

CLINICAL PRACTICE GUIDELINES

**MICHAEL T. CIBULKA, DPT • NANCY J. BLOOM, DPT
KEELAN R. ENSEKI, PT, MS • CAMERON W. MacDONALD, DPT
JUDITH WOEHRLE, PT, PhD • CHRISTINE M. McDONOUGH, PT, PhD**

Hip Pain and Mobility Deficits - Hip Osteoarthritis: Revision 2016

*Clinical Practice Guidelines
Linked to the International Classification
of Functioning, Disability, and Health
from the Orthopaedic Section of the
American Physical Therapy Association*

J Orthop Sports Phys Ther, 2016; 46(). A1-A. doi: ##.####/jospt.####.####

SUMMARY OF RECOMMENDATIONS.....xx
INTRODUCTION.....xx
METHODS.....xx
CLINICAL GUIDELINES:
Impairment/Function-Based Diagnosis.....xx
CLINICAL GUIDELINES:
Examinations.....xx
CLINICAL GUIDELINES:
Interventions.....xx
AUTHOR/REVIEWER AFFILIATIONS AND CONTACTS.....xx
REFERENCES.....xx

Reviewers: Roy D. Altman, MD · John Dewitt, DPT · Amanda Ferland, DPT
Helene Fearon, PT · Kathleen Kline Mangione, PT, PhD · Marcie Harris-Hayes, PT, PhD
Elizabeth Hammond, MD · Sandra L. Kaplan, DPT, PhD · Heather Stone Keely, DPT
David Killoran, PhD · Leslie Torburn, DPT · Douglas M. White, DPT

For author, coordinator, contributor, and reviewer affiliations see end of text. ©2016 Orthopaedic Section American Physical Therapy Association (APTA), Inc, and the *Journal of Orthopaedic & Sports Physical Therapy*. The Orthopaedic Section, APTA, Inc., and the *Journal of Orthopaedic & Sports Physical Therapy* consent to the reproducing and distributing this guideline for educational purposes. Address correspondence to: Brenda Johnson, ICF-based Clinical Practice Guidelines Coordinator, Orthopaedic Section, APTA Inc., 2920 East Avenue South, Suite 200; La Crosse, WI 54601. Email: icf@orthopt.org

HIP PAIN AND MOBILITY DEFICITS - HIP OSTEOARTHRITIS: CLINICAL PRACTICE GUIDELINES REVISION 2016

J Orthop Sports Phys Ther. 2016;46().A1-A_. doi:##.####/jospt.####.####

SUMMARY OF RECOMMENDATIONS*

DIAGNOSIS/CLASSIFICATION

A

Clinicians should use the following criteria to classify adults over the age of 50 into the International Statistical Classification of Diseases and Related Health Problems (ICD) category of unilateral coxarthrosis and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of hip pain (b2816 Pain in joints) and mobility deficits (b7100 Mobility of a single joint): moderate anterior or lateral hip pain during weight bearing activities, morning stiffness less than 1 hour after wakening, hip internal rotation range of motion less than 24° or internal rotation and hip flexion limited by 15° when comparing the painful to the non-painful side, hip pain associated with passive hip internal rotation.

DIFFERENTIAL DIAGNOSIS

F

Clinicians should revise the physical therapy diagnosis and change their plan of care or refer the patient to the referring physician 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 patient's functioning.

EXAMINATION – OUTCOME MEASURES

ACTIVITY LIMITATION – SELF REPORT MEASURES

A

Clinicians should use validated outcome measures that include domains of hip pain, body function impairment, activity limitation, and participation restriction. Activity limitation and participation restriction outcome measures may include: Western Ontario and McMaster Universities Arthritis Index (WOMAC) physical function subscale, The Hip Disability and Osteoarthritis Outcome Measure (HOOS) Lower Extremity Functional Scale (LEFS), Harris Hip Score (HHS).

Hip pain measures may include: Numeric pain rating scale (NPRS), WOMAC pain subscale, Brief Pain Inventory (BPI), Pain Pressure Threshold (PPT), Visual analog scale (VAS).

ACTIVITY LIMITATION – PHYSICAL PERFORMANCE MEASURES

A

To assess activity limitation, participation restrictions, and changes in the patient's level of function over the episode of care clinicians should utilize reliable and valid physical performance measures, such as the: 6-minute walk, Thirty-second chair stand, Stair measure, Timed up-and-go test, and Self-paced walk , Timed single leg stance, Four square step test, Step test.

A

Clinicians should measure balance performance and activities that predict the risk of falls in adult with hip osteoarthritis especially those with decreased physical function or a high risk of falls because of past history. Recommended balance tests for patients with osteoarthritis include: Berg balance scale, Four-square step test, and Timed single leg stance test.

F

Clinicians should use existing guidelines⁶ for fall risk management in patients with hip osteoarthritis to assess and manage fall risk.

EXAMINATION – PHYSICAL IMPAIRMENT MEASURES

A

When examining a patient with hip pain/hip osteoarthritis over an episode of care, clinicians should conduct the FABER (Patrick's) Test, the Scour Test, and measure passive hip range of motion and hip muscle strength including: internal rotation, external rotation, flexion, extension, abduction, adduction.

INTERVENTION – PATIENT EDUCATION

B

Clinicians should provide patient education combined with exercise and/or manual therapy to teach activity modification, exercise, support weight reduction when overweight, and methods of unloading the arthritic joints.

INTERVENTION – FUNCTIONAL, GAIT, AND BALANCE TRAINING

B

Clinicians should provide impairment based functional, gait and balance training, including the proper use of assistive devices (canes, crutches, walkers) in patients with hip osteoarthritis and activity limitations, balance impairment, and/or gait limitations when associated problems are observed during the history or physical assessment of the patient.

B

Clinicians should individualize prescription of therapeutic activities based on patient's values, daily life participation and functional activity needs.

INTERVENTION – MANUAL THERAPY

A

Clinicians should use manual therapy for patients with mild to moderate hip osteoarthritis and impairment of joint mobility, flexibility, and/or pain. Doses and duration for effects should range from 1-3 times per week over 6-12 weeks in patients with mild to moderate hip osteoarthritis. As hip motion improves, clinicians should add exercises including stretching and strengthening to improve the patient's range of motion, flexibility, and strength.

INTERVENTION – FLEXIBILITY, STRENGTHENING, AND ENDURANCE EXERCISES

A

Clinicians should use individualized flexibility, strengthening, and endurance exercises to address impairments in hip range of motion, specific muscle weaknesses, and limited thigh (hip) muscle flexibility. For group-based exercise programs, effort should be made to tailor exercises to address patients' most relevant physical impairments.

Doses and duration for effect should range from 1-5 times per week over 6-12 weeks in patients with mild to moderate hip osteoarthritis.

INTERVENTION – MODALITIES

B

Clinicians may use ultrasound (1 Mhz; 1 Wcm² for 5 minutes each to the anterior, lateral, and posterior hip for a total of 10 treatments over a 2 week period) in addition to exercise intervention in the management of pain and activity limitation in individuals with hip osteoarthritis.

INTERVENTION – BRACING

C

Clinicians should not use bracing as a first line of treatment. A brace may be used after exercise or manual therapies are unsuccessful in improving participation in activities for patients with mild-moderate hip osteoarthritis.

INTERVENTION – WEIGHT LOSS

C

Clinicians may use structured exercise interventions to target weight loss in overweight and obese individuals with hip osteoarthritis.

F

Clinicians should collaborate with physician, nutritionist, or dietician to support weight reduction in overweight and obese individuals with hip osteoarthritis.

*These recommendations and clinical practice guidelines are based on the scientific literature published prior to April 2016

DRAFT

List of Acronyms

ACR: American College of Rheumatology	MOA: Management of Osteoarthritis
APTA: American Physical Therapy Association	MRI: Magnetic Resonance Imaging
BPI: Brief Pain Inventory	N: Number of subjects or patients
CAT: computer adaptive test	NPRS: Numerical Pain Rating Scale
CI: Confidence Interval	NSAID: Non-steroidal anti-inflammatory drug
CPG: Clinical Practice Guideline	OA: Osteoarthritis
FAI: Femoroacetabular impingement	OR: Odd's ratio
ER: External rotator or rotation	QOL: Quality of life
HHD: Hand held dynamometer	RCT: Randomized control trial
HHS: Harris Hip Score	SEM: Standard error of the measure
HOOS: Hip Disability and Osteoarthritis Outcome Score	SCFE: Slipped capital femoral epiphysis
ICC: Intraclass Correlation Coefficient	SD: Standard deviation
ICD: International Classification of Disease	SF-36: Medical Outcomes Study 36-Item Short Form Health survey
IR: Internal rotator or rotation	THA: Total hip arthroplasty
ISS: Ischial Spine Sign	TUG: Timed-up-go test
KL: Kellgren-Lawrence radiographic score	US: Ultrasound
LEFS: Lower Extremity Functional Scale	WOMAC: Western Ontario McMaster Universities Osteoarthritis Index
MCID: Minimal Clinical Important Difference	VAS: Visual Analog Scale
MDC: Minimal detectable change	

INTRODUCTION

AIM OF THE GUIDELINES

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based clinical practice guidelines (CPGs) for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability, and Health (ICF).³² 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 these 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

These guidelines are 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 based on clinician experience and expertise in light of the clinical presentation of the patient, the available evidence, available diagnostic and treatment options, and the patient's values, expectations, and preferences. However, we suggest that 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 to conduct a review of the literature and to develop an updated Hip Pain and Mobility Deficits - Hip Osteoarthritis: Clinical Practice Guideline as indicated by the current state of the evidence in the field. The aims of the revision were to provide a concise summary of the evidence since publication of the original guideline and to develop new recommendations or revise previously published recommendations to support evidence-based practice. The authors of this guideline revision worked with research librarians with expertise in systematic review to perform a systematic search for hip OA in articles published from 2008 related to classification, examination, and intervention strategies consistent with previous guideline development methods related to ICF classification. Briefly, the following databases were searched from 2008 to 2016: MEDLINE (PubMed; 2008 to 2016); CINAHL (EBSCO; 2008 to date); (EBSCO; 2008 to date); Cochrane Library (Wiley; 2008 to date); [See **APPENDIX A** for full search strategies and **APPENDIX B** for search dates and results, available at www.jostpt.org.]

The authors declared relationships and developed a conflict management plan, which included submitting a Conflict of Interest form to the Orthopaedic Section, APTA, Inc. Articles that were authored by a reviewer were assigned to an alternate reviewer. Funding was provided to the CPG development team for travel and expenses for CPG development training. The CPG development team maintained editorial independence.

Articles contributing to recommendations were reviewed based on specified inclusion and exclusion criteria with the goal of identifying evidence relevant to physical therapist clinical decision-making for adult persons with hip OA. The title and abstract of each article were reviewed independently by 2 members of the CPG development team for inclusion. [See **APPENDIX C** for Inclusion and Exclusion criteria, available at www.jospt.org]. Full text review was then similarly conducted to obtain the final set of articles for contribution to recommendations. The team leader (MTC) provided the final decision for discrepancies that were not resolved by the review team. [See **APPENDIX D** for flow chart of articles and **APPENDIX E** for articles included in recommendations by topic, available at www.jospt.org]. For selected relevant topics that were not appropriate for the development of recommendations, such as incidence and imaging, articles were not subject to systematic review process and were not included in the flow chart. Evidence tables for this CPG are available on the Clinical Practice Guidelines page of the Orthopaedic Section of the APTA website: www.orthopt.org.

This guideline was issued in 2017 based on the published literature up to 2016. This guideline will be considered for review in 2021, 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 were graded according to criteria adapted from the Centre for Evidence-Based Medicine, Oxford, United Kingdom for diagnostic, prospective, and therapeutic studies.⁵² In teams of 2, each reviewer independently assigned a level of evidence and evaluated the quality of each article using a critical appraisal tool. [See **APPENDIX F** and **G** for Levels of Evidence table and details on procedures used for assigning levels of evidence, available at www.jospt.org]. The evidence update was organized from highest level of evidence to lowest level. An abbreviated version of the grading system is provided below.

I	Evidence obtained from high quality diagnostic studies, prospective studies, systematic reviews or randomized controlled trials
II	Evidence obtained from lesser-quality diagnostic studies, prospective studies, systematic reviews or randomized controlled trials (eg, weaker diagnostic criteria and reference standards, improper randomization, no blinding, less than 80% follow-up)
III	Case controlled studies or retrospective studies
IV	Case series
V	Expert opinion

GRADES OF EVIDENCE

The strength of the evidence supporting the recommendations was graded according to the previously established methods for the original guideline and those provided below. Each team developed recommendations based on the strength of evidence, including how directly the studies addressed the question of hip pain and hip osteoarthritis. In developing their recommendations, the authors considered the strengths and limitations of the body of evidence and the health benefits, side effects, and risks of tests and interventions.

GRADES OF RECOMMENDATION		STRENGTH OF EVIDENCE
A	Strong evidence	A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study
B	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
C	Weak evidence	A single level II study or a preponderance of level III and IV studies, including statements of consensus by content experts, support the recommendation
D	Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies
E	Theoretical/foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic sciences/bench research support this conclusion
F	Expert opinion	Best practice based on the clinical experience of the guidelines development team

GUIDELINE REVIEW PROCESS AND VALIDATION

Identified reviewers who are experts in hip OA management and rehabilitation reviewed the clinical practice guideline draft for integrity, accuracy, and to ensure that it fully represents the current evidence for the condition. The guideline draft was also posted for public comment and review on www.orthopt.org and a notification of this posting was sent to the members of the Orthopaedic Section, APTA, Inc. In addition, a panel of consumer/patient representatives and external stakeholders, such as claims reviewers, medical coding experts, academic educators, clinical educators, physician specialists, and researchers also reviewed the guideline. All comments, suggestions, and feedback from the expert reviewers, public, and consumer/patient representatives were provided to the authors and editors for consideration and revisions. Guideline development methods policies, and implementation processes are reviewed at least yearly by the Orthopaedic Section, APTA's ICF-based Clinical Practice Guideline Advisory Panel, including consumer/patient representatives, external stakeholders, and experts in physical therapy practice guideline methodology.

DISSEMINATION AND IMPLEMENTATION TOOLS

In addition to publishing these guidelines in the Journal of Orthopaedic and Sports Physical Therapy (JOSPT), these guidelines will be posted on clinical practice guideline areas of both the JOSPT and the Orthopaedic Section, APTA websites, which are free access website areas, and submitted to be available free access on the Agency for Healthcare Quality and Research's website (guideline.gov). The implementation tools planned to be available for patients, clinicians, educators, payors, policy makers, and researchers, and the associated implementation strategies are:

<u>Tool</u>	<u>Strategy</u>
“Patient Perspectives”	Patient-oriented guideline summary in available on jospt.org and orthopt.org
Mobile app of guideline based exercises for patient/clients and healthcare practitioners	Marketing and distribution of app using orthopt.org and jospt.org
Clinician's Quick-Reference Guide	Summary or guideline recommendations available on orthopt.org
Read-for-credit continuing education units	Continuing Education Units available for physical therapists and athletic trainers from JOSPT
Webinars educational offering for healthcare practitioners	Guideline-based instruction available for practitioners on orthopt.org
Mobile and web-based app of guideline for training of healthcare practitioners	Marketing and distribution of app using orthopt.org and jospt.org
Physical Therapy National Outcomes Data Registry	Support the ongoing usage of data registry for common musculoskeletal conditions of the hip

Logical Observation Identifiers Names and Codes mapping

Publication of minimal data sets and their corresponding LOINC codes for the hip region on orthopt.org

Non-English versions of the guidelines and guideline implementation tools

Development and distribution of translated guidelines and tools to JOSPT's international partners and global audience via jospt.org

CLASSIFICATION

The primary ICD-10 code and condition associated with hip pain and mobility deficits is M16.1 Primary coxarthrosis, unilateral. In the ICD, the term osteoarthritis (OA) is used as a synonym for arthrosis or osteoarthrosis. Other, secondary codes associated with hip OA are M16.0 Primary coxarthrosis, bilateral; M16.2 Coxarthrosis resulting from dysplasia, bilateral; M16.3 Dysplastic coxarthrosis, unilateral; M16.4 Posttraumatic coxarthrosis, bilateral; M16.5 Posttraumatic coxarthrosis, unilateral; M16.7 Secondary coxarthrosis, not otherwise specified. The corresponding ICD-9 CM codes and conditions, which are used in the USA, are: 715.15 osteoarthritis of the pelvic region and thigh, localized, primary; 715.25 osteoarthritis of the pelvic region and thigh, localized, secondary; 715.85 osteoarthritis of the pelvic region and thigh involving more than 1 site but not specified as generalized.

