative predictive value was 0.17(95% CI = 0.04-0.40).

Specific to mechanism contributing to non-arthritic hip joint pain (femoroacetabular impingement)
No studies reporting the test characteristics specific to femoroacetabular impingement were located. In their descriptive study, Beck et al\textsuperscript{11} assessed 19 subjects with the clinical diagnosis of femoroacetabular impingement, based on clinical exam, radiograph and MRA. They found that all 19 subjects had a positive FADIR test corresponding to intra-operative dynamic impingement and labral lesions in the anterosuperior region of the hip joint.
LOG ROLL TEST

ICF Category: Measurement of impairment of body structure – fasciae and ligaments of the hip

Description: A test to determine ligamentous laxity.

Measurement Method:
The patient is positioned in supine with the hip and knee in 0° of extension. The hip is passively rotated internally and externally. The examiner ensures the rotation is occurring at the hip and not at the knee or ankle. The examiner notes any side-to-side difference in external rotation ROM. The test is positive for ligamentous laxity occurs when the involved hip demonstrates greater external rotation than the uninvolved hip.

Nature of Variable: Nominal

Units of Measurement: None

Measurement Properties:
Martin et al115 assessed the intertester reliability of the log roll test in people seeking care for intra-articular, non-arthritic hip joint pain. The examiners demonstrated 80% agreement and a kappa value of 0.61 (95% CI = 0.48-0.84) indicating substantial95 reliability.
PASSIVE HIP INTERNAL AND EXTERNAL ROTATION

ICF Category:
Measurement of impairment of body function – mobility of a single joint; and pain in joints

Description:
The amount of hip rotation measured with the hip in 90° flexion (sitting) and 0° flexion (prone). The patient is also asked to rate the amount of pain experienced during the movement on a 0-to-10 numerical pain rating scale (NPRS).

Measurement Method:

Hip Internal and External Rotation in 90° Flexion

Position and Motion: The patient is positioned sitting with the hip at 90° of flexion. The hip measured is placed in 0° of abduction, and the contralateral hip is placed in about 30° of abduction. The reference knee is flexed to 90°, and the leg is passively moved to produce hip rotation. The sitting position assists to stabilize the pelvis and the pelvis should be closely monitored to avoid pelvic movement. The tibiofemoral joint must also be controlled to prevent motion (rotation or abduction/adduction), which could be construed as hip rotation.

Measurement: The motion is stopped when the clinician reaches a firm end-feel or when pelvic movement is necessary for additional movement of the limb.

Measurement: The measurement may be taken with an inclinometer or a goniometer. The inclinometer is aligned vertically and along the shaft of the tibia, just proximal to the medial malleolus for both internal and external rotation range of motion (ROM).

Hip Internal and External Rotation in 0° Flexion

Position and Motion: The patient is positioned prone with feet over the edge of the treatment table. The hip measured is placed in 0° of abduction, and the contralateral hip is placed in about 30° of abduction. The reference knee is flexed to 90°, and the leg is passively moved to produce hip rotation. Manual stabilization is applied to the pelvis to prevent pelvic movement and also at the tibiofemoral joint to prevent motion (rotation or abduction/adduction), which could be construed as hip rotation.

Measurement: The motion is stopped when the clinician reaches a firm end-feel or when pelvic movement is necessary for additional movement of the limb.

Measurement: The measurement may be taken with an inclinometer or a goniometer. The inclinometer is aligned vertically and along the shaft of the tibia, just proximal to the medial malleolus for both internal and external rotation ROM.

