AAOS
American Academy of Orthopaedic Surgeons

# Management of Osteoarthritis of the Hip

## Evidence-Based Clinical Practice Guideline

*Adopted by*:
The American Academy of Orthopaedic Surgeons Board of Directors
December 1, 2023

*Endorsed by*:

AAHKS
American Association of Hip and Knee Surgeons

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## Disclaimer

This clinical practice guideline (CPG) was developed by a physician volunteer clinical practice guideline development group based on a formal systematic review of the available scientific and clinical information and accepted approaches to treatment and/or diagnosis. This clinical practice guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment should always be based on a clinician's independent medical judgment, given the individual patient's specific clinical circumstances.

### Disclosure Requirement

In accordance with AAOS policy, all individuals whose names appear as authors or contributors to the clinical practice guideline filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this clinical practice guideline.

### Funding Source

This clinical practice guideline was funded exclusively by the American Academy of Orthopaedic Surgeons who received no funding from outside commercial sources to support the development of this document.

### FDA Clearance

Some drugs or medical devices referenced or described in this clinical practice guideline may not have been cleared by the Food and Drug Administration (FDA) or may have been cleared for a specific use only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or device he or she wishes to use in clinical practice.



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## SUMMARY OF RECOMMENDATIONS

Recommendations are formed when there is sufficient evidence by which to create a directional statement. This is defined as evidence from two or more high quality studies (i.e., a strong recommendation), two or more moderate quality studies (i.e., a moderate recommendation), or statements resulting in a strong or moderate strength following Evidence to Decision Framework upgrading and/or downgrading.

## TRANEXAMIC ACID

**High Quality evidence supports that tranexamic acid (TXA) should be considered for patients with symptomatic osteoarthritis of the hip who are undergoing total hip arthroplasty (THA) to reduce blood loss and the need for blood transfusions.**

**Quality of Evidence:** High

**Strength of Recommendation:** Strong ★★★★

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Also requires no reasons to downgrade from the EtD framework.*

## POSTOPERATIVE PHYSICAL THERAPY

**High quality evidence supports either formal physical therapy or unsupervised home exercise after total hip arthroplasty for symptomatic osteoarthritis of the hip.**

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate ★★★☆ (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*



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## PHYSICAL THERAPY AS CONSERVATIVE TREATMENT

**Physical therapy could be considered as a treatment for patients with mild to moderate symptomatic osteoarthritis of the hip to improve function and reduce pain.**

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate★★★☆ (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*

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## INTRAARTICULAR CORTICOSTEROID INJECTION

**Intraarticular corticosteroids could be considered to improve function and reduce pain in the short-term for patients with symptomatic osteoarthritis of the hip.**

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate★★★☆ (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*

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## INTRAARTICULAR HYALURONIC ACID

**Intraarticular hyaluronic acid should not be considered for treatment of symptomatic osteoarthritis of the hip as it does not improve function or reduce pain better than placebo.**

**Quality of Evidence:** High

**Strength of Recommendation:** Strong ★★★★

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Also requires no reasons to downgrade from the EtD framework.*

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## PHARMACOLOGICAL MANAGEMENT: NSAIDs

**When not contraindicated, oral nonsteroidal anti-inflammatories (NSAIDs) should be used to reduce pain and improve function in the treatment of symptomatic hip osteoarthritis.**

**Quality of Evidence:** High

**Strength of Recommendation:** Strong ★★★★

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Also requires no reasons to downgrade from the EtD framework.*

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## CEMENTED VS. CEMENTLESS FEMORAL FIXATION

**Low quality evidence suggests in older adult patients undergoing total hip arthroplasty for symptomatic osteoarthritis, cemented femoral stems could be considered as they are associated with a lower risk of periprosthetic fracture.**

**Quality of Evidence:** Low

**Strength of Option:** Moderate ★★★☆ (Upgraded)

*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Recommendation was upgraded based on EtD framework.*