The primary ICF body function codes associated with the above noted primary ICD-10 conditions are the sensory functions related to pain and the movement-related functions related to joint mobility. These body function codes are **b2816 Pain in joints** and **b7100 Mobility of single joint**.

The primary ICF body structure codes associated with hip pain and mobility deficits are **s75001 Hip joint**, **s7402 Muscles of the pelvic region**, and **s7403 Ligaments and fascia of pelvic region**.

The primary ICF activities and participation codes associated with hip pain and mobility deficits are: **d4154 Maintaining a standing position**, **d4500 Walking short distances**, and **d4501 Walking long distances**.

The ICD-10 and primary and secondary ICF codes associated with hip pain and mobility deficits are provided in Table 3 on the facing page.

A comprehensive list of codes was published in the previous guideline.¹⁷

ORGANIZATION OF THE GUIDELINE

For each topic, the summary recommendation and grade of evidence from the 2009 guideline are presented followed by a synthesis of the recent literature with the corresponding evidence levels. Each topic concludes with the 2016 summary recommendation and its updated grade of evidence.

DRAFT

Clinical Practice Guidelines

IMPAIRMENT/FUNCTION-BASED DIAGNOSIS

PREVALANCE

2009 Summary

Hip pain associated with OA is the most common cause of hip pain in older adults. Prevalence studies have shown the rates for adult hip OA range from 0.4% to 27%.

Evidence Update

III

In a systematic review assessing age and sex-specific epidemiological data for hip and knee OA, the global age-standardized prevalence of hip OA was 0.85% (95% CI: 0.74 - 1.02). Prevalence was higher for females than males.¹⁹ In a case-control study examining the prevalence of hip OA among 978 individuals in the US, the prevalence was estimated at 19.6% (95% CI: 16.7 - 23.0). Men showed a higher prevalence of radiographic hip OA. No difference in symptomatic hip OA prevalence was observed between men and women.⁴⁰ In a study examining the prevalence of OA in 7126 residents of rural China, the prevalence of symptomatic hip OA was estimated at 0.6%.⁷⁶

2016 Summary

Osteoarthritis is the most common cause of hip pain in older adults. Prevalence rates for adult hip osteoarthritis range from 0.4% to 27%. The reported prevalence of hip osteoarthritis continues to show great variability, with men showing higher prevalence of radiographic hip osteoarthritis.

PATHOANATOMICAL FEATURES

2009 Summary

Clinicians should assess for impairments in mobility of the hip joint and the strength of the surrounding muscles, especially the hip abductor muscles, when a patient presents with hip pain.

Evidence Update

III

Acetabular retroversion is associated with the development of hip OA.⁴³ External rotation of the entire hemipelvis is often noted with acetabular retroversion. An external rotation of the hemipelvis can be identified by noting a protrusion of the ischial spine into the pelvis on that side, called the ischial spine sign (ISS).^{33,37,66}

IV

Cartilage defects and bone marrow lesions in the anterior and central superiolateral regions of the joint may represent early structural damage in the development of hip OA.

Hip OA patients also have less femoral head cartilage volume and a higher prevalence of cartilage defects and bone marrow lesions.⁶⁸

2016 Summary

Early articular changes may help identify individuals who have not been clinically diagnosed with hip osteoarthritis. In patients with hip pain, clinicians should look for signs of pelvic obliquity because of its association with acetabular retroversion, which is related to the development of hip osteoarthritis.

CLINICAL COURSE

Evidence Update

IV

French²⁴ in a secondary analysis of 131 patients meeting the ACR criteria hip OA, was unable to identify variables that predicted treatment success of patients with hip OA. Independent variables included age, sex, BMI, duration of symptoms, comorbidities, treatment adherence, baseline pain with activity, baseline WOMAC (physical function subscale), baseline Hospital Anxiety and Depression Scale, baseline aggregate ROM and treatment adherence.

2009 and 2016 Summary

Total Hip Arthroplasty (THA) is the most common surgical procedure for end-stage hip osteoarthritis. Despite the success of THA of the hip and knee over the last 30-plus years, the criteria for when to perform such surgery is not clear. There have been several attempts to develop guidelines to determine the appropriate time to perform joint replacement surgery; however, few are supported by research. Currently, there is no consensus on the appropriate time to recommend surgery as a clinical end point. However, the Group for the Respect of Ethics and Excellence in Science (GREES) suggests that conservative intervention has failed if a patient does not experience a reduction in symptoms, such as a 20% to 25% improvement on the WOMAC pain subscale and has a progressive loss of joint space of between 0.3 and 0.7 mm/year. Prognosis should ideally be determined actively via measuring response to an optimal conservative management treatment approach.

RISK FACTORS

2009 Recommendation

A

Clinicians should consider age, hip developmental disorders, and previous hip joint injury as risk factors for hip osteoarthritis.

Evidence Update

I

Early hip OA³¹ is associated with hip osteophytes, morning stiffness, male gender, higher BMI, and hip pain with reduced hip range of motion. Males exhibit less hip internal

rotation and hip flexion than females. An increase in body mass index is related to an increased risk of hip osteoarthritis of similar magnitude for men and women (RR: 1.11; CI₉₅: 1.07, 1.16).³⁴

III

Living in a high household poverty community is independently associated with radiographic OA in one or both hips (OR 1.50) Low education attainment is independently associated with symptomatic OA of one or both hips (OR 1.44).¹⁸ People with high bone mass and hip OA have a higher prevalence of osteophytosis and excessive bone formation than those with less bone mass (OR for osteophytosis: 2.12 [95% CI: 1.61, 2.79] and for subchondral sclerosis: 2.78 [95% CI: 1.49, 5.18]).^{28, 29} A genetic predisposition to end-stage hip OA an increased level of clinical OA signs in some individuals.^{55, 56}

2016 Summary

Age, history of hip developmental disorders, previous hip joint injury reduced hip range of motion (especially hip internal rotation), presence of osteophytes, lower socioeconomic status, higher bone mass, and higher body mass are risk factors for hip osteoarthritis.

NATURAL HISTORY

2009 Summary

The natural history of hip osteoarthritis is not completely understood. Many different factors contribute to this. Arthritic changes occur both inside and outside of the hip joint resulting in loss of joint space, the development of osteophytes, and subchondral sclerosis and cysts. Joint range of motion is reduced and muscle weakness develops around the joint with osteoarthritis progression.

Evidence Update

III

Degenerative hip changes occur most rapidly in those with developmental dysplasia of the hip. Cam deformities and acetabular dysplasia are associated with developing hip OA more rapidly.^{26, 44, 47} The impact of surgery to correct femoral acetabular impingement on the development of OA is unclear.⁷⁵ Femoroacetabular impingement is more common among those with a history of slipped capital femoral epiphysis.^{46, 67} The degree of pistol grip deformity is related to the presence of hip OA in early adulthood; in 121 patients with stable SCFE 96 had signs of FAI and all 121 had some radiographic signs of hip OA.¹⁴

2016 Summary

The natural history of hip osteoarthritis is not completely understood. Arthritic changes occur both inside and outside of the hip joint resulting in loss of joint space, development of osteophytes, and subchondral sclerosis and cysts. Joint range of motion is reduced and muscle weakness develops around the joint with osteoarthritis progression. Degenerative hip changes naturally develop in those with developmental dysplasia as compared to

structurally normal hips and those with FAI. Those with cam deformities and acetabular dysplasia develop hip osteoarthritis more rapidly. Pistol grip deformities that develop after slipped capital femoral epiphysis are related to the development of early hip osteoarthritis.

DIAGNOSIS/CLASSIFICATION

2009 Recommendation

A

Moderate lateral or anterior hip pain during weight bearing, in adults over the age of 50 years, with morning stiffness less than 1 hour, with limited hip internal rotation and hip flexion by more than 15°, when comparing the painful to the nonpainful side, are useful clinical findings to classify a patients with hip pain into the International Statistical Classification of Diseases and Related Health Problems (ICD) category of unilateral coxarthrosis and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of hip pain (b2816 Pain in joints) and mobility deficits (b7100 Mobility of a single joint).

Evidence Update

II

Using the ACR definition of clinical hip osteoarthritis when assessing hip range of motion the criteria for internal hip rotation should be revised from less than 15° of hip internal rotation to less than 24° of hip internal rotation.³¹ Patients with hip pain often don't have radiographic evidence of hip OA (eg spurs, joint space narrowing, etc.) and many hips with radiographic evidence of hip OA don't have hip pain.⁴¹

2016 Recommendation

A

Clinicians should use the following criteria to classify adults over the age of 50 into the International Statistical Classification of Diseases and Related Health Problems (ICD) category of unilateral coxarthrosis and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of hip pain (b2816 Pain in joints) and mobility deficits (b7100 Mobility of a single joint): moderate anterior or lateral hip pain during weight bearing activities, morning stiffness less than 1 hour after wakening, Hip internal rotation range of motion less than 24° or internal rotation and hip flexion limited by 15° when comparing the painful to the non-painful side, hip pain associated with passive hip internal rotation

DIFFERENTIAL DIAGNOSIS

2009 and 2016 Recommendation

F

Clinicians should revise the physical therapy diagnosis and change their plan of care or refer the patient to the referring physician 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 patient's impairments of body function.

IMAGING STUDIES

2009 and 2016 Summary

Plain film radiography is the most often used method when radiographically diagnosing and assessing the progression of hip osteoarthritis. Radiographs are used to look for the amount of joint space narrowing, the presence of osteophytes, and subchondral sclerosis or cysts. Research for imaging methods that can identify pre-arthritis changes, MRI and ultrasound are still underway. Currently much of the imaging research has looked at how hip dysplasia or FAI may predispose hips to hip OA; however, more research is needed.

EXAMINATION

OUTCOME MEASURES

ACTIVITY LIMITATION – SELF-REPORT MEASURES

2009 Recommendation

A

Clinicians should use validated outcome measures, such as the Western Ontario and McMaster Universities Osteoarthritis Index, the Lower Extremity Functional Scale, and the Harris Hip Score before and after interventions intended to alleviate impairments of body function and structure, activity limitations, and participation restrictions associated with hip osteoarthritis.

Evidence Update

I

Adults with hip OA have decreased physical function that can affect balance. In a prospective study of 79 individuals with hip OA, falls efficacy (individuals' belief in their ability and skill to successfully perform a task and avoid a fall) was measured using 2 questionnaires, and the results showed that falls efficacy independently predicted balance performance as measured by the last 9 items of the Berg Balance Scale.⁵

II

The forty item Hip Disability and Osteoarthritis Outcome Score (HOOS) is a reliable and valid measure to assess pain, symptoms, physical function (daily living and sports/recreation) and quality of life in patients with hip disability and osteoarthritis.^{30, 49,69} The HOOS subscale Activity of Daily Living is equivalent to that of the WOMAC physical function subscale.⁴⁹ A short version of the HOOS using function subscales was developed to reduce the redundancy of similar items and for parsimony.²⁰ The final model consists of 5 HOOS items including from easiest to most difficult: sitting, descending stairs, getting in/out of bath or shower, twisting/pivoting on loaded leg, and running.^{20 63}

II

In a prospective study of 57 patients with hip OA that were matched with 200 patients without hip pain the validity of the WOMAC was evaluated in a German sample.⁵⁹ The results of the study support the validity of a modified WOMAC physical function subscale that started with 17 items and eliminated 5 physical function items: “bending to the floor”, “putting on socks”, “going shopping”, “rising from bed”, “getting off/on toilet”, “heavy domestic duties”, and “light domestic duties”. The pain subscale was unchanged.⁵⁹

III

A prospective study³⁸ with 224 patients with hip osteoarthritis showed that the Brief Pain Inventory (BPI)³⁹ which rates hip pain as: “now, average, worst and least” can be divided into cut points that describe the nature of clinical osteoarthritic hip pain. Rating scores for hip OA pain between “1-4” reflect “mild”, “4-7” reflect “moderate” and “8-10” reflect “severe” which can be useful in determining outcome after treatment. The BPI has also been shown to have good internal consistency (Cronbach’s alpha > .80), validity, and good responsiveness in a subsequent prospective study with 250 patients with hip osteoarthritis.³⁹

III

Hyperalgesia has been associated with central pain sensitization and chronic conditions such as osteoarthritis, and there is growing interest in its potential to inform clinical decision-making and in research.⁶⁴ Although hyperalgesia may occur in response to mechanical, thermal, or chemical stimuli, the literature is most well developed in the area of mechanical hyperalgesia.⁴ A mechanical pressure algometer is commonly used to measure the pain pressure threshold (PPT) or minimal amount of pressure at which the sensation of pressure first changes to a sensation of pain. Typically, PPTs are measured in a variety of sites and low values are used as an indicator of central pain sensitization. Wylde et al found a strong negative correlation between PPT measured at the forearm and pain severity as measured by the WOMAC pain subscale in 254 patients with hip osteoarthritis.⁷⁴ Those with low PPT values had high pain severity ($p < .001$). Aranda-Villalobos et al found a similar negative correlation between PPT measured at the 2nd metacarpal, gluteus medius, vastus lateralis, vastus medialis, and anterior tibialis and VAS scores in 40 adults with hip osteoarthritis.³ Emerging research has demonstrated a strong negative correlation between Pain Pressure Threshold (PPT) and pain severity in patients with hip OA.⁷⁴

2016 Recommendation

A

Clinicians should use validated outcome measures that include domains of hip pain, body function impairment, activity limitation, and participation restriction.

Activity limitation and participation restriction outcome measures may include: Western Ontario and McMaster Universities Arthritis Index (WOMAC) physical function subscale, The Hip Disability and Osteoarthritis Outcome Measure (HOOS), Lower Extremity Functional Scale (LEFS), and Harris Hip Score (HHS).

Hip pain measures may include: Numeric Pain Rating scale (NPRS), WOMAC pain subscale, Brief Pain Inventory (BPI), Pain Pressure Threshold (PPT), and Pain Visual analog scale (VAS).

ACTIVITY-LIMITATION-PHYSICAL PERFORMANCE MEASURES

2009 Recommendation

A

Clinicians should utilize easily reproducible physical performance measures, such as the 6-minute walk, self-paced walk, stair measure, and timed up-and-go tests to assess activity limitation and participation restrictions associated with their patient's hip pain and to assess the changes in the patient's level of function over the episode of care.

Evidence Update

I

A prospective study in patients with clinical hip OA based on ACR criteria were tested for standing balance including the Four-Square Step, Timed Single Leg Stance, and Functional Reach Tests. All tests had ICCs above 0.85 except the Functional Reach Test (ICC = 0.62-0.68). The Step Test had both high inter and intra rater reliability (ICC = 0.90) and low measurement error.¹⁶

I

Thirty-Second Chair Stand Test⁹

ICF Category: Measurement of activity limitation: changing basic body position

Description: The number of full sit-to-stand repetitions completed in 30 seconds.

Measurement Method: A standard/folding chair is placed with the back against the wall. The clinician should demonstrate the movements, and ask the patient to complete a practice trial. Then, the patient begins seated on the chair with feet shoulder width apart and flat on the floor, and arms crossed at chest. The patient rises to a full stance and repeats as many as possible in the time allotted. The clinician records the total number of completed chairs stands (full rise back to seated position) in 30 seconds.