Nature of Variable: Continuous (ROM) ordinal (Pain)

Units of Measurement: Degrees and 0-to-10 NPRS

Measurement Properties:
Limited internal rotation ROM when the hip flexed to 90° has been associated with bony impingement due to femoroacetabular impingement.\textsuperscript{194} There are no known studies reporting the measurement properties of hip ROM in individuals with non-arthritic hip joint pain. Studies reporting tester reliability in healthy adults and individuals with other musculoskeletal pain provide evidence of excellent intrarater reliability of hip rotation range of motion measurements. Ellison et al\textsuperscript{44} reported intraclass correlation coefficients (ICC) for hip internal and external rotation ranging from 0.96 to 0.99 in healthy individuals and 0.95 to 0.97 in people with low back pain. In patients with hip OA, Pua et al\textsuperscript{153} reported ICCs of 0.93 (95% CI = 0.83-0.97; SEM = 3.4°) and 0.96 (95% CI = 0.91-0.99; SEM 3.1°) for internal and external rotation respectively. The clinically important difference for the NPRS, derived from patients with low back pain, has been shown to be a reduction of 2 points.\textsuperscript{28,48}
PASSIVE HIP FLEXION AND PASSIVE HIP ABDUCTION

ICF Category:
Measurement of impairment of body function – mobility of a single joint; and pain in joints

Description:
Measurement of the amount of passive hip flexion and hip abduction. The patient is also asked to rate the amount of pain experienced during the movement on a 0-to-10 numerical pain rating scale (NPRS).

Measurement Method

Hip Flexion
Position and Motion: The patient is in the supine position and the hip in 0° of abduction, adduction and rotation. With the knee flexed, the hip is passively flexed while the lumbar spine is monitored to avoid posterior pelvic tilt. The motion is stopped when the clinician reaches a firm end-feel or when pelvic movement is necessary for additional movement of the limb. 
Measurement: The axis of the goniometer is placed at the greater trochanter; the stationary arm is placed along the midline of the pelvis, and the moving arm along the midline of the femur.

Hip Abduction
Position and Motion: The patient is positioned in supine with the hip in 0° of flexion and rotation. With the knee extended, the hip is passively abducted. Manual stabilization is provided at the pelvis to prevent lateral pelvic tilt or pelvic rotation. The motion is stopped when the clinician reaches a firm end-feel or when pelvic movement is necessary for additional movement of the limb. 
Measurement: The axis of the goniometer is placed on the anterior superior iliac spine (ASIS), the stationary arm along an imaginary line between the two ASIS landmarks and the moving arm along the anterior midline of the femur.

Nature of Variable: Continuous (ROM) ordinal (Pain)

Units of Measurement: Degrees and 0-to-10 NPRS

Measurement Properties:
There are no known studies reporting the measurement properties of hip ROM in individuals with non-arthritic hip disorders. Studies reporting tester reliability in healthy adults and individuals with other musculoskeletal pain provide evidence of excellent intrarater reliability of hip flexion. In patients with hip OA, Pua et al153 reported ICCs of 0.97 (95% CI = 0.93-0.99; SEM = 3.5°) and 0.94 (95% CI = 0.86-0.98; SEM 3.2°) for flexion and abduction respectively. The MDC for hip flexion, determine using 22 participants with knee OA and 17 participants with without lower extremity symptoms or known pathology, is 5°, meaning any change more than 5° is considered to be change beyond measurement error.30 The MDC for pain for hip flexion is a change of 1.2 on the 0-10 NPRS.30 The clinically important difference for the NPRS, derived from patients with low back pain, has been shown to be a reduction of 2 points.28, 48
HIP ABDUCTOR MUSCLE AND POSTERIOR GLUTEUS MEDIUS STRENGTH TEST

ICF Category:
Measurement of impairment of body function – power of isolated muscles and muscle groups

Description:
A test to determine the strength of the hip abductor muscles

Measurement Method:

Hip Abductor Strength
Hip abductor strength is measured with the patient in side lying. The patient is positioned with the trunk in neutral alignment and the pelvis perpendicular to the testing surface. The non-tested hip and knee are flexed. The patient’s tested limb is placed in hip abduction, neutral rotation and neutral flexion/extension. The examiner then monitors for compensation as the patient holds the test position. If the patient can maintain the test position for 3 seconds without compensation, resistance may be applied. The examiner places one hand on the iliac crest to prevent the pelvis from rotating or tilting.