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## EXPOSURE APPROACH

**High quality evidence supports that there are specific risks and benefits to each surgical approach and that there is not a preferred surgical approach for patients with symptomatic osteoarthritis of the hip undergoing total hip arthroplasty.**

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate ★★★☆ (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*

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## SUMMARY OF OPTIONS

Options are formed when there is little or no evidence on a topic. This is defined as low quality evidence or a single moderate quality study (i.e., a limited strength option), no evidence or only conflicting evidence (i.e., a consensus option), or statements resulting in a limited or consensus strength following Evidence to Decision Framework upgrading and/or downgrading.

## BMI: ADVERSE EVENTS

### Limited evidence suggests that elevated BMI may increase the risk of adverse events in patients undergoing total hip arthroplasty for symptomatic hip osteoarthritis.

**Quality of Evidence:** Low

**Strength of Option:** Limited ★★☆☆

*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

## BMI: CLINICAL OUTCOMES

### Limited evidence supports that patients with elevated BMI and symptomatic osteoarthritis of the hip may achieve lower absolute patient reported outcome scores but a similar degree of improvement in patient satisfaction, pain, function, and quality of life after total hip arthroplasty.

**Quality of Evidence:** Low

**Strength of Option:** Limited ★★☆☆

*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

## PRESCRIPTION OPIOID AS CONSERVATIVE TREATMENT

**In the absence of sufficient evidence, it is the opinion of the workgroup that oral opioids not be utilized for nonoperative treatment of symptomatic osteoarthritis of the hip.**

**Quality of Evidence:** Consensus
**Strength of Option:** Consensus ★☆☆☆
*There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of reliable evidence, the guideline work group is making a recommendation based on their clinical opinion.*

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## DIABETES: ADVERSE EVENTS

**Limited evidence suggests that patients with symptomatic osteoarthritis of the hip and poorly controlled diabetes may be at a higher risk for adverse events after total hip arthroplasty.**

**Quality of Evidence:** Low
**Strength of Option:** Limited ★★☆☆
*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

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## SOCIAL DETERMINANTS OF HEALTH

**Limited evidence suggests that social determinants of health (e.g., education, income level, food desert, insurance type) may negatively impact length of stay, total cost of care, and mortality after total hip arthroplasty.**

**Quality of Evidence:** Low
**Strength of Option:** Limited ★★☆☆
*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

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## PHARMACOLOGICAL MANAGEMENT: ACETAMINOPHEN

**In the absence of sufficient evidence, it is the opinion of the workgroup that when not contraindicated, oral acetaminophen may be considered to improve pain and function in the treatment of symptomatic osteoarthritis of the hip.**

**Quality of Evidence:** Consensus
**Strength of Option:** Consensus ★☆☆☆
*There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of reliable evidence, the guideline work group is making a recommendation based on their clinical opinion.*

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## HIP-SPINE RELATIONSHIP

**In the absence of sufficient evidence, it is the opinion of the workgroup that patients with osteoarthritis of the hip and stiff spine syndrome may be at increased risk of dislocation after total hip arthroplasty compared to patients without stiff spine syndrome.**

**Quality of Evidence:** Low
**Strength of Option:** Consensus ★☆☆☆ (Downgraded)
*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Option was downgraded based on EtD framework.*

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## NEURAXIAL VS. GENERAL ANESTHESIA

**Limited evidence suggests that neuraxial anesthesia may be used to reduce adverse events in patients with symptomatic osteoarthritis of the hip undergoing total hip arthroplasty.**

**Quality of Evidence:** Low
**Strength of Option:** Limited ★★☆☆
*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

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## TOBACCO

**Limited evidence suggests that patients with symptomatic osteoarthritis of the hip who use tobacco products may be at an increased risk for adverse events after total hip arthroplasty.**

**Quality of Evidence:** Low

**Strength of Option:** Limited 

*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*



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# DEVELOPMENT GROUP ROSTER

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# INTRODUCTION

## OVERVIEW

This clinical practice guideline is based on a systematic review of published studies examining the treatment of osteoarthritis (OA) of the hip in adults. It provides recommendations that will help practitioners integrate the current evidence and clinical practice. It also highlights gaps in the literature in need of future research. This guideline is intended to be used by trained physicians and clinicians who manage the surgical and non-surgical treatment of OA of the hip. It also serves as an informational resource for developers and applied users of clinical practice guidelines.