Nature of Variable: Continuous

Units of Measurement: the completed number of chair stands

Measurement Properties: In a cohort of 37 adults with hip OA based on American Academy of Rheumatology clinical diagnostic criteria⁹

- Intrarater reliability (ICC) = 0.88
- MDC₉₀ = 3.5
- SEM = 1.5

I

Four Square Step Test¹⁶

ICF Category: Measurement of activity limitation: Moving around within the home

Description: Assesses how well a person can manage moving in different directions.

Measurement Method: Four canes are placed with handles out at 90 degree angles to form 4 squares. Upon demonstration from clinician, and a practice trial, the participant begins by standing in square 1 (always facing square 2 throughout the test), and step forward with both feet into square 2, then side step right into square 3, and back step into square 4, then return to square 1 with a side step left. The sequence is then reversed back to starting (square 1,4,3,2, back to 1). Both sequences are completed as quickly as possible.

Nature of Variable: Continuous

Units of Measurement: Seconds

Measurement Properties: In a cohort of 30 adults with hip OA based on the American Academy of Rheumatology clinical diagnostic criteria:¹⁶

- Test-retest reliability (ICC) = 0.86 (95% CI: 0.72, 0.93)
- MDC₉₀: 1.80 (95% CI: 1.53, 2.42)
- SEM: 0.77 (95% CI: 0.65, 1.04)

I

Step Test¹⁶

ICF Category: Measurement of activity limitation: Climbing; moving the whole body upwards or downwards, such as climbing steps.

Description: Determine how many steps a person can complete while standing on the painful hip side assessing a participants standing balance.

Method of Measurement: Upon demonstration from clinician, and one practice trial, the participant steps up onto and then off of a 15 cm high step while maintaining stance of the painful leg on a 5-cm wide cardboard template that is used as a starting marker and placed on floor in front of step. The less or nonpainful leg is then moved up onto the step then back down to the floor (foot must be flat to floor and then to step to count as a completed step). The test is performed for 15 seconds and full steps are counted without the patient moving stance leg from starting position (overbalancing).

Nature of Variable: Continuous

Units of Measurement: Number of steps

Measurement Properties: In a cohort of 30 adults with hip OA based on clinical diagnostic criteria established by the American Academy of Rheumatology¹⁶:

- Test-retest reliability (ICC) = 0.94 (95% CI: 0.88, 0.97)
- MDC₉₀: 3.0 (95% CI: 1.97, 3.33)
- SEM: 1.06 (95% CI: 0.85, 1.43)¹⁶

I

Timed Single Leg Stance¹⁶

ICF Category: Measurement of activity limitation: Maintaining and shifting center of gravity

Description: Assesses static balance.

Measurement Method: Upon demonstration from clinician, and one practice trial, the patient places hands on hips and stands on 1 leg with knee of nonstance leg flexed so foot is behind patient and the nonstance hip is in neutral position while focusing on a stationary target 1 to 3 meters ahead for as long as possible for up to 30 seconds. The test is complete when the patient touches the stance leg, removes hands from hip, or if stance leg touches the nonstance leg. The longer of 2 trials on each leg to the nearest 10th of a second is recorded.

Nature of Variable: Continuous

Units of Measurement: Seconds

Measurement Properties: In a cohort of 30 adults with hip OA based on clinical diagnostic criteria established by the American Academy of Rheumatology¹⁶

- Test-retest reliability (ICC) = 0.89; (95% CI: 0.78, 0.95)
- MDC₉₀: 8.08 (95% CI: 6.44, 10.87)
- SEM: 3.46 (95% CI: 2.76, 4.66)

2016 Recommendation

A

To assess activity limitation, participation restrictions, and changes in the patient's level of function over the episode of care clinicians should utilize reliable and valid physical performance measures, such as the: 6-minute walk, Thirty-second chair stand, Stair measure, Timed up-and-go test, and Self-paced walk, Timed single leg stance, Four square step test, Step test.

A

Clinicians should measure balance performance and activities that predict the risk of falls in adults with hip osteoarthritis especially those with decreased physical function or a high risk of falls because of past history. Recommended balance tests for patients with osteoarthritis include: Berg Balance Scale, Four-Square Step test, Timed Single Leg Stance test

F

Clinicians should use existing guidelines⁶ for fall risk management in patients with hip osteoarthritis to assess and manage fall risk.

PHYSICAL IMPAIRMENT MEASURES

2009 Recommendation

Recommended impairment measures and their properties are provided in the 2009 CPG.¹⁷

Evidence Update

I

Passive Hip Range of Motion

ICF Category: Measurement of impairment of body function: mobility of a single joint

Description: The amount of active and passive hip motion measure prone and supine. Although assessing the range in the 3 most commonly limited hip motions is important, occasionally clinicians may need to assess other hip motions. The patient can be asked to rate the amount of pain experienced during movement on a 0-10 numerical pain rating scale (NPRS) to help with understanding the amount of hip joint irritability or give direction regarding possible interventions.

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

Unit of Measurement: Degrees and 0/10 NPRS rating

Measurement Properties: Limited ROM is associated with high levels of disability in patients with hip OA.⁵⁸ Pua found both excellent intra and inter-rater reliability for hip passive range of motion when testing 22 patients with clinical and radiographic evidence of hip OA.⁵⁸ Measurement properties for passive hip ROM are provided below.⁵⁸

	Reliability: ICC (95% CI)	SEM	MDC ₉₀
Flexion	0.97 (0.93 - 0.99)	3.5	8.2°
Extension: knee flexed	0.86 (0.67 - 0.94)	4.5	10.5°
Extension: knee unconstrained	0.89 (0.72 - 0.95)	4.7	11.0°
Abduction	0.94 (0.86 - 0.98)	3.2	7.3°
Internal Rotation	0.93 (0.83 - 0.97)	3.4	7.8°
External Rotation	0.96 (0.91 - 0.99)	3.1	7.1°

Measurement Method:

Hip Internal Rotation: Hip IR can be measured prone or sitting. Goniometer placement is the same as with sitting.⁵⁸ The patient is positioned the knee flexed to 90°. The movement arm of the goniometer is placed along the center of the tibia while the

stationary arm is placed along a vertical plane. The bubble goniometer or goniometer's movement arm is placed along the shaft of the fibula. Use of a belt is preferable to stabilize and prevent movement of the pelvis. The fibula is actively or passively moved into IR and measured when a firm end feel is appreciated or the pelvis begins to move.⁵⁸

Hip External Rotation: For rotation the patient is seated with the hip flexed to 90° the knee is flexed to 90°. The movement arm of the goniometer is placed along the center of the tibia while the stationary arm is placed along a vertical plane. The bubble goniometer or goniometer's movement arm is placed along the shaft of the tibia. Use of a belt is preferable to stabilize and prevent movement of the pelvis. The tibia is actively or passively moved into ER and measured when a firm end feel is appreciated or the pelvis begins to move.⁵⁸ Hip IR/ER may be measured in the prone position rather than when sitting to stabilize the pelvis more securely. Goniometer placement is the same as with sitting.⁵⁸

Hip Flexion: Hip flexion is measured with the patient in supine. A strap can be placed across the contralateral thigh to stabilize the pelvis. The stationary goniometer is aligned along the long axis of the trunk while the movement arm is aligned parallel with the femur. When using a bubble goniometer or goniometer, the inclinometer is zeroed on a horizontal surface and then the goniometer is placed parallel to the femur.⁵⁸

Hip Abduction: Hip abduction is measured in the supine position (passive) or side lying (active). The stationary goniometer is placed as to connect an imaginary line from the left and right anterior superior iliac spines. The movement arm parallel along the thigh. The bubble goniometer or goniometer is zeroed in the neutral position. The hip is abducted until a firm end feel is noted or the pelvis begins to move. For active abduction the procedure is the same; however, stabilization of the pelvis is created by body weight.

Hip Extension: Hip extension is measured with the patient in the supine position and their hip joints positioned at the edge of the treatment table then both hips are flexed and the measured hip is slowly extended until there was adequate hip flexion to produce a flattened lumbar spine (Thomas test position). Hip extension is measured as the angle between the femur and the horizontal surface. Goniometer placement is stationary along the horizontal surface and movement arm along the thigh.⁵⁸

I

Hip Muscle Strength:

ICF Category: Measurement of impairment of body function: strength of a single joint

Description: The amount of muscle strength in hip muscles measured in different positions.

Measurement Method:

Hip Internal Rotators: Hip internal rotators are tested with patient seated in a chair or prone with the knee flexed to 90° stabilizing the pelvis as necessary to prevent unwanted movement. A HHD is placed 5 cm above the lateral malleolus.

Hip External Rotators: External rotators are tested with patient seated in a chair or prone with the knee flexed to 90° stabilizing the pelvis to prevent unwanted movement. A HHD is placed 5 cm above the medial malleolus.

Hip Flexors: Hip flexor's are tested with patient seated in a chair or supine with the knee flexed to 90° (while seated) or knee extended fully (supine) stabilizing the pelvis as necessary by placing a rolled up towel between the thighs to prevent unwanted movement. A HHD is placed 5 cm proximal to the superior pole of the patella (sitting) or 5 cm proximal to the ankle joint (supine).

Hip Abductors: Hip abductors are measured with patient supine or side lying by placing a HHD 5 cm proximal to the lateral femoral condyle to isolate the hip joint.

Hip Extensors: Pua measured hip extensor strength with the patient in the supine position with the uninvolved thigh stabilized and the measured hip placed in 20° of hip flexion suspended by a strap that was attached to a force transducer.⁵⁸ An alternative method, is to measure using the same position with a HHD 5 cm proximal to the ankle on the Achilles tendon.

Nature of Variable: Continuous

Unit of Measurement: Newtons, kilograms, or pounds.

Measurement Properties: Limited strength is associated with high levels of disability in patients with hip OA.⁵⁸ Pua found both excellent intra and inter-rater reliability for hip muscle strength when testing 22 patients with clinical and radiographic evidence of hip OA.⁵⁸ Tests of isometric muscle strength should be performed for hip abductor: IR, ER, flexors, adductors, hip extensors muscles. Beiler also measured hip muscle strength in patients with hip OA and found similar results.⁹ Measurement properties for hip muscle strength are provided below.⁵⁸

Hip Muscle	Reliability: ICC (95% CI)	SEM	MDC ₉₀
Flexors	0.87 (0.69 - 0.95)	10.9	25.3
Extensors	0.97 (0.92 - 0.99)	13.3	30.8
Abductors	0.84 (0.55 - 0.94)	12.1	28
Internal Rotators	0.98 (0.94 - 0.99)	3.7	8.5
External Rotators	0.98 (0.96 - 0.99)	3.2	7.4

III

Pain Pressure Threshold

ICF Category: Measurement of impairment of body function: pain hyperalgesia

Description: A measure of pressure/tenderness taken over the hip joint and in areas away from the hip joint

Measurement method: Place the rubber disk of the algometer on the site of choice and apply pressure until the patient indicates the sensation of pressure has changed to pain. Record the value indicated on the strain gauge. Always begin with the algometer on 0 Kg/cm². Change the location on the skin slightly and repeat 2 more times. Allow 30 seconds between trials. Record the average of the 3 trials. Sites to test include the gluteus medius, 2nd metacarpal, vastus medialis or lateralis, and anterior tibialis. Test both sides.

Nature of variable: Continuous

Units of measure: Kg/cm²

Measurement properties: The reliability of pressure algometry has been found to be high with an ICC of 0.91 (95% confidence interval) 0.82, 0.97¹⁵ Construct validity has been demonstrated with high correlations between force plate readings and algometer readings (r=0.990).⁴² Values of pressure pain thresholds (kPa) reported by Maquet et al obtained from healthy male and female adults ranged from 190-350 kPa depending on the site tested.⁴⁸ Abnormal tenderness is a pressure pain threshold that is lower by 2 kg/cm² relative to a normal sensitive corresponding point.²³ PPT values suggestive of hyperalgesia for individuals with hip osteoarthritis have not been published.

2016 Recommendation

A

When examining a patient with hip pain/hip osteoarthritis over an episode of care, clinicians should conduct the FABER (Patrick's) Test, the Scour Test, and measure passive hip range of motion and hip muscle strength, including: internal rotation, external rotation, flexion, extension, abduction, adduction.

BEST PRACTICE POINT ESSENTIAL DATA ELEMENTS

Clinicians should use the following measures at least at baseline and at one follow-up time point for all patients with hip osteoarthritis to support standardization for quality improvement in clinical care and research:

Activity Limitations - Self-report Measures

- Western Ontario and McMaster Universities Arthritis Index (WOMAC) physical function subscale

Activity Limitations - Physical Performance Measures

- 6-Minute Walk Test
- Timed Single Leg Stance

Physical Impairment Measures

- Hip ROM and muscle strength for the following:
 - Internal rotation
 - External rotation
 - Flexion
 - Extension

- Abduction
- Adduction
- Pain
 - Numeric Pain Rating Scale (NPRS)

INTERVENTIONS

ANTI-INFLAMMATORY AGENTS

2009 and 2016 Summary

Use of NSAIDs, Cox-2 inhibitors, and steroid injections are an effective treatment for relief of symptoms in patients with hip osteoarthritis. Some evidence suggests that NSAIDs may increase the progression of hip osteoarthritis by decreasing glycosaminoglycan synthesis; however, further studies are needed.

ALTERNATIVE/COMPLEMENTARY MEDICATION

2009 Summary

There is some evidence to support the short-term use of injectable viscosupplementation with hyaluronic acid into hip joint of patients with hip osteoarthritis. Despite a paucity of evidence, the use of injectable synthetic hyaluronic acid (hyaluronan) into the hip joint has been shown to be an elective treatment for symptomatic hip osteoarthritis. Evidence also shows that injectable hyaluronan works best in mild to moderate hip osteoarthritis, especially when conservative therapy has failed. A recent published meta-analysis suggests the benefit of hyaluronan for the treatment of hip osteoarthritis, but so far it is only approved by the Federal Drug Administration for the knee. More controlled studies are needed to show its effectiveness in patients with hip osteoarthritis.

Evidence Update

I

Rozendaal studied 222 patients with hip OA treated with glucosamine or placebo once daily for 2 years. No differences were noted after 2 years in joint space on x-ray or in WOMAC physical function score.^{60, 61} Wandel et al conducted a meta-analysis of glucosamine, and/or chondroitin on joint pain and joint space in patients with hip or knee osteoarthritis.⁷² Pain was not improved nor did the glucosamine have an effect on joint space narrowing.

2016 Summary

There is insufficient evidence to support the use of supplements such as glucosamine, chondroitin or similar substances for the treatment of hip osteoarthritis.

PATIENT EDUCATION

2009 Recommendation

B

Clinicians should consider the use of patient education to teach activity modification, exercise, weight reduction when overweight, and methods of unloading the arthritic joints.

Evidence Update

I

Svege et al⁶⁵ conducted a follow-up study of a previous RCT of 109 patients with symptomatic and radiographic OA comparing exercise and patient education to a control group. Results showed that exercise therapy plus education was associated with 6-year cumulative survival of the native hip of 41% and 25%, respectively (p=0.034).

I

Fernandes et al²² enrolled 109 patients with mild to moderate hip OA and compared patient education versus patient education plus exercise. Improvements were noted for WOMAC physical function score for the education and exercise group. WOMAC scores improved significantly from an initial score of 21.1 to 15.1 16 months later while those receiving only patient education improved minimally from 23.6 to 22.8.

I

Poulsen et al⁵⁷ compared patient education only, patient education plus manual therapy, and home stretching exercises. At 6 weeks, significant differences were found in all HOOS subscales favoring patient education plus manual therapy versus the control group. At 6 weeks 76.5% of patients in patient education plus manual therapy improved versus 22.2% in patient education and 12.5% in the control group. No overall difference was found between groups for mean pain severity. At 12 months no differences were noted among groups for pain, HOOS scores or ROM.