Measurement
Manual Muscle Test: The examiner uses the other hand to place resistance at the ankle in the direction of femoral adduction. The amount of force generated may be measured subjectively using manual muscle grades 0-5.
Hand held dynamometer: The examiner places the dynamometer at the lateral aspect of the distal thigh. A “make” test\textsuperscript{16} is performed by asking the participant to push maximally against the dynamometer, simulating their maximum isometric contraction. To eliminate the effect of tester strength,\textsuperscript{174} it is best to perform the make test using straps to hold the dynamometer in place and to provide the resistance to the motion. A “break” test\textsuperscript{92} is performed by the tester manually applying the resistance. The participant is asked to hold against the examiner’s resistance. Maximum strength is assumed when the tester’s force is able to overcome the participant’s force. Using the dynamometer, force may be expressed as pounds, kilograms or Newtons. The test may also be performed in supine.

Posterior Gluteus Medius Strength\textsuperscript{84}
Posterior gluteus medius strength is measured with the patient in side lying. The patient is positioned with the trunk in neutral alignment and the pelvis rotated slightly forward. The non-tested hip and knee are flexed. The patient’s tested limb is placed in hip abduction, slight external rotation and slight extension. The examiner monitors for compensation as the patient holds the test position. If the patient can maintain the test position for 3 seconds without compensation, resistance may be applied. The examiner firmly places one hand on the iliac crest to prevent the pelvis from rotating or tilting.

Measurement
Manual Muscle Test: The examiner uses the other hand to place resistance at the ankle in the direction of femoral adduction and flexion. The amount of force generated may be measured subjectively using manual muscle grades 0-5.
Hand held dynamometer: The examiner places the dynamometer at the lateral aspect of the distal thigh. A “make” test\textsuperscript{16} is performed by asking the participant to push maximally against the dynamometer, simulating their maximum isometric contraction. To eliminate the effect of tester strength, \textsuperscript{174} it is best to perform the make test using straps to hold the dynamometer in place and to provide the resistance to the motion. A “break” test\textsuperscript{92} is performed by the tester manually applying the resistance. The participant is asked to hold against the examiner’s resistance. Maximum strength is assumed with the tester’s force is able to overcome the participant’s force. Using the dynamometer, force may be expressed as pounds, kilograms or Newtons.

**Nature of Variable:**  
Dynamometer: Continuous  
Manual muscle test: Ordinal

**Units of Measurement:**  
Dynamometer: Force in pounds, kilograms or Newtons  
Manual muscle test: none

**Measurement Properties**  
There are no known studies reporting the measurement properties of hip abductor or posterior gluteus medius strength in people with non-arthritis hip disorders. Studies reporting tester reliability in healthy adults and people with hip OA provide evidence of good to excellent intrarater reliability of hip abductors.

*Hip abductors in side lying position using hand held dynamometer:*  
The intratester reliability (ICC\textsubscript{2,1}) of force measures in healthy subjects was 0.90 (95% CI = 0.74-0.97).\textsuperscript{191} The coefficient of variation was 3.67%.\textsuperscript{191}

*Hip abductors in supine position using hand held dynamometer:*  
The intratester reliability (ICC\textsubscript{2,1}) of force measures in healthy subjects was 0.83 (95% CI = 0.57-0.94)\textsuperscript{191} to 0.96.\textsuperscript{195} The coefficient of variation was 6.11%.\textsuperscript{191} The MDC\textsubscript{95} determined from a sample of healthy subjects was 5.4% of body weight for males and 5.3% of body weight for females.\textsuperscript{195} In subjects with hip OA, the intratester reliability (ICC\textsubscript{2,2}) for hip abductor muscle torque was 0.84 (95% CI = 0.55-0.94 SEM = 12.1 Nm).\textsuperscript{153}
HIP INTERNAL ROTATOR MUSCLE STRENGTH TEST WITH THE HIP FLEXED
AND THE HIP EXTENDED

ICF Category:
Measurement of impairment of body function – power of isolated muscles and muscle groups

Description:
A test to determine the strength of the hip internal and external rotator muscles

Measurement Method

Hip internal rotators

Hip flexed. The internal rotators are measured with the patient in sitting with the knees flexed to 90°. The patient is positioned with the trunk in neutral alignment and the hip in 90° of flexion and 0° of abduction/adduction.