## GOALS AND RATIONALE

The purpose of this clinical practice guideline is to evaluate the current best evidence associated with treatment. Evidence-based medicine (EBM) standards advocate for use of empirical evidence by physicians in their clinical decision making. To assist with access to the large resources of information, a systematic review of the literature in publication was conducted between August 2022 and August 2023. It highlights where there is good evidence, where evidence is lacking, and what topics future research will need to target to help facilitate evidence-based decision making in the treatment of patients with OA of the hip. AAOS staff methodologists assisted the physician/clinician work group in evaluating the existing literature so that they could formulate the following recommendations based on a rigorous systematic process. Musculoskeletal care is provided in many different settings and by a variety of providers. We created this guideline as an educational tool to guide qualified physicians and clinicians in making treatment decisions that improve the quality and efficacy of care. This guideline should not be construed as including all possible methods of care or excluding acceptable interventions similarly directed at obtaining favorable outcomes. The final decision to use a specific procedure must be made after assessing all concerns presented by the patient and consideration of locality-specific resources.

## INTENDED USERS

This guideline is intended to be used by orthopaedic surgeons and other healthcare providers managing OA of the hip. It serves as an information resource for medical practitioners. In general, individual practicing physicians and clinicians do not have the resources required to complete a project of comparable scope and duration involving the evaluation of an extensive literature base. In April 2019, the AAOS adopted the use of the GRADE Evidence-to-Decision Framework into its clinical practice guideline development methodology. This Framework enables work group members to incorporate additional factors into the strength of each recommendation and move away from the rigidity of previous AAOS recommendation language stems. The AAOS intends for this guideline to assist treatment providers not only in making shared clinical decisions with their patients, but also in describing to patients and their loved ones why a selected intervention represents the best available course of treatment. This guideline is not intended for use as a benefits determination document. It does not cover allocation of resources, business and ethical considerations, and other factors needed to determine the material value of orthopaedic care. Users of this guideline may also want to consider the appropriate use criteria (AUC) related to the treatment of OA of the hip.

## PATIENT POPULATION

This guideline is intended for use with adult patients (ages 18 years and older) who have been diagnosed by a trained healthcare



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provider with OA of the hip and are undergoing treatment.

## SCOPE

The scope of this guideline includes non-surgical treatment and surgical treatment with total hip arthroplasty of symptomatic OA of the hip. It does not provide recommendations for patients diagnosed with rheumatoid arthritis, OA of other joints, hip dysplasia, or other inflammatory arthropathies. It does not provide recommendations for surgical interventions less invasive than total hip arthroplasty.

## ETIOLOGY

The etiology of OA is multifactorial arising from several complex biological processes that lead to abnormal tissue metabolism and degradation of cartilage.

## INCIDENCE AND PREVALENCE

The global prevalence of hip OA is estimated at 7.2% (Fan 2023). The global incidence of hip OA is estimated at 2 million people or 7.8 per 1000 person-years (James 2023, Arslan 2022). The incidence and prevalence of OA of the hip have risen over time and is expected to continue to do so, particularly as life expectancy and obesity rates continue to rise.

## BURDEN OF DISEASE

In 2013, OA of any joint was the primary diagnosis for 23.7 million ambulatory care visits. OA of the hip accounts for 14% of all hospital discharges related to OA and 6% of all physician office visits for OA (Hochberg 2014). The lifetime costs for persons diagnosed with hip OA are over $180,000 (Kunkel 2018). Women are disproportionately affected with OA (including hip) represent 78% of the patients diagnosed with OA between 2008 and 2014.