II

Voorn et al⁷¹ observed 29 patients with hip osteoarthritis that were given tailored management advice and a follow-up phone call by a physical therapist and/or a nurse practitioner to assess if education was effective in changing their quality of life after 10 weeks. Significant improvement was found in the HOOS subscale for sports, the ICOAP hip score, the SF-36 physical function score and the EQ-5D score.

2016 Recommendation

B

Clinicians should provide patient education combined with exercise and/or manual therapy to teach activity modification, exercise, support weight reduction when overweight, and methods of unloading the arthritic joints.

FUNCTIONAL, GAIT, AND BALANCE TRAINING

2009 Recommendation

C

Functional gait and balance training, including the use of assistive devices such as canes, crutches, and walkers, can be used in patients with hip osteoarthritis to improve function associated with weight bearing activities.

Evidence Update

I

Bossen et al¹⁰ conducted a randomized trial comparing a self-paced physical activity intervention individualized based on favorite recreational activity to a control condition. At 3 months, the intervention group demonstrated greater improvement in HOOS physical function score (6.5 points/100) and global rating of change. At 12 months, the intervention group showed higher levels of self-reported physical activity but no difference in HOOS physical function score or global rating of change compared to the control group.

2016 Recommendation

B

Clinicians should provide impairment based functional, gait and balance training, including the proper use of assistive devices (canes, crutches, walkers) in patients with hip osteoarthritis and activity limitations, balance impairment, and/or gait limitations when associated problems are observed during the history or physical assessment of the patient.

B

Clinicians should individualize prescription of therapeutic activities based on patient's values, daily life participation and functional activity needs.

MANUAL THERAPY

2009 Recommendation

B

Clinicians should consider the use of manual therapy procedures to provide short-term pain relief and improve hip mobility and function in patients with mild hip osteoarthritis.

Evidence Update

I

Abbott et al¹ conducted a randomized controlled trial (RCT) of usual medical care, manual therapy and/or exercise therapy in addition to usual medical care in 193 patients with hip or knee OA. Results for hip and knee OA were similar therefore were combined. Each intervention group demonstrated statistically significant improvement at 1 year. WOMAC composite score improvement was greater than the minimal clinically

important difference (MCID) of >28 points for the usual care plus manual therapy group and usual care plus exercise therapy groups. The magnitude of improvement in WOMAC composite score was greater for usual care plus manual therapy group than for the other two groups.

I

Bennell et al⁷ completed a randomized trial of 102 patients with mild, moderate and severe hip OA confirmed by radiographs comparing education/advice, manual therapy, home exercise and gait aid if needed to a sham intervention consisting of inactive ultrasound. The protocol included hip thrust mobilization/manipulation and deep tissue massage in the thigh/hip region. Over half of the sample had moderate to severe hip OA (KL grade 3-4) with significantly reduced total hip rotation (mean: 42°), and long duration of hip OA symptoms (intervention group: 36 months, sham group: 30 months). After 13 weeks there was no between-group differences for pain or function. Forty-one percent reported mild adverse events in active group versus 14% in Sham group, including hip pain (33%) and spinal stiffness (4%), with one in three active participants reporting increased hip pain. This study shows that those who have radiographic evidence of moderate/severe hip OA, limited hip rotation, and a long duration of hip pain will not likely have success with PT including manual therapy.

I

Beselga et al⁸ performed a RCT of 40 patients to test the effect of a single session of mobilization with movement (MWM) techniques compared to a sham treatment on pain, hip ROM, and function. Compared to the sham group the MWM group had decreased pain (2/10 points), increased hip flexion (12.2°) and internal rotation (4.4°), and clinically significant improvement in 40 meter self-paced walk test by 11.2 seconds. The intervention was performed by a single physical therapist that reduced the external validity of the study.

I

Brantingham et al¹³ conducted a RCT comparing manipulative therapy and stretching versus a “full kinetic chain” approach in 111 patients with mild to moderate hip osteoarthritis (based on ACR criteria, with KL grades from 0-3). The manipulative group received high velocity hip traction and stretching of thigh muscles. The “full kinetic chain” group received manipulative therapy and stretching to the hip plus soft tissue mobilization and manipulation to the low back, and ipsilateral knee, ankle, and foot at the discretion of the practitioner. Results indicated that applying manual therapy distal to the hip (knee, ankle, or foot) offers no additional benefit.

I

French et al²⁴ completed a RCT comparing the effects of exercise therapy, exercise plus manual therapy, and no therapy in the management of 131 patients with hip OA based on ACR criteria. Manual therapy included Grade II and III mobilizations for the 2 most restricted movements. Both exercise and exercise plus manual therapy

groups showed statistically significant improvement in WOMAC physical function score, aggregate ROM, and global rating of change at 9 weeks compared to no therapy. There were no significant differences in mean WOMAC physical function or pain score found between exercise therapy and exercise plus manual therapy.

I

Brantingham¹¹ in 2012 published a systematic review of the effectiveness of manipulative interventions throughout the lower extremity. Using a range of measures they found fair evidence for benefit of manual therapy in hip OA. All of the RCTs included in this review have been included separately in initial CPG or in this revision, additionally this review included 5 case-series that provided lower level support for manual therapy for hip OA.

II

Pinto et al⁵³ in 2013 conducted an economic evaluation of Abbott's trial¹ of patients who met American College of Rheumatology (ACR) criteria of hip OA using one year outcomes. Manual therapy, exercise therapy, and combined manual and exercise therapy provided gains in Quality Adjusted Life Years compared to usual medical care. From the societal perspective, manual therapy was cost-saving compared to usual care, and exercise therapy was cost-effective. Individual therapy was more cost-effective than the combination of the two. This study was limited by a short time frame for economic evaluation which is important since gains that are sustained over time would increase cost-effectiveness.

II

Poulsen⁵⁷ completed an RCT of 118 patients with hip OA assigned to 3 groups: 1) patient education, 2) patient education plus manual therapy, and 3) control: home stretching. At 6 weeks no significant differences found between the groups for mean pain severity. Comparing change in pain pairwise, the education plus manual therapy group showed reduction in pain versus the control group (effect size 0.92) and the education group. No difference was noted between education and control group. All HOOS subscales showed improvement for patient education plus manual therapy group compared to the control. For hip ROM, no differences found.

II

In 2011 Peter et al⁵¹ provided an update to the Dutch Clinical Practice Guideline for Hip OA adding manual therapy to exercise as a level 2 recommendation for pain and reversible joint mobility limitation. Manual therapy according to the guidelines includes manipulation, manual traction, and muscle stretching. The CPG recommends adding manual therapy when hip joint mobility is limited as a preparation for exercise.

III

Wright⁷³ completed a secondary analysis of data from 70 of the patients in Abbott et al study¹ to determine whether within-session changes in pain after manual hip traction predicted outcomes at 9 weeks and whether this differed for those who received manual therapy and those who did not. The group receiving manual hip traction and manual

therapy showed improvement in pain reduction and global rating of pain. Intra-session changes in pain intensity were not predictive of a positive treatment response over the longer term.

IV

Brantingham et al conducted a prospective single group, pre-post-test study of 18 participants with hip OA, low composite WOMAC scores, age lower than 40 or more than 80 years of age, or had contralateral hip replacement.¹² Treatment included axial manipulation to the hip combined with manipulative therapy to spine, knee, ankle or foot. Results reported included reduced hip pain and improved function as evidenced by lower composite WOMAC scores and also improved hip flexion ROM that was sustained up to 3 months

IV

Hando²⁷ performed a case series of 27 patients with mild to severe hip osteoarthritis based on ACR criteria. Treatment included ten 30-minute sessions over 8 weeks for pre-selected manual therapy (muscle stretching, non-thrust and thrust manipulation), and performed therapeutic exercise as a home program. After 8 weeks the Harris Hip score improvement on average was 20.4 points (on 100 point scale), and NRPS reduction on average was 2.3 (0-10) points.

2016 Recommendation

A

Clinicians should use manual therapy for patients with mild to moderate hip osteoarthritis and impairment of joint mobility, flexibility, and/or pain. Doses and duration for effects should range from 1-3 times per week over 6-12 weeks in patients with mild to moderate hip osteoarthritis. As hip motion improves, clinicians should add exercises including stretching and strengthening to improve the patient's range of motion, flexibility, and strength

FLEXIBILITY, STRENGTHENING, AND ENDURANCE EXERCISES

2009 Recommendation

B

Clinicians should consider the use of flexibility, strengthening, and endurance exercises in patients with hip osteoarthritis.

Evidence Update

I

Abbott et al¹ conducted a RCT of usual medical care, manual therapy and/or exercise therapy in addition to usual medical care in 193 patients with hip or knee OA. Results for hip and knee OA were similar, therefore combined. Each intervention group demonstrated statistically significant improvement at 1 year. WOMAC composite score improvement was greater than the MCID of >28 points for the usual care plus manual

therapy group and usual care plus exercise therapy groups. The magnitude of improvement in WOMAC composite score was smaller for usual care plus exercise than for usual care plus manual therapy.

I

Villadsen et al⁷⁰ performed a secondary analysis of a RCT comparing the effects of an 8-week neuromuscular exercise and an education program versus an education only group on activity in 84 patients scheduled for total hip replacement. The exercise plus education group had significant improvement in the HOOS ADL scale compared to the education group (7.3 points; effect size: 0.63). HOOS Pain, Sport and Recreation Function and Joint-related Quality of Life (QOL), chair stands, and 20m self-paced walk all significantly improved in the exercise plus education group.

I

Juhakoski et al's³⁶ RCT investigated short and long-term effects of exercise on pain and function in 120 people with ACR clinical diagnosis of hip OA and KL score >1. The control group received general practitioner (GP) care consisting of medication (NSAID's and analgesics) and physiotherapy (e.g. thermal modalities, TENS, electrical stimulation, and acupuncture). The intervention group received usual medical care and 12 supervised group exercise sessions plus a booster session at one year. Mean difference in WOMAC physical function score indicated improvement by approximately 7 points in the intervention group at 6 and 18 months. No differences were found between groups for WOMAC pain or SF-36 physical component summary. The exercise program was standardized and intensity was not adjusted individually.

I

Pisters et al⁵⁴ in a RCT compared the effect at 5 years of usual exercise and exercise plus behavioral graded activity (BGA) in a RCT. Usual exercise followed the Dutch guideline²¹ for hip OA (hip muscle strengthening, aerobic capacity, function and gait with focus on limitation of activities and restrictions on participation), advice, and encouraged coping strategies. BGA consisted of tailored exercise program using operant conditioning. A difference was found at 3 months and at 9 months for reduction of pain and improved physical function in favor of BGA. At 60 months both groups showed improvement, but no differences were found between groups. BGA also reduced the likelihood of joint replacement surgery and improved exercise adherence.

I

Bennell et al⁷ randomized 102 patients with hip osteoarthritis and compared a physical therapy intervention consisting of manual therapy to the hip and spine, deep tissue massage, stretching, strengthening of the hip and leg, functional balance, gait drills, home exercises, and education and advice for 12 weeks to a sham intervention consisting of inactive ultrasound. Differences between groups for pain and function were not significant except at week 13 in the active group with improvement noted in the balance step test.

II

Fukumoto²⁵ randomized 46 women diagnosed with hip osteoarthritis using the Japanese Orthopaedic Association guidelines to assess the difference between a high-velocity and low-velocity resistance exercise program at 8 weeks. Women were stratified by age and hip OA severity into groups. Both training approaches reduced hip pain and improved function (Harris Hip Score), but did not demonstrate improvements beyond minimal detectable change for isometric strength, muscle power, clinical assessment, muscle mass, and composition. The results support the use of exercise in patients with hip OA but not a preference for high versus low velocity resistive exercise.

III

Ageberg et al² evaluated a training program in 38 patients with severe hip OA based on pain, disability, and radiographic findings suggestive of severe hip OA. Patients received up to 20 individualized goal-based interventions that consisted of neuromuscular training exercises. HOOS scores for pain, symptom, ADL, Sport and QOL all had improvements of 6.1, 4.7, 5.0, 6.9 and 7.1 points (0-100) from baseline scores. Improvements found in this study of an individual approach to exercise should be confirmed in controlled studies.

III

Paans et al⁵⁰ studied the effect of an 8 month combined exercise and weight loss program in a prospective cohort of thirty-five patients with hip OA. Significant improvements were found at 3 months for WOMAC physical function, WOMAC pain and stiffness scores, pain VAS, SF-36 physical component summary score, body mass and body fat. At eight months, improvements were found the WOMAC physical function (33%), WOMAC pain and stiffness, SF-36, pain VAS, 6-minute and 20-meter walk tests, and body mass and body fat. Adherence to the exercise diet components were 94% and 82% respectively.

III

Jigami et al³⁵ provided land-based and aquatic exercises to two groups of 36 patients. One group exercised weekly the other group every two weeks each for a total of 10 sessions. Muscle strength improved in the weekly group only (hip flexors +5.7, extensors +5.8, abductors +4.3 kg). Both groups improved in TUG and timed one-leg standing with eyes open test.

2016 Recommendation

A

Clinicians should use individualized flexibility, strengthening, and endurance exercises to address impairments in hip range of motion, specific muscle weaknesses, and limited thigh (hip) muscle flexibility. For group-based exercise programs, effort should be made to tailor exercises to address patients' most relevant physical impairments. Doses and duration for effect should range from 1-5 times per week over 6-12 weeks in patients with mild to moderate hip osteoarthritis.

MODALITIES

2009 No Recommendation

Evidence Update

I

Koybasi et al⁴⁵ completed a prospective RCT exploring the effects of ultrasound (US) in 45 patients (mean age 65.3) with primary hip OA and KL score of 2 or 3 based on radiographs. Three groups were randomized, Group I exercise and hot packs, II exercise, hot packs and sham US, Group III exercise, hot packs, and ultrasound (1Mhz continuous, 1 W/cm² with 5 cm head size). US was administered for 5 minutes to anterior, posterior, and lateral hip for 10 treatments total. After 10 treatments all 3 groups showed significant improvement in pain intensity, WOMAC scores, and 15-minute timed walk. The PT plus US group III improvements remained significant at 1 and 3 months after completion of treatment. Ultrasound may be beneficial for short term pain reduction in patients with hip OA.

2016 Recommendation

B

Clinicians may use ultrasound (1 Mhz; 1 Wcm² for 5 minutes each to the anterior, lateral, and posterior hip for a total of 10 treatments over a 2 week period) in addition to exercise intervention in the management of pain and activity limitation in individuals with hip osteoarthritis.

BRACING

2009 No Recommendation

Evidence Update

III

Sato et al⁶² explored the effects of using an S-form brace (WISH) with a cross-sectional survey in 16 patients with mild hip OA with an “on versus off” brace design. Improvement in mean TUG time for left and right turning, improvements were found at 3 months and maintained at 12 months. Improvement found in TUG for turning with the unbraced leg at 6 or 12 months. The Harris Hip Scores improved in 9 out of 10 hips at 1 month. Economic cost and the demands of daily wear are drawbacks.

2016 Recommendation

C

Clinicians should not use bracing as a first line of treatment. A brace may be used after exercise or manual therapies are unsuccessful in improving participation in activities for patients with mild-moderate hip osteoarthritis.

WEIGHT LOSS

2009 No Recommendation

Evidence Update

III

Paans et al.⁵⁰ investigated the effect of exercise and weight loss on function in individuals with hip OA with the following inclusion criteria: ACR hip OA criteria, ≥ 25 years of age, overweight (BMI >25 kg/m²) or obesity (BMI >30 kg/m²). A significant decrease of body mass and body fat were found at 8 months (5% and 3.3%) respectively.

2016 Recommendations

C

Clinicians may use structured exercise interventions to target weight loss in overweight and obese individuals with hip osteoarthritis.