Hip extended: The internal rotators are measured with the patient in supine with the knee flexed to 90° over the edge of the testing surface. The patient is positioned with the trunk in neutral alignment and the hip in 0° of flexion/extension and 0° of abduction/adduction. To assist in maintaining the trunk in neutral alignment, the opposite hip and knee are placed in flexion with the foot resting on the support surface.

The patient’s tested limb is placed at end range internal rotation. The examiner then monitors for compensation as the patient holds the test position. If the patient can maintain the test position for 3 seconds without compensation, resistance may be applied. The examiner places one hand on the medial distal thigh to prevent hip abduction/adduction.

Measurement

Manual Muscle Test: The examiner uses the other hand to place resistance at the ankle in the direction of external rotation. The amount of force generated may be measured subjectively using manual muscle grades 0-5.

Hand held dynamometer: The examiner places the dynamometer at the lateral aspect of the distal thigh. A “make” test is performed by asking the participant to push maximally against the dynamometer, simulating their maximum isometric contraction. To eliminate the effect of tester strength, it is best to perform the make test using straps to hold the dynamometer in place and to provide the resistance to the motion. A “break” test is performed by the tester manually applying the resistance. The participant is asked to hold against the examiner’s resistance. Maximum strength is assumed with the tester’s force is able to overcome the participant’s force. Using the dynamometer, force may be expressed as pounds, kilograms or Newtons.

Nature of Variable: Dynamometer: Continuous
Manual muscle test: Ordinal

Units of Measurement: Dynamometer: Force in pounds, kilograms or Newtons
Manual muscle test: none
**Measurement Properties:**
There are no known studies reporting the measurement properties of hip internal rotator strength in people with non-arthritic hip disorders.

*Hip internal rotation with the hip flexed:*
In subjects with hip OA, the intratester reliability (ICC$_{2,2}$) for hip internal rotator muscle torque (force in Newtons x lever arm) was 0.98 (95% CI = 0.94-0.99 SEM = 3.7 Nm).$^{153}$
HIP EXTERNAL ROTATOR MUSCLE STRENGTH TEST WITH THE HIP FLEXED AND THE HIP EXTENDED

ICF Category:
Measurement of impairment of body function: power of isolated muscles and muscle groups

Description:
A test to determine the strength of the hip internal and external rotator muscles.

Measurement Method

Hip external rotators

Hip flexed: The external rotators are measured with the patient in sitting with the knees flexed to 90°. The patient is positioned with the trunk in neutral alignment and the hip in 90° of flexion and 0° of abduction/adduction.

Hip extended: The external rotators are measured with the patient in supine with the knee flexed to 90° over the edge of the testing surface. The patient is positioned with the trunk in neutral alignment and the hip in 0° of flexion/extension and 0° of abduction/adduction. To assist in maintain the trunk in neutral alignment, the opposite hip and knee are placed in flexion with the foot resting on the support surface.

The patient’s tested limb is placed at end range external rotation. The examiner then monitors for compensation as the patient holds the test position. If the patient can maintain the test position for 3 seconds without compensation, resistance may be applied. The examiner places one hand on the lateral distal thigh to prevent hip abduction/adduction.

Measurement

Manual Muscle Test: The examiner uses the other hand to place resistance at the ankle in the direction of internal rotation. The amount of force generated may be measured subjectively using manual muscle grades 0-5.

Hand held dynamometer: The examiner places the dynamometer at the lateral aspect of the distal thigh. A “make” test is performed by asking the participant to push maximally against the dynamometer, simulating their maximum isometric contraction. To eliminate the effect of tester strength, it is best to perform the make test using straps to hold the dynamometer in place and to provide the resistance to the motion. A “break” test is performed by the tester manually applying the resistance. The participant is asked to hold against the examiner’s resistance. Maximum strength is assumed with the tester’s force is able to overcome the participant’s force. Using the dynamometer, force may be expressed as pounds, kilograms or Newtons.