## EMOTIONAL AND PHYSICAL IMPACT

OA of the hip leads to significant functional impairment interfering with quality of life. In addition to the physical impact, OA influences emotional wellbeing and mental health with a reported 19% of patients with OA diagnosed experience anxiety and depression (Stubbs 2016). As a result of the physical and emotional impacts, older adults with OA seek medical care more frequently and experience greater functional limitations compared to aged-matched controls. Patients with OA of the hip and knee have 20% excess mortality compared to age-matched controls (March 2016). As life expectancy and rates of obesity increase, the emotional and physical impact of OA of the hip will continue to be widespread.

## POTENTIAL BENEFITS, HARM, AND CONTRAINDICATIONS

Patients with OA of the hip present with increased pain, decreased mobility, decreased function, and decreased quality of life. The aim of treatment of OA of the hip is to reduce pain, improve function, and secondarily improve quality of life. All treatments are associated with risks for adverse outcomes, especially operative intervention, and must be considered for each patient. Contraindications and risks vary widely by treatment. In addition, each patient presents with certain risks, modifiable or non-modifiable, that should be considered by the patient and physician when making treatment decisions. When possible, modifiable risk factors should be addressed as reducing risks improve treatment efficacy. Ultimately, treatment decisions for OA of the hip should be made through a shared decision-making process with the physician and patient after discussing the unique risks and benefits of a specific treatment for that patient.

## DIFFERENCES BETWEEN THE PRESENT AND PREVIOUS GUIDELINES

This updated clinical practice guideline replaces the first edition that was completed in 2017, “Treatment of OA of the Hip.” This update considered the literature that we previously examined as well as the empirical evidence published since the 2017 guideline. In April 2019, the AAOS adopted the use of the GRADE Evidence-to-Decision Framework into its clinical practice guideline development methodology. This Framework enables work group members

to incorporate additional factors into the strength of each recommendation and move away from the rigidity of previous AAOS recommendation language stems. The complete listing of inclusion criteria for this guideline is detailed in the section, "Inclusion Criteria," (Appendix II).

# METHODS

The methods used to perform this systematic review were employed to minimize bias and enhance transparency in the selection, appraisal, and analysis of the available evidence. These processes are vital to the development of reliable, transparent, and accurate clinical recommendations. To view the full AAOS clinical practice guideline methodology please visit https://www.aaos.org/quality/research-resources/methodology/ .

This clinical practice guideline evaluates the management of osteoarthritis of the hip patient outcomes. The AAOS approach incorporates practicing physicians (clinical experts) and methodologists who are free of potential conflicts of interest relevant to the topic under study, as recommended by clinical practice guideline development experts.[1]

This clinical practice guideline was prepared by the AAOS Osteoarthritis of the Hip Guideline physician development group (clinical experts) with the assistance of the AAOS Clinical Quality and Value (CQV) Department (methodologists). To develop this clinical practice guideline, the clinical practice guideline development group held an introductory meeting on August 21st, 2022, to establish the scope of the clinical practice guideline. As the physician experts, the clinical practice guideline development group defined the scope of the clinical practice guideline by creating PICO Questions (i.e., population, intervention, comparison, and outcome) that directed the literature search. The AAOS Medical Librarian created and executed the search (see Appendix III for search strategy).

## LITERATURE SEARCHES

The systematic review begins with a comprehensive search of the literature. Articles considered were published prior to the start date of the search in a minimum of three electronic databases; PubMed, EMBASE, and the Cochrane Central Register of Controlled Trials. The medical librarian conducts the search using key terms determined from the guideline development group's PICO questions.