F

Clinicians should collaborate with physician, nutritionist, or dietician to support weight reduction in overweight and obese individuals with hip osteoarthritis.

Authors:

Michael T. Cibulka, DPT
Associate Professor
Physical Therapy Program
Maryville University
St. Louis, MO
mcibulka@maryville.edu

Nancy J. Bloom, DPT, MSOT
Associate Professor in Physical Therapy
and Department of Orthopaedic Surgery
Washington University School of
Medicine
St. Louis, MO
bloom@wustl.edu

Keelan R. Enseki, PT, MS
Physical Therapy Orthopaedic
Residency Program Director Centers for
Rehab Services
University of Pittsburgh Medical Center
Center for Sports Medicine
Pittsburgh, PA
ensekr@upmc.edu

Cameron W. MacDonald, PT, DPT
Assistant Professor
School of Physical Therapy
Regis University
Denver, CO
cmacdona@regis.edu

Judy Woehrle, PT, PhD
Professor
Physical Therapy Program
Midwestern University
Glendale, AZ
jwoehr@midwestern.edu

Christine M. McDonough, PT, PhD
ICF-based Clinical Practice Guidelines
Editor
Orthopaedic Section, APTA Inc.
La Crosse, WI
and
Adjunct Clinical Assistant Professor

Reviewers:

Roy Altman, MD
Professor of Medicine
Division of Rheumatology and Immunology
David Geffen School of Medicine at UCLA
Los Angeles, CA
journals@royaltman.com

John Dewitt, DPT
Director of Physical Therapy Sports &
Orthopaedic Residencies
The Ohio State University
Columbus, OH
john.dewitt@osumc.edu

Amanda Ferland, DPT
Clinical Faculty
Intech Rehabilitation Group / USC Division of
Biokinesiology and Physical Therapy
Orthopaedic Physical Therapy Residency and
Spine Rehabilitation Fellowship
Beijing, China
AmandaFerland@incarehab.com

Helene Fearon, PT
Arizona Physical Therapy Specialists
Phoenix, AZ
hfearon123@mac.com

Elizabeth Hammond, MD
Liz.hammond@hotmail.com

Marcie Harris-Hayes, PT, PhD
Associate Professor
Physical Therapy and Orthopaedic Surgery
Washington University School of Medicine
harrisma@wustl.edu

Sandra Kaplan, PT, PhD
Clinical Practice Guidelines Coordinator
Pediatric Section, APTA
and
Professor, Doctoral Programs in Physical
Therapy
Rutgers University

Department of Orthopaedic Surgery
Geisel School of Medicine at Dartmouth
Dartmouth-Hitchcock Medical Center
Lebanon, NH
and
Research Assistant Professor
Health & Disability Research Institute
Boston University School of Public
Health
Boston, MA
cmm@bu.edu

kaplansa@shrp.rutgers.edu

Heather Stone Keelty, DPT
Director of Professional Development
San Francisco Sport and Spine Physical
Therapy
San Francisco, CA
hstone2@gmail.com

David Killoran, PhD
Patient/Consumer Representative for the
ICF-based Clinical Practice Guidelines
Orthopaedic Section, APTA Inc.
La Crosse, WI
and
Professor Emeritus
Loyola Marymount University
Los Angeles, CA
david.killoran@lmu.edu

Kathleen Kline Mangione, PT, PhD
Professor
Department of Physical Therapy
Arcadia University
Glenside, PA
and
Associate Fellow
Institute of Aging
University of Pennsylvania
Philadelphia, PA
mangionk@arcadia.edu

Leslie Torburn, DPT
Principal and Consultant
Silhouette Consulting, Inc.
Sacramento, CA
torburn@yahoo.com

Doug White, DPT
Milton Orthopaedic & Sports Physical
Therapy, PC
Milton, MA
dr.white@miltonortho.com

Guidelines Editors

Christine M. McDonough, PT, PhD
ICF-based Clinical Practice Guidelines Editor
Orthopaedic Section, APTA Inc.
La Crosse, WI
and
Adjunct Clinical Assistant Professor
Department of Orthopaedic Surgery
Geisel School of Medicine at Dartmouth
Dartmouth-Hitchcock Medical Center
Lebanon, NH
and
Research Assistant Professor
Health & Disability Research Institute
Boston University School of Public Health
Boston, MA
cmm@bu.edu

Joseph J. Godges, DPT, MA
ICF-based Clinical Practice Guidelines Editor
Orthopaedic Section, APTA Inc.
La Crosse, WI
and
Adjunct Associate Professor of Clinical
Physical Therapy
Division of Biokinesiology and Physical
Therapy
University of Southern California
Los Angeles, CA
godges@usc.edu

Acknowledgements: The authors would like to acknowledge the contributions of Dartmouth Biomedical Libraries Research and Education Librarians, Heather Blunt and Pamela Bagley, for their guidance and assistance in the design and implementation of the literature search.

References:

1. Abbott JH, Robertson MC, Chapple C, et al. Manual therapy, exercise therapy, or both, in addition to usual care, for osteoarthritis of the hip or knee: a randomized controlled trial. 1: clinical effectiveness. *Osteoarthritis Cartilage*. 2013;21:525-534.
2. Ageberg E, Link A, Roos EM. Feasibility of neuromuscular training in patients with severe hip or knee OA: the individualized goal-based NEMEX-TJR training program. *BMC Musculoskelet Disord*. 2010;11:126.
3. Aranda-Villalobos P, Fernandez-de-Las-Penas C, Navarro-Espigares JL, et al. Normalization of widespread pressure pain hypersensitivity after total hip replacement in patients with hip osteoarthritis is associated with clinical and functional improvements. *Arthritis Rheum*. 2013;65:1262-1270.
4. Arendt-Nielsen L, Graven-Nielsen T. Translational musculoskeletal pain research. *Best Pract Res Clin Rheumatol*. 2011;25:209-226.
5. Arnold CM, Faulkner RA. Does falls-efficacy predict balance performance in older adults with hip osteoarthritis? *J Gerontol Nurs*. 2009;35:45-52.
6. Avin KG, Hanke TA, Kirk-Sanchez N, et al. Management of falls in community-dwelling older adults: clinical guidance statement from the Academy of Geriatric Physical Therapy of the American Physical Therapy Association. *Physical therapy*. 2015;95:815-834.
7. Bennell KL, Egerton T, Martin J, et al. Effect of physical therapy on pain and function in patients with hip osteoarthritis: a randomized clinical trial. *Jama*. 2014;311:1987-1997.
8. Beselga C, Neto F, Albuquerque-Sendin F, Hall T, Oliveira-Campelo N. Immediate effects of hip mobilization with movement in patients with hip osteoarthritis: A randomised controlled trial. *Man Ther*. 2016;22:80-85.
9. Bieler T, Magnusson SP, Kjaer M, Beyer N. Intra-rater reliability and agreement of muscle strength, power and functional performance measures in patients with hip osteoarthritis. *J Rehabil Med*. 2014;46:997-1005.
10. Bossen D, Veenhof C, Van Beek KE, Spreeuwenberg PM, Dekker J, De Bakker DH. Effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis: randomized controlled trial. *J Med Internet Res*. 2013;15:e257.
11. Brantingham JW, Bonnefin D, Perle SM, et al. Manipulative therapy for lower extremity conditions: update of a literature review. *J Manipulative Physiol Ther*. 2012;35:127-166.
12. Brantingham JW, Globe GA, Cassa TK, et al. A single-group pretest posttest design using full kinetic chain manipulative therapy with rehabilitation in the treatment of 18 patients with hip osteoarthritis. *J Manipulative Physiol Ther*. 2010;33:445-457.
13. Brantingham JW, Parkin-Smith G, Cassa TK, et al. Full kinetic chain manual and manipulative therapy plus exercise compared with targeted manual and manipulative therapy plus exercise for symptomatic osteoarthritis of the hip: a randomized controlled trial. *Arch Phys Med Rehabil*. 2012;93:259-267.

14. Castaneda P, Ponce C, Villareal G, Vidal C. The natural history of osteoarthritis after a slipped capital femoral epiphysis/the pistol grip deformity. *Journal of pediatric orthopedics*. 2013;33 Suppl 1:S76-82.
15. Chesterton LS, Sim J, Wright CC, Foster NE. Interrater reliability of algometry in measuring pressure pain thresholds in healthy humans, using multiple raters. *Clin J Pain*. 2007;23:760-766.
16. Choi YM, Dobson F, Martin J, Bennell KL, Hinman RS. Interrater and intrarater reliability of common clinical standing balance tests for people with hip osteoarthritis. *Physical therapy*. 2014;94:696-704.
17. Cibulka MT, White DM, Woehrle J, et al. Hip pain and mobility deficits--hip osteoarthritis: clinical practice guidelines linked to the international classification of functioning, disability, and health from the orthopaedic section of the American Physical Therapy Association. *J Orthop Sports Phys Ther*. 2009;39:A1-25.
18. Cleveland RJ, Schwartz TA, Prizer LP, et al. Associations of educational attainment, occupation, and community poverty with hip osteoarthritis. *Arthritis Care Res (Hoboken)*. 2013;65:954-961.
19. Cross M, Smith E, Hoy D, et al. The global burden of hip and knee osteoarthritis: estimates from the global burden of disease 2010 study. *Ann Rheum Dis*. 2014;73:1323-1330.
20. Davis AM, Perruccio AV, Canizares M, et al. The development of a short measure of physical function for hip OA HOOS-Physical Function Shortform (HOOS-PS): an OARSI/OMERACT initiative. *Osteoarthritis Cartilage*. 2008;16:551-559.
21. EMHM V, HJM H, ME VB, et al. Clinical Practice Guidelines for Physical Therapy in Patients with Osteoarthritis of the Hip or Knee. *Amersfoort; KNGF*. 2001;
22. Fernandes L, Storheim K, Sandvik L, Nordstletten L, Risberg MA. Efficacy of patient education and supervised exercise vs patient education alone in patients with hip osteoarthritis: a single blind randomized clinical trial. *Osteoarthritis Cartilage*. 2010;18:1237-1243.
23. Fischer AA. Algometry in the daily practice of pain management. *J Back Musculoskelet Rehabil*. 1997;8:151-163.
24. French HP, Cusack T, Brennan A, et al. Exercise and manual physiotherapy arthritis research trial (EMPART) for osteoarthritis of the hip: a multicenter randomized controlled trial. *Arch Phys Med Rehabil*. 2013;94:302-314.
25. Fukumoto Y, Tateuchi H, Ikezoe T, et al. Effects of high-velocity resistance training on muscle function, muscle properties, and physical performance in individuals with hip osteoarthritis: a randomized controlled trial. *Clin Rehabil*. 2014;28:48-58.
26. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. *Clinical orthopaedics and related research*. 2003;112-120.
27. Hando BR, Gill NW, Walker MJ, Garber M. Short- and long-term clinical outcomes following a standardized protocol of orthopedic manual physical

- therapy and exercise in individuals with osteoarthritis of the hip: a case series. *J Man Manip Ther.* 2012;20:192-200.
28. Hardcastle SA, Dieppe P, Gregson CL, et al. Osteophytes, enthesophytes, and high bone mass: a bone-forming triad with potential relevance in osteoarthritis. *Arthritis Rheumatol.* 2014;66:2429-2439.
 29. Hardcastle SA, Dieppe P, Gregson CL, et al. Prevalence of radiographic hip osteoarthritis is increased in high bone mass. *Osteoarthritis Cartilage.* 2014;22:1120-1128.
 30. Hawker GA, Davis AM, French MR, et al. Development and preliminary psychometric testing of a new OA pain measure--an OARSI/OMERACT initiative. *Osteoarthritis Cartilage.* 2008;16:409-414.
 31. Holla JF, Steultjens MP, van der Leeden M, et al. Determinants of range of joint motion in patients with early symptomatic osteoarthritis of the hip and/or knee: an exploratory study in the CHECK cohort. *Osteoarthritis Cartilage.* 2011;19:411-419.
 32. International Classification of Functioning DaHI. World Health Organization. Geneva, Switzerland: 2001.
 33. Ipach I, Mittag F, Walter C, Syha R, Wolf P, Kluba T. The prevalence of acetabular anomalies associated with pistol-grip-deformity in osteoarthritic hips. *Orthopaedics & traumatology, surgery & research : OTSR.* 2013;99:37-45.
 34. Jiang L, Rong J, Wang Y, et al. The relationship between body mass index and hip osteoarthritis: a systematic review and meta-analysis. *Joint Bone Spine.* 2011;78:150-155.
 35. Jigami H, Sato D, Tsubaki A, et al. Effects of weekly and fortnightly therapeutic exercise on physical function and health-related quality of life in individuals with hip osteoarthritis. *J Orthop Sci.* 2012;17:737-744.
 36. Juhakoski R, Tenhonen S, Malmivaara A, Kiviniemi V, Anttonen T, Arokoski JP. A pragmatic randomized controlled study of the effectiveness and cost consequences of exercise therapy in hip osteoarthritis. *Clin Rehabil.* 2011;25:370-383.
 37. Kakaty DK, Fischer AF, Hosalkar HS, Siebenrock KA, Tannast M. The ischial spine sign: does pelvic tilt and rotation matter? *Clinical orthopaedics and related research.* 2010;468:769-774.
 38. Kapstad H, Hanestad BR, Langeland N, Rustoen T, Stavem K. Cutpoints for mild, moderate and severe pain in patients with osteoarthritis of the hip or knee ready for joint replacement surgery. *BMC Musculoskelet Disord.* 2008;9:55.
 39. Kapstad H, Rokne B, Stavem K. Psychometric properties of the Brief Pain Inventory among patients with osteoarthritis undergoing total hip replacement surgery. *Health Qual Life Outcomes.* 2010;8:148.
 40. Kim C, Linsenmeyer KD, Vlad SC, et al. Prevalence of radiographic and symptomatic hip osteoarthritis in an urban United States community: the Framingham osteoarthritis study. *Arthritis Rheumatol.* 2014;66:3013-3017.
 41. Kim C, Nevitt MC, Niu J, et al. Association of hip pain with radiographic evidence of hip osteoarthritis: diagnostic test study. *BMJ.* 2015;351:h5983.
 42. Kinser AM, Sands WA, Stone MH. Reliability and validity of a pressure algometer. *J Strength Cond Res.* 2009;23:312-314.