Nature of Variable: Dynamometer: Continuous
Manual muscle test: Ordinal

Units of Measurement: Dynamometer: Force in pounds, kilograms or Newtons
Manual muscle test: none

Measurement Properties:
There are no known studies reporting the measurement properties of hip external rotator strength in people with non-arthritic hip disorders.

*Hip external rotation with the hip flexed:*  
In subjects with hip OA, the intratester reliability (ICC2,2) for hip external rotator muscle torque (force in Newtons X lever arm) was 0.98 (95% CI = 0.96-0.99 SEM = 3.2Nm).\textsuperscript{153}
SINGLE JOINT HIP FLEXOR MUSCLE STRENGTH TEST

ICF Category: Measurement of impairment of body function: power of isolated muscles and muscle groups

Description: A test to determine the strength of the hip flexor muscles.

Measurement Method
The hip flexors are measured with the patient in sitting with the knee flexed to 90° over the edge of the testing surface. The patient is positioned with the trunk in neutral alignment and the hip in 0° external/internal rotation, 0° abduction/adduction. The patient’s tested limb is placed at end range flexion. The examiner then monitors for compensation as the patient holds the test position. If the patient can maintain the test position for 3 seconds without compensation, resistance may be applied. The examiner places one hand on the anterior shoulder to prevent trunk flexion.

Measurement Manual Muscle Test: The examiner uses the other hand to place resistance at the anterior distal femur in the direction of hip extension. The amount of force generated may be measured subjectively using manual muscle grades 0-5.

Hand held dynamometer: The examiner places the dynamometer at the lateral aspect of the distal thigh. A “make” test is performed by asking the participant to push maximally against the dynamometer, simulating their maximum isometric contraction. To eliminate the effect of tester strength, it is best to perform the make test using straps to hold the dynamometer in place and to provide the resistance to the motion. A “break” test is performed by the tester manually applying the resistance. The participant is asked to hold against the examiner’s resistance. Maximum strength is assumed with the tester’s force is able to overcome the participant’s force. Using the dynamometer, force may be expressed as pounds, kilograms or Newtons.

Nature of Variable: Dynamometer: Continuous
Manual muscle test: Ordinal

Units of Measurement: Dynamometer: Force in pounds, kilograms or Newtons
Manual muscle test: none

Measurement Properties:
There are no known studies reporting the measurement properties of hip flexor-strength in people with non-arthritic hip disorders.

Hip flexion with the hand held dynamometer:
In subjects with hip OA, the intratester reliability (ICC2,2) for hip flexor muscle torque (force in Newtons X lever arm) was 0.87 (95% CI = 0.69-0.95 SEM = 10.9 Nm).
INTERVENTIONS

These guidelines will address the major non-surgical interventions of non-arthritis hip joint disorders. Because the available evidence examining non-surgical management of individuals with non-arthritis hip pain is limited, all of the interventions discussed in these guidelines are based on expert opinion. Clinicians should consider a course of conservative management as the initial line of treatment for this population.

Patient Education and Counseling

Griffin et al\textsuperscript{59} described the importance of preoperative physical therapy for patients preparing to undergo arthroscopic procedures of the hip joint. Patients may be provided education in regard to joint protection strategies and avoidance of symptom-provoking activities. All individuals with an acetabular labral tear should be counseled to avoid activities that would put the labrum at risk for further injury. Advice on activity modifications is indicated for all individuals with non-arthritis hip disorders and should be individually tailored to meet the functional demands and the diagnostic subgroup unique to the individual. Education recommendations based upon the presence of specific osseous abnormalities are listed below:

Femoroacetabular impingement – The patient should avoid activities that consistently place the hip joint in positions that create the impingement effect. Activities that place the hip joint in end-range flexion, internal rotation, and in some cases abduction are of particular concern.\textsuperscript{40}

Structural Instability – Activities that place repetitive strain on the passive restraints of the hip should be limited. Such activities may include the motions of forced extension or rotational loading.