A CQV methodologist will review/include only primary literature but will supplement the electronic search with a manual search of the bibliographies of secondary literature sources, such as systematic reviews, as available. The methodologist will then evaluate all recalled articles for possible inclusion based on the study selection criteria and will summarize the evidence for the guideline work group who assist with reconciling possible errors and omissions.

A study attrition diagram is provided in the Methods section of each document that details the numbers of identified abstracts, recalled, and selected studies, and excluded studies that were evaluated in the CPG. The search strategies used to identify the abstracts are also included in the Appendix of each CPG document.

## DEFINING THE QUALITY OF EVIDENCE

The quality of evidence for a recommendation is determined by the quality and quantity of included literature for the statement. Statements with evidence from two or more "High" quality studies are considered to have "High Quality Evidence". Statements with evidence from two or more "Moderate" quality studies, or evidence from a single "High" quality study are considered to have "Moderate Quality Evidence". Statements with evidence from two or more "Low" quality studies or evidence from



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a single “Moderate” quality study are considered to have “Low Quality Evidence”. Statements with evidence from one “Low” quality study or no supporting evidence are considered to have “Very Low Quality Evidence” or “Consensus” respectively.

### DEFINING THE STRENGTH OF RECOMMENDATION

Judging the quality of evidence is only a steppingstone towards arriving at the strength of a CPG recommendation. The strength of recommendation also takes into account the quality, quantity, and the trade-off between the benefits and harms of a treatment, the magnitude of a treatment’s effect, and whether data exists on critical outcomes.

Strength of recommendation expresses the degree of confidence one can have in a recommendation. As such, the strength expresses how possible it is that a recommendation will be overturned by future evidence. It is very difficult for future evidence to overturn a recommendation that is based on many high quality randomized controlled trials that show a large effect. It is much more likely that future evidence will overturn recommendations derived from a few small retrospective comparative studies.

Consequently, recommendations based on the former kind of evidence are given a “strong” strength of recommendation and statement based on the latter kind of evidence are presented as options to the practicing clinician, rather than a directional recommendation, with either a “limited” strength or, in the event of no supporting or only conflicting evidence, a “consensus” strength.

## VOTING ON THE RECOMMENDATIONS

The recommendations and their strength were voted on by the guideline development group members during the final meeting. If disagreement between the guideline development group occurred, there was further discussion to see whether the disagreement(s) could be resolved. Recommendations were approved and adopted in instances where a simple majority (60%) of the guideline development group voted to approve; however, the guideline development group had consensus (100% approval) when voting on every recommendation for this guideline. Any recommendation strength upgrade or downgrade based on the Evidence-to-Decision Framework requires a super majority (75%) approval of the work group.

## UNDERSTANDING THE QUALITY OF EVIDENCE AND STRENGTH OF STATEMENT

### Table I. Strength and Quality Descriptions

| Statement Strength | Evidence Quality | Statement Description | Strength Visual |
|---|---|---|---|
| **Strong** | High* | Evidence from two or more "High" quality studies with consistent findings recommending for or against the intervention. Or Rec is upgraded using the EtD framework. |  |
| **Moderate** | Moderate* | Evidence from two or more "Moderate" quality studies with consistent findings or evidence from a single "High" quality study recommending for or against the intervention. Or Rec is upgraded or downgraded using the EtD framework. |  |
| **Limited** | Low* | Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Or Rec is downgraded using the EtD framework. |  |
| **Consensus*** | Very Low, or Consensus* | Evidence from one "Low" quality study, no supporting evidence, or Rec is downgraded using the EtD framework. In the absence of sufficient evidence, the guideline work group is making a statement based on their clinical opinion. |  |

*Unless statement was upgraded or downgraded in strength, using the EtD Framework.