43. Kiyama T, Naito M, Shiramizu K, Shinoda T. Postoperative acetabular retroversion causes posterior osteoarthritis of the hip. *International orthopaedics*. 2009;33:625-631.
44. Kowalczyk M, Yeung M, Simunovic N, et al. Does Femoroacetabular Impingement Contribute to the Development of Hip Osteoarthritis? A Systematic Review. *Sports Med Arthrosc*. 2015;23:174-179.
45. Koybasi M, Borman P, Kocaoglu S, Ceceli E. The effect of additional therapeutic ultrasound in patients with primary hip osteoarthritis: a randomized placebo-controlled study. *Clin Rheumatol*. 2010;29:1387-1394.
46. Leunig M, Casillas MM, Hamlet M, et al. Slipped capital femoral epiphysis: early mechanical damage to the acetabular cartilage by a prominent femoral metaphysis. *Acta orthopaedica Scandinavica*. 2000;71:370-375.
47. Leunig M, Ganz R. [Femoroacetabular impingement. A common cause of hip complaints leading to arthrosis]. *Unfallchirurg*. 2005;108:9-10, 12-17.
48. Maquet D, Croisier JL, Demoulin C, Crielaard JM. Pressure pain thresholds of tender point sites in patients with fibromyalgia and in healthy controls. *Eur J Pain*. 2004;8:111-117.
49. Nilsdotter AK, Lohmander LS, Klassbo M, Roos EM. Hip disability and osteoarthritis outcome score (HOOS)--validity and responsiveness in total hip replacement. *BMC Musculoskelet Disord*. 2003;4:10.
50. Paans N, van den Akker-Scheek I, Dilling RG, et al. Effect of exercise and weight loss in people who have hip osteoarthritis and are overweight or obese: a prospective cohort study. *Physical therapy*. 2013;93:137-146.
51. Peter WF, Jansen MJ, Hurkmans EJ, et al. Physiotherapy in hip and knee osteoarthritis: development of a practice guideline concerning initial assessment, treatment and evaluation. *Acta Reumatol Port*. 2011;36:268-281.
52. Phillips B, Ball C, Sackett D, et al. Levels of Evidence. Available at: <http://www.cebm.net/index.aspx?o=4590>. Accessed August 4, 2009.
53. Pinto D, Robertson MC, Abbott JH, Hansen P, Campbell AJ. Manual therapy, exercise therapy, or both, in addition to usual care, for osteoarthritis of the hip or knee. 2: economic evaluation alongside a randomized controlled trial. *Osteoarthritis Cartilage*. 2013;21:1504-1513.
54. Pisters MF, Veenhof C, Schellevis FG, De Bakker DH, Dekker J. Long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a randomized controlled trial comparing two different physical therapy interventions. *Osteoarthritis Cartilage*. 2010;18:1019-1026.
55. Pollard TC, Batra RN, Judge A, et al. The hereditary predisposition to hip osteoarthritis and its association with abnormal joint morphology. *Osteoarthritis Cartilage*. 2013;21:314-321.
56. Pollard TC, Villar RN, Norton MR, et al. Genetic influences in the aetiology of femoroacetabular impingement: a sibling study. *The Journal of bone and joint surgery. British volume*. 2010;92:209-216.
57. Poulsen E, Hartvigsen J, Christensen HW, Roos EM, Vach W, Overgaard S. Patient education with or without manual therapy compared to a control group in patients with osteoarthritis of the hip. A proof-of-principle three-arm parallel group randomized clinical trial. *Osteoarthritis Cartilage*. 2013;21:1494-1503.

58. Pua YH, Wrigley TV, Cowan SM, Bennell KL. Intrarater test-retest reliability of hip range of motion and hip muscle strength measurements in persons with hip osteoarthritis. *Arch Phys Med Rehabil.* 2008;89:1146-1154.
59. Rothenfluh DA, Reedwisch D, Muller U, Ganz R, Tennant A, Leunig M. Construct validity of a 12-item WOMAC for assessment of femoro-acetabular impingement and osteoarthritis of the hip. *Osteoarthritis Cartilage.* 2008;16:1032-1038.
60. Rozendaal RM, Koes BW, van Osch GJ, et al. Effect of glucosamine sulfate on hip osteoarthritis: a randomized trial. *Ann Intern Med.* 2008;148:268-277.
61. Rozendaal RM, Uitterlinden EJ, van Osch GJ, et al. Effect of glucosamine sulphate on joint space narrowing, pain and function in patients with hip osteoarthritis; subgroup analyses of a randomized controlled trial. *Osteoarthritis Cartilage.* 2009;17:427-432.
62. Sato E, Sato T, Yamaji T, Watanabe H. Effect of the WISH-type hip brace on functional mobility in patients with osteoarthritis of the hip: evaluation using the Timed Up & Go Test. *Prosthet Orthot Int.* 2012;36:25-32.
63. Singh JA, Luo R, Landon GC, Suarez-Almazor M. Reliability and clinically important improvement thresholds for osteoarthritis pain and function scales: a multicenter study. *J Rheumatol.* 2014;41:509-515.
64. Suokas AK, Walsh DA, McWilliams DF, et al. Quantitative sensory testing in painful osteoarthritis: a systematic review and meta-analysis. *Osteoarthritis Cartilage.* 2012;20:1075-1085.
65. Svege I, Nordsletten L, Fernandes L, Risberg MA. Exercise therapy may postpone total hip replacement surgery in patients with hip osteoarthritis: a long-term follow-up of a randomised trial. *Ann Rheum Dis.* 2013;
66. Tannast M, Pfannebecker P, Schwab JM, Albers CE, Siebenrock KA, Buchler L. Pelvic morphology differs in rotation and obliquity between developmental dysplasia of the hip and retroversion. *Clinical orthopaedics and related research.* 2012;470:3297-3305.
67. Tanzer M, Noiseux N. Osseous abnormalities and early osteoarthritis: the role of hip impingement. *Clinical orthopaedics and related research.* 2004;170-177.
68. Teichtahl AJ, Wang Y, Smith S, et al. Structural changes of hip osteoarthritis using magnetic resonance imaging. *Arthritis Res Ther.* 2014;16:466.
69. Thorborg K, Roos EM, Bartels EM, Petersen J, Holmich P. Validity, reliability and responsiveness of patient-reported outcome questionnaires when assessing hip and groin disability: a systematic review. *Br J Sports Med.* 2010;44:1186-1196.
70. Villadsen A, Overgaard S, Holsgaard-Larsen A, Christensen R, Roos EM. Immediate efficacy of neuromuscular exercise in patients with severe osteoarthritis of the hip or knee: a secondary analysis from a randomized controlled trial. *J Rheumatol.* 2014;41:1385-1394.
71. Voorn VM, Vermeulen HM, Nelissen RG, et al. An innovative care model coordinated by a physical therapist and nurse practitioner for osteoarthritis of the hip and knee in specialist care: a prospective study. *Rheumatol Int.* 2013;33:1821-1828.

72. Wandel S, Juni P, Tendal B, et al. Effects of glucosamine, chondroitin, or placebo in patients with osteoarthritis of hip or knee: network meta-analysis. *BMJ*. 2010;341:c4675.
74. Wylde V, Sayers A, Lenguerrand E, et al. Preoperative widespread pain sensitization and chronic pain after hip and knee replacement: a cohort analysis. *Pain*. 2015;156:47-54.
75. Wyles CC, Heidenreich MJ, Jeng J, Larson DR, Trousdale RT, Sierra RJ. The John Charnley Award: Redefining the Natural History of Osteoarthritis in Patients With Hip Dysplasia and Impingement. *Clinical orthopaedics and related research*. 2016;
76. Zhang JF, Song LH, Wei JN, et al. Prevalence of and risk factors for the occurrence of symptomatic osteoarthritis in rural regions of Shanxi Province, China. *Int J Rheum Dis*. 2014;

DRAFT

APPENDIX A: SEARCH STRATEGIES FOR ALL DATABASES SEARCHED

Assessment

PubMed

((Questionnaires [mesh]) OR (womac[tiab] OR hoos[tiab] OR mactar[tiab] OR lish[tiab] OR oakhqol[tiab] OR “walk test”[tiab] OR “stair measure”[tiab] OR “timed up and go”[tiab] OR “lower extremity functional scale”[tiab] OR lefs[tiab] OR “harris hip score”[tiab] OR “faber test”[tiab] OR “scour test”[tiab] OR “sit to stand test”[tiab] OR “step test”[tiab] OR “stance test”[tiab] OR “stair climb”[tiab] OR “performance-based”[tiab] OR Questionnaire [tiab] OR Questionnaires[tiab] OR Instrument[tiab] OR Instruments[tiab] OR Scale[tiab] OR Scales[tiab] OR Measurement[tiab] OR Measurements[tiab] OR Index[tiab] OR Indices[tiab] OR Score[tiab] OR Scores[tiab])

((diagnosis[sh] OR "Diagnosis"[Mesh])) OR (radiograph*[tiab] OR radiologic*[tiab] OR diagnos*[tiab] OR misdiagnos*[tiab] OR ultrasonography[tiab] OR sonography[tiab] OR ultrasound*[tiab] OR sonogram*[tiab] OR CT[tiab] OR tomography[tiab] OR xray[tiab] OR x-ray[tiab] OR mri[tiab] OR imaging[tiab] OR examination[tiab] OR exam[tiab] OR evaluat*[tiab] OR classific*[tiab] OR specificity[tiab] OR kellgren*[tiab] OR mankin[tiab])

(“osteoarthritis, hip”[mesh]) OR ((hip[mesh] OR “hip joint”[mesh] OR hip[tiab] OR hips[tiab]) AND (osteoarthritis[mesh:noexp] OR osteoarthr*[tiab])

Cochrane

((CT or radiograph* or radiologic* or diagnos* or misdiagnos* or ultrasonography or sonography or ultrasound* or sonogram* or tomography or xray or x-ray or mri or imaging or examination or exam or evaluat* or classific* or specificity or kellgren* or mankin:womac or hoos or mactar or lish or oakhqol or "walk test" or "stair measure" or "timed up and go" or "lower extremity functional scale" or lefs or "harris hip score" or "faber test" or "scour test" or "sit to stand test" or "step test" or "stance test" or "stair climb" or "performance-based" or Questionnaire or Questionnaires or Instrument or Instruments or Scale or Scales or Measurement or Measurements or Index or Indices or Score Scores)

CINAHL

((womac OR hoos OR mactar OR lish OR oakhqol OR “walk test” OR “stair measure ”OR“ timed up and go ”OR“ lower extremity functional scale ”OR lefs OR “harris hip score”OR“faber test”OR“scour test”OR“sit to stand test”OR“step test ”OR“ stance test”OR“stair climb”OR“performance-based”OR Questionnaire OR Questionnaires OR Instrument OR Instruments OR Scale OR Scales OR Measurement OR Measurements OR Index OR Indices OR Score Scores) ORAB (womac OR hoos OR mactar OR lish OR oakhqol OR“walk test”OR“stair measure”OR“timed up and go”OR“lower extremity functional scale”OR lefs OR“harris hip score”OR“faber test”OR“scour test”OR“ sit to stand test” OR “step test”OR“stance test” OR “stair climb” OR “performance-based”OR Questionnaire OR Questionnaires OR Instrument

OR Instruments OR Scale OR Scales OR Measurement OR Measurements OR Index OR Indices OR Score Scores

T1(radiograph* OR radiologic* OR diagnos* OR misdiagnos* OR ultrasonography OR sonography OR ultrasound* OR sonogram* OR tomography OR xray OR x-ray OR mri OR imaging OR examination OR exam OR evaluat* OR classific* OR specificity OR kellgren* OR mankin) OR AB (radiograph* OR radiologic* OR diagnos* OR misdiagnos* OR ultrasonography OR sonography OR ultrasound* OR sonogram* OR tomography OR xray OR x-ray OR mri OR imaging OR examination OR exam OR evaluat* OR classific* OR specificity OR kellgren* OR mankin)

Intervention

PubMed

Search ((Combined Modality Therapy[mesh] OR Electric Stimulation Therapy[mesh] OR Electric Stimulation[mesh] OR Transcutaneous Electric Nerve Stimulation[mesh] OR Traction[mesh] OR Laser Therapy[mesh] OR Rehabilitation[mesh] OR rehabilitation[sh] OR Phototherapy[mesh] OR Lasers[mesh] OR Physical Therapy Modalities[mesh] OR Cryotherapy[mesh] OR Cryoanesthesia[mesh] OR Ice[mesh] OR Acupuncture Therapy[mesh] OR Acupuncture[mesh] OR modalit*[tiab] OR "electric stimulation"[tiab] OR "electrical stimulation"[tiab] OR electrotherapy[tiab] OR tens[tiab] OR "transcutaneous electric nerve stimulation"[tiab] OR electroacupuncture[tiab] OR acupuncture[tiab] OR needling[tiab] OR heat[tiab] OR cold[tiab] OR traction[tiab] OR laser[tiab] OR lasers[tiab] OR rehabilitation[tiab] OR "physical therapy"[tiab] OR "physical therapies"[tiab] OR physiotherap*[tiab] OR cryotherapy[tiab] OR hyperthermia[tiab] OR "vapocoolant spray"[tiab] OR cryoanesthesia[tiab] OR ice[tiab] OR faradic[tiab] OR traction[tiab] OR iontophoresis[tiab] OR phonophoresis[tiab] OR phototherapy[tiab] OR hydrotherapy[tiab] OR "light therapy"[tiab] OR diathermy[tiab] OR ultraviolet[tiab] OR infrared[tiab]))

Search (("Exercise Therapy"[Mesh] OR Exercise[mesh] OR "Self-Help Devices"[Mesh] OR "education" [Subheading] OR "Patient Education as Topic"[Mesh] OR crutches[Mesh] OR Canes[Mesh] OR Walkers[Mesh] OR "orthotic devices"[mesh] OR therapy[sh:noexp])) OR (exercis*[tiab] OR massag*[tiab] OR "manual therapy"[tiab] OR accupressure[tiab] OR manipul*[tiab] OR "applied kinesiology"[tiab] OR stretching[tiab] OR stretch[tiab] OR stretches[tiab] OR "continuous passive movement"[tiab] OR "continuous passive motion"[tiab] OR plyometric[tiab] OR plyometrics[tiab] OR "resistance training"[tiab] OR "strength training"[tiab] OR strengthening[tiab] OR "weight-bearing"[tiab] OR weightbearing[tiab] OR "weight-lifting"[tiab] OR weightlifting[tiab] OR "physical conditioning"[tiab] OR education[tiab] OR balneotherapy[tiab] OR "aquatic therapy"[tiab] OR "pool therapy"[tiab] OR "water aerobics"[tiab] OR "water running"[tiab] OR "water training"[tiab] OR "gait aids"[tiab] OR "gait aid"[tiab] OR "gait training"[tiab] OR crutches[tiab] OR walker[tiab] OR walkers[tiab] OR cane[tiab] OR canes[tiab] OR orthotic*[tiab] OR orthoses[tiab] OR orthosis[tiab] OR "activity modification"[tiab] OR "balance training"[tiab] OR "functional training"[tiab] OR "assistive devices"[tiab] OR "assistive device"[tiab] OR mobilization[tiab] OR mobilisation[tiab] OR "flexibility training"[tiab] OR "endurance

training"[tiab] OR "proprioceptive neuromuscular facilitation"[tiab] OR "manual resistance"[tiab] OR "aerobic activity"[tiab]

("osteoarthritis, hip"[mesh]) OR ((hip[mesh] OR "hip joint"[mesh] OR hip[tiab] OR hips[tiab]) AND (osteoarthritis[mesh:noexp] OR osteoarthr*[tiab]))

Cochrane

((hip or hips) and osteoarthr*modalit* or "electric stimulation" or "electrical stimulation" or electrotherapy or tens or "transcutaneous electric nerve stimulation" or electroacupuncture or acupuncture or needling or heat or cold or traction or laser or lasers or rehabilitation or "physical therapy" or "physical therapies" or physiotherap* or cryotherapy or hyperthermia or "vapocoolant spray" or cryoanesthesia or ice or faradic or traction or iontophoresis or phonophoresis or phototherapy or hydrotherapy or "light therapy" or diathermy or ultraviolet or infrared; exercis* or massag* or "manual therapy" or accupressure or manipul* or "applied kinesiology" or stretching or stretch or stretches or "continuous passive movement" or "continuous passive motion" or plyometric or plyometrics or "resistance training" or "strength training" or strengthening or "weight-bearing" or weightbearing or "weight-lifting" or weightlifting or "physical conditioning" or education or balneotherapy or "aquatic therapy" or "pool therapy" or "water aerobics" or "water running" or "water training" or "gait aids" or "gait aid" or "gait training" or crutches or walker or walkers or cane or canes or orthotic* or orthoses or orthosis or "activity modification" or "balance training" or "functional training" or "assistive devices" or "assistive device" or mobilization or mobilisation or "flexibility training" or "endurance training" or "proprioceptive neuromuscular facilitation" or "manual resistance" or "aerobic activity":ti,ab,kw)