Daily activities such as sitting, sit to stand, ambulation on level surfaces and stairs, and sleeping positions should be assessed to determine if the patient is able to perform these activities without an increase in pain. The movement pattern and alignment of the hip demonstrated during the activities should be assessed to determine if the movement pattern or alignment may be contributing to the pain problem.\textsuperscript{102} If the movement pattern or alignment appears to be contributing to the pain problem, then instruction should be provided to modify the patient’s performance. For example, a patient with a positive FADIR test, should be instructed to avoid assuming positions that place the hip in the impingement position, such as sitting in a low, soft chair. Sitting in a low, soft chair may place the hip in a flexed and internally rotation position and therefore contribute to impingement-related pain.

If pain is increased or the patient demonstrates a significant impaired movement pattern during ambulation, they may need to be instructed in the use of assistive devices, such as walker, crutches or a cane. Assistive devices, when used appropriately, will reduce the amount of force through the hip joint. When using a cane, the cane should be placed in the hand opposite the injured limb.

In addition to basic daily activities that increase the patient’s pain, such as work-related or fitness activities should be assessed and modified as appropriate. The activity may be modified by
changing the patient’s movement or alignment, such as their sitting position at work, or by reducing the intensity of the activity. For instance, if the patient has femoroacetabular impingement, their flexibility routine may need to be modified to limit the use of aggressive end-range flexion or internal rotation stretches.

Any modifications of the physical environment that can decrease the overall amount of repetitive shear forces experienced at the hip joint should made if feasible. As an example, a patient with femoroacetabular impingement may be instructed to use a higher seat position during work or fitness activities such as cycling. The higher seat position will result in the hips being positioned higher than the knees, thus excessive hip flexion will be avoided.

### Manual Therapy

A progressive trial of manual therapy, which may include soft tissue or joint mobilization, may be beneficial in pain reduction and restoration of motion. Utilization of manual therapy in an attempt to improve the rate of nutrient imbibition has been suggested. Indications for mobilization of the hip joint include decreased PROM with a capsular end-feel. Indications for mobilization of the pelvis and hip soft tissue, such as myofascial that may be limiting normal hip mobility, include decreased PROM with an elastic end-feel and immediate positive gains in mobility following application of procedures to inhibit, or relax the targeted myofascia.

Individuals with identified osseous abnormalities may be subject to specific concerns in regard to manual therapy:

- **Femoroacetabular impingement** - End-range physiologic techniques such as flexion and internal rotation should be avoided if the patient has cam or pincer impingement. Impingement may be suspected if a bony end-feel is detected at the end of hip flexion and internal rotation.

- **Structural instability** – Joint mobilization may be contraindicated in individuals classified as hypermobile.
In the absence of contraindications, joint mobilization procedures are indicated when capsular restrictions are suspected to impair hip mobility and soft tissue mobilization procedures are indicated when muscles and their related fascia are suspected to impair hip mobility.

**Therapeutic Exercise**

*Strengthening*
Strength impairments of the lower extremity and trunk identified through physical examination should be addressed. Particular attention should be placed on the strength of the hip abductors and hip rotators in patients with structural instability. It has been suggested that loss of rotational stability may be linked to acetabular labral tears.\(^{147}\)

*Muscle Flexibility*
Soft tissue restrictions of the lower extremity and trunk can be addressed through soft tissue mobilization, contract/relax stretching, and prolonged stretching that does not increase the patient’s symptoms. Decreased motion secondary to soft tissue length will have a “muscular” end-feel as compared to a “hard” end-feel due to bony approximation. Osseous limitations to range of motion (femoracetaubluar impingement) should not be treated with excessive flexibility exercises as this may exacerbate symptoms.

*Cardiorespiratory Endurance*
Individuals with non-arthritis hip joint pain may be deconditioned secondary to decreased activity levels due to pain. Cardiorespiratory/aerobic conditioning is necessary to promote optimal health and prevent or remediate metabolic disorders such as obesity and diabetes. Activities that minimize shearing/frictional forces experienced at the hip joint are optimal. In addition, activities that increase pain should be modified. Activities that enable aerobic conditioning with limited stress to the hip include stationary cycling, swimming, and use of the elliptical machine.