### Table II. Interpreting the Strength of a Recommendation or Option

| Strength of Statement | Patient Counseling (Time) | Decision Aids | Impact of Future Research |
|---|---|---|---|
| Strong | Least | Least Important, unless the evidence supports no difference between two alternative interventions | Not likely to change |
| Moderate | Less | Less Important | Less likely to change |
| Limited | More | Important | Change possible/anticipated |
| Consensus | Most | Most Important | Impact unknown |

## REVIEW PERIOD

Following the final meeting, the CPG draft undergoes a 3-week review period for additional input from external content experts. Written comments are provided on the structured review form. All reviewers are required to disclose their conflicts of interest.

Specialty societies relevant to the topic are solicited for nominations of individual reviewers approximately six weeks before the final meeting. The review period is announced as it approaches, and others interested are able to volunteer to review the draft. The chairs of the guideline work group review the draft of the guideline prior to dissemination.

Some specialty societies (both orthopaedic and non-orthopaedic) ask their evidence-based practice (EBP) committee to provide review of the guideline. The organization is responsible for coordinating the distribution of our materials and consolidating their comments onto one form. The chair of the external EBP committees provides disclosure of their conflicts of interest (COI) and manages the potential conflicts of their members.

Again, the AAOS asks for comments to be assembled into a single response form by the specialty society and for the individual submitting the review to provide disclosure of potentially conflicting interests. The review stage gives external stakeholders an opportunity to provide evidence-based direction for modifications that they believe have been overlooked. Since the draft is subject to revisions until its approval by the AAOS Board of Directors as the final step in the guideline development process, confidentiality of all working drafts is essential.

The CPG is also provided to members of the AAOS Board of Directors (BOD), members of the Research and Quality Council (RQC), members of the Board of Councilors (BOC), and members of the Board of Specialty Societies (BOS) and members of the Committee on Evidence-Based Quality and Value (EBQV) for review and comment. The CPG is automatically forwarded to the AAOS BOD, RQC, and EBQV so that they may review it and provide comment prior to being asked to approve the document. Based on these bodies, over 200 commentators have the opportunity to provide input into each CPG.

The chairs of the guideline work group, the manager of the AAOS CQV unit, and the Director of AAOS CQV draft the initial responses to comments that address methodology. These responses are then reviewed by the chair and co-chair, who respond to questions concerning clinical practice and techniques. All comments received and the initial drafts of the responses are also reviewed by all members of the guideline development group. All proposed changes to recommendation language as a result of the review period are based on the available evidence that met inclusion criteria. Final revisions are summarized in a report that is provided alongside the guideline document throughout the remainder of the approval processes and final publication.

The AAOS believes in the importance of demonstrating responsiveness to input received during the review process and welcomes the critiques of external specialty societies. Following final approval of the guideline, all individual responses are posted on our website http://www.aaos.org/quality with a point-by-point reply to each non-editorial comment. Reviewers who wish to remain anonymous notify the AAOS to have their names de-identified; their comments, our responses, and their COI disclosures are still posted.

## THE AAOS CPG APPROVAL PROCESS

This final clinical practice guideline draft must be approved by the AAOS Committee on Evidence Based Quality and Value, and subsequently the AAOS Research and Quality Council, and the AAOS Board of Directors. These decision-making bodies are described in the OAH CPG eAppendix I. Their charge is to approve or reject its publication by majority vote.

## REVISION PLANS

This clinical practice guideline represents a cross-sectional view of current treatment and may become outdated as new evidence becomes available. This clinical practice guideline will be revised in accordance with new evidence, changing practice, rapidly emerging treatment options, and new technology. This clinical practice guideline will be updated or withdrawn in five years.

## CPG DISSEMINATION PLANS

The primary purpose of the present document is to provide interested readers with full documentation of the best available evidence for various procedures associated with the topic of this review. Publication of most clinical practice guidelines is announced by an Academy press release, articles authored by the

clinical practice guideline development group and published in the Journal of the American Academy of Orthopaedic Surgeons, and articles published in AAOS *Now*. Most clinical practice guidelines are also distributed at the AAOS Annual Meeting in the Resource Center. he final guideline recommendations and their supporting rationales will be hosted on www.OrthoGuidelines.org.