CINAHL

((MH Exercise+ OR MH Assistive Technology Devices+ OR MW ED OR MH "Patient Education+ OR MH orthoses + OR MW TH) OR TI (exercise * OR massage* OR manual therapy OR accupressure OR manipul* OR applied kinesiology OR stretching OR stretch OR stretches OR "continuous passive movement" OR "continuous passive motion" OR plyometric OR plyometrics OR resistance training OR strength training OR strengthening OR weight-bearing OR weightbearing OR weight-lifting OR weightlifting OR physical conditioning OR education OR balneotherapy OR aquatic therapy OR pool therapy OR water aerobics OR water running OR water training OR gait aids OR gait aide OR gait training OR crutches OR walker OR walkers OR cane OR canes OR orthotic* OR orthoses OR orthosis OR activity modification OR balance training OR functional training OR assistive devices OR assistive device OR mobilization OR mobilisation OR flexibility training OR endurance training OR proprioceptive neuromuscular facilitation OR manual resistance OR aerobic activity) OR AB (exercise * OR massage * OR manual therapy OR accupressure OR manipulate * OR applied kinesiology OR stretching OR stretch OR stretches OR "continuous passive movement" OR "continuous passive motion" OR plyometric OR plyometrics OR resistance training OR strength training OR strengthening OR weight-bearing OR weightbearing OR weight-lifting OR weightlifting OR physical conditioning OR education OR balneotherapy OR aquatic therapy OR pool therapy OR water aerobics OR water running

OR water training OR gait aids OR gait aid OR gait training OR crutches OR Search modes - walker OR walkers OR cane OR canes OR orthotic* OR orthoses OR orthosis OR activity modification OR balance training OR functional training OR assistive devices OR assistive device OR mobilization OR mobilisation OR flexibility training OR endurance training OR proprioceptive neuromuscular facilitation OR manual resistance OR aerobic activity))

(MH "Combined Modality Therapy" OR MH Physical Therapy + OR MH Rehabilitation OR MW RH OR MH Traction OR MH Laser Therapy OR MH Ice OR MH Acupuncture+ OR MH Acupressure) OR TI (modalities * OR "electric stimulation" OR "electrical stimulation" OR electrotherapy OR tens OR "transcutaneous electric nerve stimulation" OR electroacupuncture OR acupuncture OR needling OR heat OR cold OR traction OR laser OR lasers OR rehabilitation OR "physical therapy" OR Physical therapies OR physiotherap* OR cryotherapy OR hyperthermia OR "vapocoolant spray" OR cryoanesthesia OR ice OR faradic OR traction OR iontophoresis OR phonophoresis OR phototherapy OR hydrotherapy OR "light therapy" OR diathermy OR ultraviolet OR infrared) OR AB (modalit * OR "electric stimulation" OR "electrical stimulation" OR electrotherapy OR tens OR "transcutaneous electric nerve stimulation" OR electroacupuncture OR acupuncture OR needling OR heat OR cold OR traction OR laser OR lasers OR rehabilitation OR "physical therapy" OR physical therapies OR physiotherap* OR cryotherapy OR hyperthermia OR "vapocoolant spray" OR cryoanesthesia OR ice OR faradic OR traction OR iontophoresis OR phonophoresis OR phototherapy OR hydrotherapy OR "light therapy" OR diathermy OR ultraviolet OR infrared)

Appendix B: Search Results

Assessment Database	Platform	Years covered	Date conducted	# results
Medline	PubMed	2008 - current	8-4-14	3464
Medline	PubMed	7-14-current	4-8-16	100
CINAHL	EBSCO	2008-7-14	8-4-14	183
CINAHL	ESSCO	7-14-current	4-8-16	47
Cochrane	Wiley	Issue #, etc Current as of August 4, 2014	8-4-14	412
Cochrane	Wiley	2014-current Issue # Month dsr - 4(April 16) dare - 2(Apr 15) trials - 3(Mar 16) tech - 1(Jan 16)	4-8-16	258 dsr-13 other-2 trials-242 tech -1
Pedro		2008-current	8-4-14	83
			4-8-16	29
Total			8-4-14	4142
Total			4-8-16	1734
With dupes removed			8-4-14	3691
With dupes removed			4-8-16	1589

Intervention Database	Platform	Years covered	Date conducted	# results
Medline	PubMed	2008 - 7-14-14	7-14-14	1057
Medline	PubMed	7-14-current	3-11-16	431
CINAHL	EBSCO	2008-	7-1-14	445
CINAHL	ESSCo	2014-current	3-11-16	131
Cochrane	Wiley	Issue #, etc dsr - 7/12 dare - 2/4 trials - 6/12 econ - 2/4	7-14-14	132 dsr - 13 dare - 14 trials - 171 econ eval -6
Cochrane	Wiley	Issue # Month dsr - 3(March 2016) dare - 2(April 2015) trials - 2(Feb 2016) tech- 1(Jan 2016)	3-11-16	132 dsr-8 dare-3 trials-120 tech-1
Pedro		2008-current	7-15-14	81
Pedro			3-11-16	27
Total			7-15-14	1706
Total			3-11-16	721
With dupes removed			7-15-14	1297
With dupes removed			3-11-16	579

Appendix C

ARTICLE INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria

We included articles providing evidence of the following types:

Systematic reviews meta-analysis, experimental, cohort, and cross-sectional studies reporting on:

- Must have diagnostic hip osteoarthritis with either radiographic or clinical confirmation (using established criteria such as the ACR criteria)

AND

- Have at least a sample size of 15 or greater

AND

- If the study included both hip and knee osteoarthritis the results must be reported separately

OR

- Tests and measures for diagnosis and/or differential diagnosis of hip osteoarthritis within the scope of physical therapy practice (including but not limited to lumbar spine, sacroiliac joint, hernia, and cancer).

OR

- Tests and methods for diagnosis and/or differential diagnosis of hip osteoarthritis using imaging (including but not limited to ultrasound, plain film radiography, and MRI).

OR

- Measurement properties of tests and measures specific to hip osteoarthritis – related symptoms and outcomes (WOMAC, Harris Hip Scale, HOOS, LISH, OAKHQOL, AAOS, Hip and knee scale, lower limb core scale, VAS, LEFS, SF-36, WHO, QOL)

OR

- Measurement properties of tests/measurements using data from a sample of patients with hip osteoarthritis including active and passive range of motion, pain, manual muscle tests, muscle length measures, and special tests including but not limited to the Faber, FADIR, FAIR, Log Roll, and Scour.

OR

- Measurement properties of tests and measures specific to hip osteoarthritis – related functions, activity and participation (including but not limited to the 6-minute walk test, self paced walk test, stair measure, Timed up and go test, Berg balance, 5 times sit to stand test, Functional gait, 10 meter walk test, and Euro QOL)

AND

- Interventions within the scope of the practice of physical therapy including coordination training, functional training, gait training, balance training, modalities (including but not limited to heat, electrical stimulation, ultrasound, diathermy), manual therapy (including but not limited to manipulation, joint mobilization, soft tissue mobilization, massage) exercise (including but not limited to stretching/flexibility, proprioceptive neuromuscular facilitation, manual resistance, resistance/strength training, aerobic and endurance activities, community based and self-management programs) assistive devices, and education.

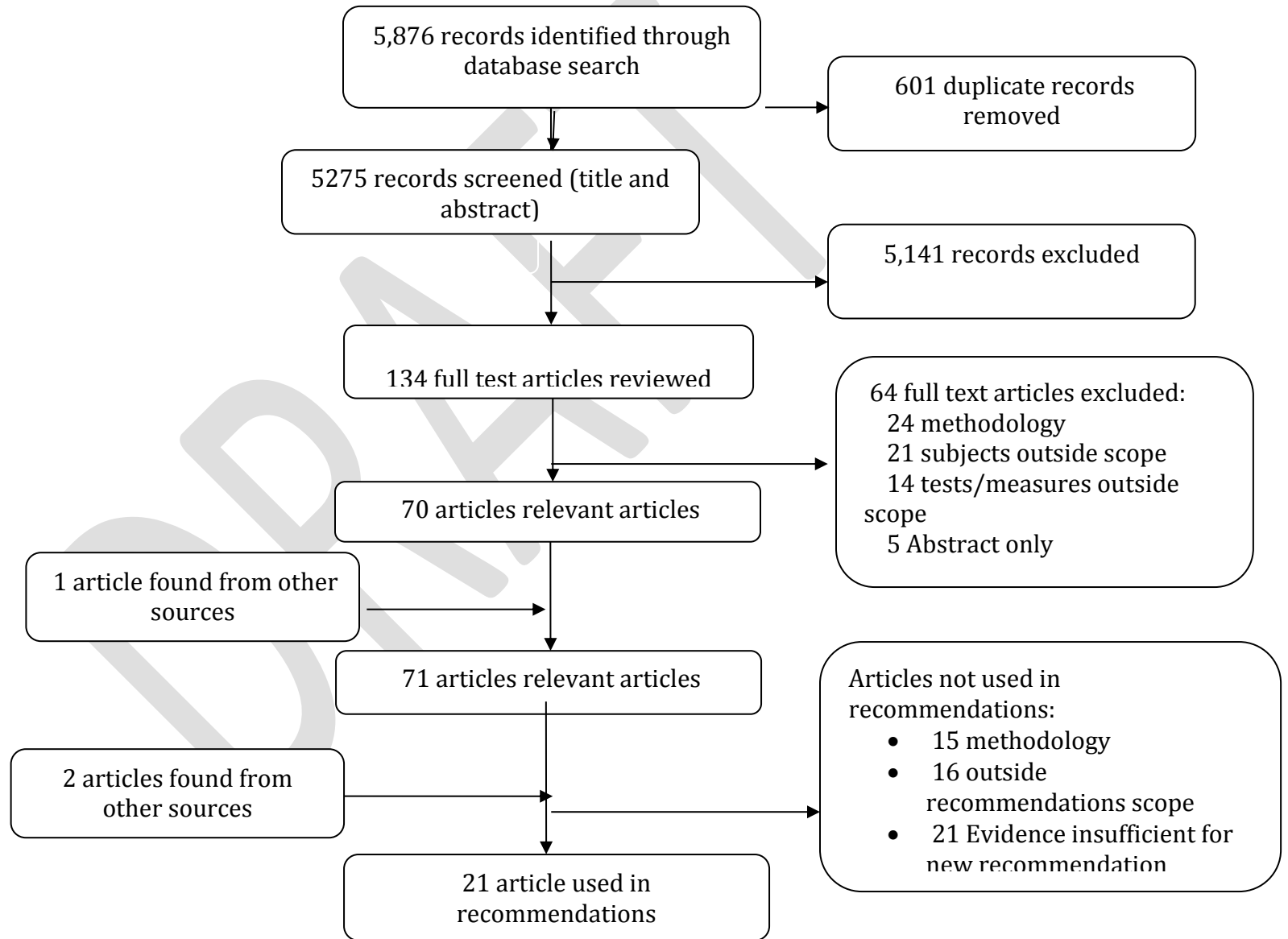
Exclusion Criteria

We excluded abstracts, press reports, editorial letters and articles reporting on:

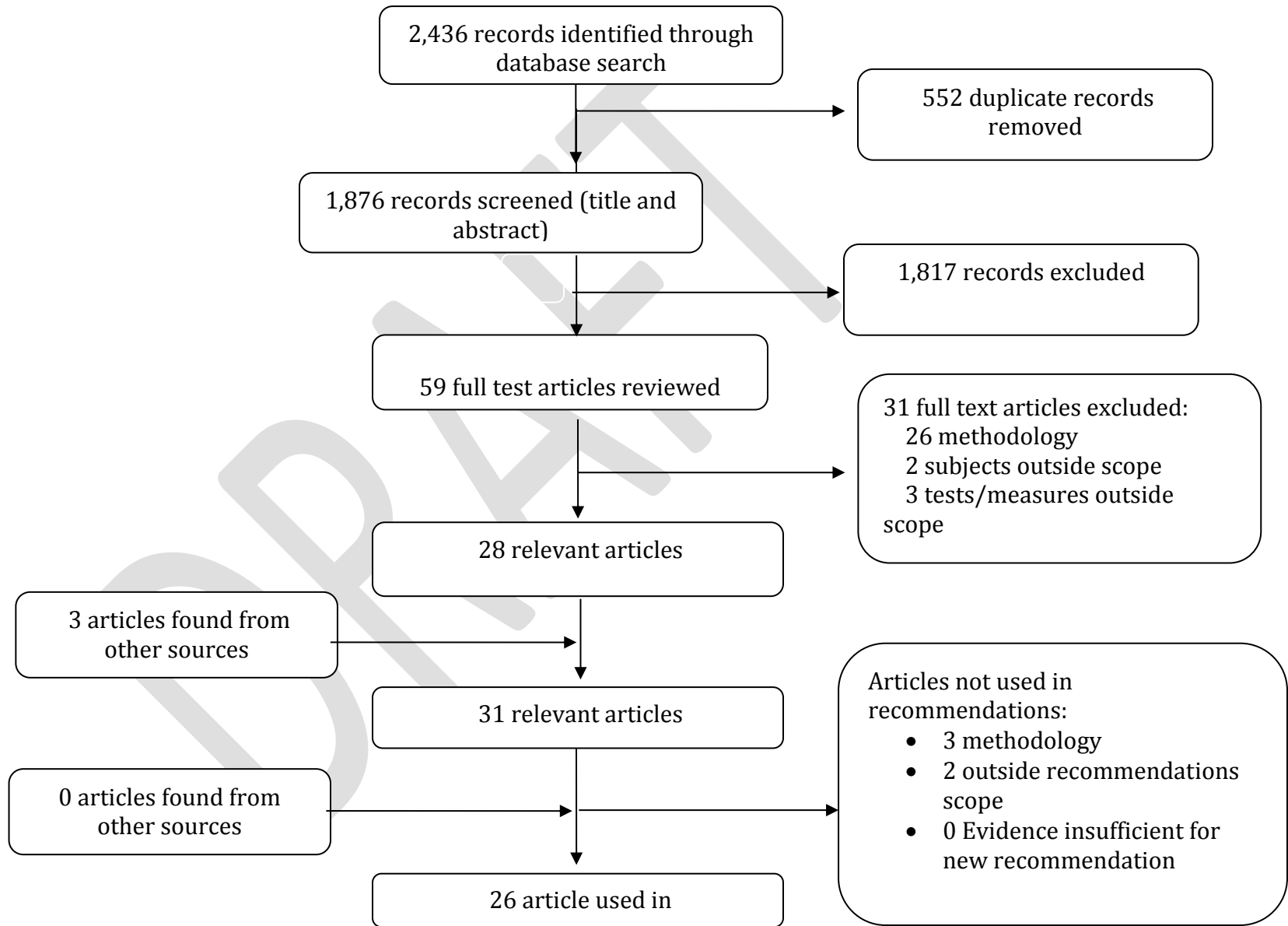
- Study protocols
- Animal studies
- Children (age less than 18 years)
- Primary surgical studies
- Legg-Calve Perthes
- Congenital hip dislocation
- Slipped capital femoral epiphysis
- Hip dysplasia
- Femoral acetabular impingement

Appendix D: Flow Chart of Articles

Assessment



Intervention



Appendix E

ARTICLES INCLUDED IN RECOMMENDATIONS BY TOPIC

Diagnosis/Classification

Holla, JF, Steultjens, MP, van der Leeden, M, Roorda, LD, Bierma-Zeinstra, SM, den Broeder, AA, Dekker, J. Determinants of range of joint motion in patients with early symptomatic osteoarthritis of the hip and/or knee: an exploratory study in the CHECK cohort. *Osteoarthritis Cartilage*. 2011;19: 411-419.

Kim C, Nevitt MC, Niu J, et al. Association of hip pain with radiographic evidence of hip osteoarthritis: diagnostic test study. *BMJ*. 2015;351:h5983.

Examination

Outcome Measures

Activity Limitations - Self Report Measures

Aranda-Villalobos P, Fernandez-de-Las-Penas C, Navarro-Espigares JL, et al. Normalization of widespread pressure pain hypersensitivity after total hip replacement in patients with hip osteoarthritis is associated with clinical and functional improvements. *Arthritis Rheum*. 2013;65:1262-1270.