**E**
Therapeutic exercises should be utilized to address joint mobility, muscle flexibility, muscle strength, and muscle power deficits identified during the physical examination of patients with hip joint pain. Cardiorespiratory/aerobic endurance exercise that involves minimal stress to the hip should be utilized to promote optimal health and prevent or remediate metabolic disorders.

**Neuromuscular Reeducation**

Neuromuscular reeducation or neuromuscular (proprioceptive) training has been previously defined as “movement training progressions that facilitate the development of multi-joint neuromuscular engrams that combine joint stabilization, acceleration, deceleration and kinesthesia through intermittent protocols that progress from low intensity movements focused in a single plane to multi-planar power training.”\(^{69}\) Neuromuscular reeducation has had some
success in other lower extremity disorders,\textsuperscript{51,159} and may provide an effective intervention in non-arthritic hip pain. Kim and Azuma\textsuperscript{87} suggested nerve endings located within the acetabular labrum potentially have an effect on proprioception. Individuals with compromise of the labrum may benefit from training to increase the efficiency of musculature to provide dynamic stabilization.

F

Neuromuscular reeducation procedures should be offered to diminish movement coordination impairments identified in patients with non-arthritic hip pain.
CLINICAL GUIDELINES

SUMMARY OF RECOMMENDATIONS

Risk Factors
Clinicians should consider the presence of osseous abnormalities, local or global ligamentous laxity, connective tissue disorders, and nature of the patient’s activity and participation as risk factors for hip joint pathology.

Diagnosis/Classification
Clinicians should use the clinical findings of anterior groin pain or generalized hip joint pain that is reproduced with the FAIR or FABER test, along with collaborative imaging findings, to classifying a patient with hip pain into the International Statistical Classification of Diseases and Related Health Problems (ICD) categories of M25.5 Pain in joint, M24.7 Protrusio acetabula, M24.0 Loose body in joint, and M24.2 Disorder of ligament, and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of hip pain (b28016 Pain in joints) and mobility impairments (b7100 Mobility of a single joint; b7150 Stability of a single joint).

Differential Diagnosis
Clinicians should consider diagnostic categories other than non-arthritic joint pain when the patient’s history, reported activity limitations, or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline or when the patient’s symptoms are not diminishing with interventions aimed at normalization of the impairments of body function.

Examination – Outcome Measures
Clinicians should utilize the Hip Outcome Score, the Copenhagen Hip and Groin Outcome Score, the International Hip Outcome Tool for individuals with higher levels of function, and may use the use of the Modified Harris Hip Score and the Western Ontario and McMaster Universities Osteoarthritis Index with individuals with lower levels of function, before and after interventions intended to alleviate the impairments of body function and structure, activity limitations, and participation restrictions associated with hip joint pathology.

Examination – Physical Impairment Measures
When evaluating a patient with suspected or confirmed hip pathology over an episode of care, assessment of impairment of body function should include objective and reproducible measures of hip pain, mobility, muscle power, and movement coordination.

Interventions: Patient Education and Counseling
Patient education should be linked to the clinical presentation. In the presence of femoracetabular impingement, activities that involve end ranges hip flexion and hip internal rotation should be avoided. In the presence of structural instability, activities that involve end ranges of hip extension and external rotation should be limited. In the presence of intra-articular injury, activities that involve end ranges of all motions or that produce or increase
pain should be avoided. Instruction in use of assistive devices, such as a cane, should be provided when pain interferes with normal gait.

**Interventions: Manual Therapy**

In the absence of contraindications, joint mobilization procedures are indicated when capsular restrictions are suspected to impair hip mobility and soft tissue mobilization procedures are indicated when muscles and their related fascia are suspected to impair hip mobility.

**Interventions: Therapeutic Exercises**

Therapeutic exercises should be utilized to address joint mobility, muscle flexibility, muscle strength, and muscle power deficits identified during the physical examination of patients with hip joint pain. Cardiorespiratory/aerobic endurance exercise that involves minimal stress to the hip should be utilized to promote optimal health and prevent or remediate metabolic disorders.

**Interventions: Neuromuscular Reeducation**

Neuromuscular reeducation procedures should be offered to diminish movement coordination impairments identified in patients with non-arthritic hip pain.
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