Selected clinical practice guidelines are disseminated by webinar, the AAOS Learning Management System (LMS), Media Briefings, and by distributing them at relevant Continuing Medical Education (CME) courses and at the AAOS Resource Center.



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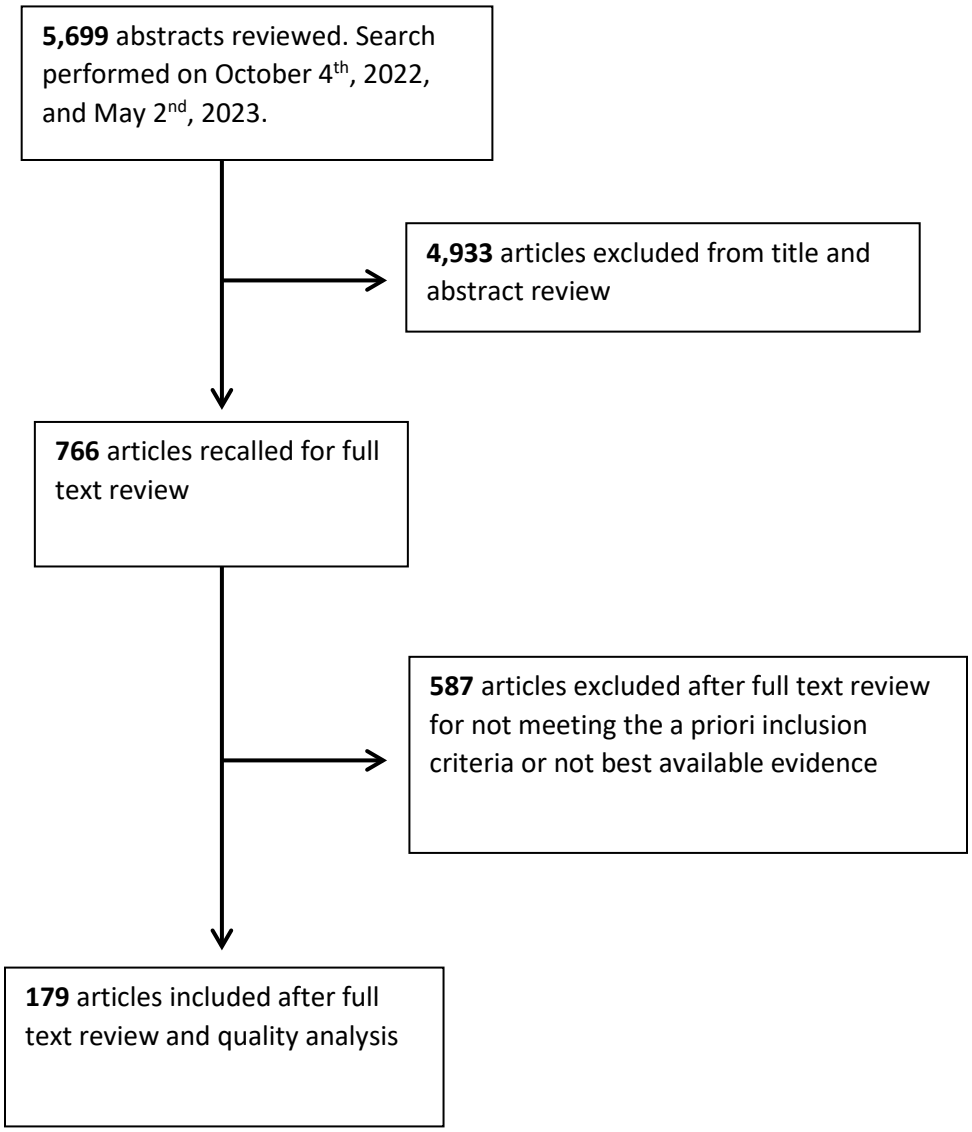
**Study Attrition Flowchart**