Arendt-Nielsen L, Graven-Nielsen T. Translational musculoskeletal pain research. *Best Pract Res Clin Rheumatol*. 2011;25:209-226.

Arnold CM, Faulkner RA. Does falls-efficacy predict balance performance in older adults with hip osteoarthritis? *J Gerontol Nurs*. 2009;35:45-52.

Avin KG, Hanke TA, Kirk-Sanchez N, et al. Management of falls in community-dwelling older adults: clinical guidance statement from the Academy of Geriatric Physical Therapy of the American Physical Therapy Association. *Physical therapy*. 2015;95:815-834.

Davis AM, Perruccio AV, Canizares M, et al. The development of a short measure of physical function for hip OA HOOS-Physical Function Shortform (HOOS-PS): an OARSI/OMERACT initiative. *Osteoarthritis Cartilage*. 2008;16:551-559

Hawker GA, Davis AM, French MR, et al. Development and preliminary psychometric testing of a new OA pain measure--an OARSI/OMERACT initiative. *Osteoarthritis Cartilage*. 2008;16:409-414.

Kapstad H, Hanestad BR, Langeland N, Rustoen T, Stavem K. Cutpoints for mild, moderate and severe pain in patients with osteoarthritis of the hip or knee ready for joint replacement surgery. *BMC Musculoskelet Disord*. 2008;9:55.

Kapstad H, Rokne B, Stavem K. Psychometric properties of the Brief Pain Inventory among patients with osteoarthritis undergoing total hip replacement surgery. *Health Qual Life Outcomes*. 2010;8:148.

Nilsdotter AK, Lohmander LS, Klassbo M, Roos EM. Hip disability and osteoarthritis outcome score (HOOS)--validity and responsiveness in total hip replacement. *BMC Musculoskelet Disord*. 2003;4:10.

Rothenfluh DA, Reedwisch D, Muller U, Ganz R, Tennant A, Leunig M. Construct validity of a 12-item WOMAC for assessment of femoro-acetabular impingement and osteoarthritis of the hip. *Osteoarthritis Cartilage*. 2008;16:1032-1038.

Singh JA, Luo R, Landon GC, Suarez-Almazor M. Reliability and clinically important improvement thresholds for osteoarthritis pain and function scales: a multicenter study. *J Rheumatol*. 2014;41:509-515.

Suokas AK, Walsh DA, McWilliams DF, et al. Quantitative sensory testing in painful osteoarthritis: a systematic review and meta-analysis. *Osteoarthritis Cartilage*. 2012;20:1075-1085.

Thorborg K, Roos EM, Bartels EM, Petersen J, Holmich P. Validity, reliability and responsiveness of patient-reported outcome questionnaires when assessing hip and groin disability: a systematic review. *Br J Sports Med*. 2010;44:1186-1196.

Wylde V, Sayers A, Lenguerrand E, et al. Preoperative widespread pain sensitization and chronic pain after hip and knee replacement: a cohort analysis. *Pain*. 2015;156:47-54.

Activity Limitation-Physical Performance Measures

Bieler T, Magnusson SP, Kjaer M, Beyer N. Intra-rater reliability and agreement of muscle strength, power and functional performance measures in patients with hip osteoarthritis. *J Rehabil Med*. 2014;46:997-1005.

Choi YM, Dobson F, Martin J, Bennell KL, Hinman RS. Interrater and intrarater reliability of common clinical standing balance tests for people with hip osteoarthritis. *Physical therapy*. 2014;94:696-704.

Physical Impairment Measures

Bieler T, Magnusson SP, Kjaer M, Beyer N. Intra-rater reliability and agreement of muscle strength, power and functional performance measures in patients with hip osteoarthritis. *J Rehabil Med*. 2014;46:997-1005.

Chesterton LS, Sim J, Wright CC, Foster NE. Interrater reliability of algometry in

measuring pressure pain thresholds in healthy humans, using multiple raters. *Clin J Pain.* 2007;23:760-766.

Fischer AA. Algometry in the daily practice of pain management. *J Back Musculoskelet Rehabil.* 1997;8:151-163.

Kinser AM, Sands WA, Stone MH. Reliability and validity of a pressure algometer. *J Strength Cond Res.* 2009;23:312-314.

Maquet D, Croisier JL, Demoulin C, Crielaard JM. Pressure pain thresholds of tender point sites in patients with fibromyalgia and in healthy controls. *Eur J Pain.* 2004;8:111-117.

Pua YH, Wrigley TV, Cowan SM, Bennell KL. Intrarater test-retest reliability of hip range of motion and hip muscle strength measurements in persons with hip osteoarthritis. *Arch Phys Med Rehabil.* 2008;89:1146-1154.

Interventions

Patient Education

Fernandes L, Storheim K, Sandvik L, Nordsletten L, Risberg MA. Efficacy of patient education and supervised exercise vs patient education alone in patients with hip osteoarthritis: a single blind randomized clinical trial. *Osteoarthritis Cartilage.* 2010;18:1237-43.

Poulsen E, Hartvigsen J, Christensen HW, Roos EM, Vach W, Overgaard S. Patient education with or without manual therapy compared to a control group in patients with osteoarthritis of the hip. A proof-of-principle three-arm parallel group randomized clinical trial. *Osteoarthritis Cartilage.* 2013;21:1494-503.

Svege I, Nordsletten L, Fernandes L, Risberg MA. Exercise therapy may postpone total hip replacement surgery in patients with hip osteoarthritis: a long-term follow-up of a randomised trial. *Ann Rheumatic Dis.* 2013 Nov 20.

Voorn VM, Vermeulen HM, Nelissen RG, et al. An innovative care model coordinated by a physical therapist and nurse practitioner for osteoarthritis of the hip and knee in specialist care: a prospective study. *Rheumatol Int.* 2013;33(7):1821-8.

Functional, Gait, and Balance Training

Bossen D, Veenhof C, Van Beek KE, Spreeuwenberg PM, Dekker J, De Bakker DH. Effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis: randomized controlled trial. *J Med Internet Res.* 2013;15:e257.

Manual Therapy

Abbott JH, Robertson MC, Chapple C, et al. Manual therapy, exercise therapy, or both, in

addition to usual care, for osteoarthritis of the hip or knee: a randomized controlled trial. 1: clinical effectiveness. *Osteoarthritis Cartilage*. 2013;21:525-34.

Bennell KL, Egerton T, Martin J, et al. Effect of physical therapy on pain and function in patients with hip osteoarthritis: a randomized clinical trial. *Jama*. 2014;311:1987-97.

Beselga C, Neto F, Albuquerque-Sendin F, Hall T, Oliveira-Campelo N. Immediate effects of hip mobilization with movement in patients with hip osteoarthritis: A randomised controlled trial. *Man Ther*. 2016;22:80-85.

Brantingham JW, Bonnefin D, Perle SM, et al. Manipulative therapy for lower extremity conditions: update of a literature review. *J Manipulative Physiol Ther*. 2012;35:127-166.

Brantingham JW, Globe GA, Cassa TK, et al. A single-group pretest posttest design using full kinetic chain manipulative therapy with rehabilitation in the treatment of 18 patients with hip osteoarthritis. *J Manipulative Physiol Ther*. 2010;33:445-457.

Brantingham JW, Parkin-Smith G, Cassa TK, et al. Full kinetic chain manual and manipulative therapy plus exercise compared with targeted manual and manipulative therapy plus exercise for symptomatic osteoarthritis of the hip: a randomized controlled trial. *Arch Phys Med Rehabil*. 2012;93:259-267.

French HP, Cusack T, Brennan A, et al. Exercise and manual physiotherapy arthritis research trial (EMPART) for osteoarthritis of the hip: a multicenter randomized controlled trial. *Arch Phys Med Rehabil*. 2013;94:302-14.

Hando BR, Gill NW, Walker MJ, Garber M. Short- and long-term clinical outcomes following a standardized protocol of orthopedic manual physical therapy and exercise in individuals with osteoarthritis of the hip: a case series. *J Man Manip Ther*. 2012;20(4):192-200.

Peter WF, Jansen MJ, Hurkmans EJ, et al. Physiotherapy in hip and knee osteoarthritis: development of a practice guideline concerning initial assessment, treatment and evaluation. *Acta Reumatol Port*. 2011;36:268-81.

Pinto D, Robertson MC, Abbott JH, Hansen P, Campbell AJ. Manual therapy, exercise therapy, or both, in addition to usual care, for osteoarthritis of the hip or knee. 2: economic evaluation alongside a randomized controlled trial. *Osteoarthritis Cartilage*. 2013;21:1504-13.

Poulsen E, Hartvigsen J, Christensen HW, Roos EM, Vach W, Overgaard S. Patient education with or without manual therapy compared to a control group in patients with osteoarthritis of the hip. A proof-of-principle three-arm parallel group randomized clinical trial. *Osteoarthritis Cartilage*. 2013;21:1494-503.

Wright AA, Abbott JH, Baxter D, Cook C. The ability of a sustained within-session finding of pain reduction during traction to dictate improved outcomes from a manual

therapy approach on patients with osteoarthritis of the hip. *J Man Manip Therapy*. 2010;18:166-72.

Flexibility, strengthening, and endurance exercises

Abbott JH, Robertson MC, Chapple C, et al. Manual therapy, exercise therapy, or both, in addition to usual care, for osteoarthritis of the hip or knee: a randomized controlled trial. 1: clinical effectiveness. *Osteoarthritis Cartilage*. 2013;21:525-34.

Ageberg E, Link A, Roos EM. Feasibility of neuromuscular training in patients with severe hip or knee OA: the individualized goal-based NEMEX-TJR training program. *BMC Musculoskeletal Disorders*. 2010;11:126.

Bennell KL, Egerton T, Martin J, et al. Effect of physical therapy on pain and function in patients with hip osteoarthritis: a randomized clinical trial. *Jama*. 2014;311:1987-97.

EMHM V, HJM H, ME VB, et al. Clinical Practice Guidelines for Physical Therapy in Patients with Osteoarthritis of the Hip or Knee. *Amersfoort; KNGF*. 2001.

Fukumoto Y, Tateuchi H, Ikezoe T, et al. Effects of high-velocity resistance training on muscle function, muscle properties, and physical performance in individuals with hip osteoarthritis: a randomized controlled trial. *Clin Rehabil*. 2014;28:48-58.

Jigami H, Sato D, Tsubaki A, et al. Effects of weekly and fortnightly therapeutic exercise on physical function and health-related quality of life in individuals with hip osteoarthritis. *J Orthop Sci*. 2012;17:737-44.

Juhakoski R, Tenhonen S, Malmivaara A, Kiviniemi V, Anttonen T, Arokoski JP. A pragmatic randomized controlled study of the effectiveness and cost consequences of exercise therapy in hip osteoarthritis. *Clinical Rehab*. 2011;25:370-83.

Paans N, van den Akker-Scheek I, Dilling RG, et al. Effect of exercise and weight loss in people who have hip osteoarthritis and are overweight or obese: a prospective cohort study. *Physical therapy*. 2013;93:137-46.

Pisters MF, Veenhof C, Schellevis FG, De Bakker DH, Dekker J. Long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a randomized controlled trial comparing two different physical therapy interventions. *Osteoarthritis Cartilage*. 2010;18:1019-26.

Villadsen A, Overgaard S, Holsgaard-Larsen A, Christensen R, Roos EM. Immediate efficacy of neuromuscular exercise in patients with severe osteoarthritis of the hip or knee: a secondary analysis from a randomized controlled trial. *J Rheumatol*. 2014;41:1385-94.

Modalities

Koybasi M, Borman P, Kocaoglu S, Ceceli E. The effect of additional therapeutic ultrasound in patients with primary hip osteoarthritis: a randomized placebo-controlled study. *Clin Rheumatol*. 2010;29:1387-94.

Bracing

Sato E, Sato T, Yamaji T, Watanabe H. Effect of the WISH-type hip brace on functional mobility in patients with osteoarthritis of the hip: evaluation using the Timed Up & Go Test. *Prosthet Orthot Int*. 2012;36:25-32.

Weight Loss

Paans N, van den Akker-Scheek I, Dilling RG, et al. Effect of exercise and weight loss in people who have hip osteoarthritis and are overweight or obese: a prospective cohort study. *Physical therapy*. 2013;93:137-146.

DRAFT

APPENDIX F. LEVELS OF EVIDENCE TABLE*

Level	Intervention/ Prevention	Pathoanatomic/Risk/ Clinical Course/Prognosis/ Differential Diagnosis	Diagnosis/Diagnostic Accuracy	Prevalence of Condition/Disorder	Exam/Outcomes
I	Systematic review of high-quality RCTs High-quality RCT†	Systematic review of prospective cohort studies High-quality prospective cohort study‡	Systematic review of high-quality diagnostic studies High-quality diagnostic study§ with validation	Systematic review, high-quality cross-sectional studies High-quality cross-sectional study	Systematic review of prospective cohort studies High-quality prospective cohort study
II	Systematic review of high-quality cohort studies High-quality cohort study‡ Outcomes study or ecological study Lower-quality RCT¶	Systematic review of retrospective cohort study Lower-quality prospective cohort study High-quality retrospective cohort study Consecutive cohort Outcomes study or ecological study	Systematic review of exploratory diagnostic studies or consecutive cohort studies High-quality exploratory diagnostic studies Consecutive retrospective cohort	Systematic review of studies that allows relevant estimate Lower-quality cross-sectional study	Systematic review of lower-quality prospective cohort studies Lower-quality prospective cohort study
III	Systematic reviews of case-control studies High-quality case-control study Lower-quality cohort study	Lower-quality retrospective cohort study High-quality cross-sectional study Case-control study	Lower-quality exploratory diagnostic studies Nonconsecutive retrospective cohort	Local nonrandom study	High-quality cross-sectional study
IV	Case series	Case series	Case-control study		Lower-quality cross-sectional study
V	Expert opinion	Expert opinion	Expert opinion	Expert opinion	Expert opinion

Abbreviation: RCT, randomized clinical trial.

*Adapted from Phillips et al62 (<http://www.cebm.net/index.aspx?o=1025>). See also **APPENDIX G**.

†High quality includes RCTs with greater than 80% follow-up, blinding, and appropriate randomization procedures.

‡High-quality cohort study includes greater than 80% follow-up.

§High-quality diagnostic study includes consistently applied reference standard and blinding.

|| High-quality prevalence study is a cross-sectional study that uses a local and current random sample or censuses

Weaker diagnostic criteria and reference standards, improper randomization, no blinding, and less than 80% followup may add bias and threats to validity.

APPENDIX G. PROCEDURES FOR ASSIGNING LEVELS OF EVIDENCE

- Level of evidence is assigned based on the study design using the Levels of Evidence table (**APPENDIX F**), assuming high quality (eg, for intervention, randomized clinical trial starts at level I)
- Study quality is assessed using the critical appraisal tool, and the study is assigned 1 of 4 overall quality ratings based on the critical appraisal results
- Level of evidence assignment is adjusted based on the overall quality rating:
 - High quality (high confidence in the estimate/results): study remains at assigned level of evidence (eg, if the randomized clinical trial is rated high quality, its final assignment is level I). High quality should include:
 - Randomized clinical trial with greater than 80% follow-up, blinding, and appropriate randomization procedures
 - Cohort study includes greater than 80% follow-up
 - Diagnostic study includes consistently applied reference standard and blinding
 - Prevalence study is a cross-sectional study that uses a local and current random sample or censuses
 - Acceptable quality (the study does not meet requirements for high quality and weaknesses limit the confidence in the accuracy of the estimate): downgrade 1 level
 - Based on critical appraisal results
 - Low quality: the study has significant limitations that substantially limit confidence in the estimate: downgrade 2 levels
 - Based on critical appraisal results
 - Unacceptable quality: serious limitations - exclude from consideration in the guideline
 - Based on critical appraisal results