# RECOMMENDATIONS

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## TRANEXAMIC ACID

**High quality evidence supports that tranexamic acid (TXA) should be considered for patients with symptomatic osteoarthritis of the hip who are undergoing total hip arthroplasty (THA) to reduce blood loss and the need for blood transfusions.**

**Quality of Evidence:** High

**Strength of Recommendation:** Strong ★★★★

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Also requires no reasons to downgrade from the EtD framework.*

### Rationale

Based on the available evidence, both intravenous (IV) and topical tranexamic acid (TXA) have shown significant positive effects on various outcomes in patients undergoing total hip arthroplasty. One high-quality article by Rizzo (2020) indicated that the combination of IV and topical TXA had significantly positive effects on hemoglobin levels and reduced the number of transfusions required.

Thirteen studies, including nine high-quality (Fraval 2019, Fraval 2017, Zufferey 2017, Xu 2019, Imai 2012, Niskanen 2005, Juraj 2021, Benoni 2001, Clave 2019), one moderate-quality (Na 2016), and three low-quality studies (Mahmood 2017, Konarski 2022, Akti 2022), investigated the effects of IV TXA alone. The majority of these studies (nine high-quality, one moderate-quality) found significantly positive effects of IV TXA on various outcomes, including reduced blood loss, decreased number of transfusions, lower amounts of blood transfused, improved hemoglobin levels, reduced drainage, and decreased complication rates.

Four articles were identified that studied the effects of topical TXA alone, including three high-quality and one low-quality studies. These studies collectively demonstrated that topical TXA also had significantly positive effects on blood loss, number of transfusions, hemoglobin levels, drainage, and complication rates.

One study by Chin (2020) which was a moderate-quality study on IV TXA did not find any significant effects on the outcomes mentioned above. However, this study's reliability is compromised due to missing key information, such as the patient demographics and group characteristics, which may limit the validity of its conclusions.

Furthermore, Fraval (2017) and Fraval (2019) conducted two high-quality studies with similar methodologies, the latter including additional deep vein thrombosis (DVT) chemoprophylactics (Enoxaparin and Aspirin). Both studies found no significant effects of TXA on patient-reported outcome measures (PROMs) or functional outcomes.



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### Benefits/Harms of Implementation

While there is concern that there may be contraindications to the use of TXA, none of the papers cited above demonstrated an increased risk of adverse events related to the perioperative use of TXA for total hip arthroplasty (THA).

### Outcome Importance

Reducing blood loss and transfusion rates after total hip arthroplasty has a major impact on improving outcomes, reducing complications, and improving value.

### Cost Effectiveness/Resource Utilization

Reductions in perioperative blood loss and transfusion rates improve perioperative recovery, costs related to transfusion, and utilization of limited resources.

### Acceptability

Some stakeholders may have concerns regarding the risk/benefit profile of tranexamic acid in higher risk patients with vascular disease, coronary stents, and thromboembolic disease. However, prior retrospective studies have found tranexamic acid use to be safe in these high-risk patients (Porter 2020). Randomized, prospective trials to address these concerns would be beneficial.

### Future Research

Randomized, prospective trials comparing IV TXA, topical TXA, and oral TXA are warranted to specifically assess dosing, technique and timing of administration, uniform measures of perioperative blood loss, cost, including impact on blood transfusion, and contraindications. Studies focused on refining dosing recommendations and risks/benefits in higher risk patients may be of particular value.

## POSTOPERATIVE PHYSICAL THERAPY

### High quality evidence supports either formal physical therapy or unsupervised home exercise after total hip arthroplasty for symptomatic osteoarthritis of the hip.

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate ★★★★ (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*

#### Rationale

The strength of recommendation was downgraded to moderate for several reasons including heterogeneity in the duration, timeframe, types of modalities and interventions, and frequency of the physical therapy interventions in these studies, making direct comparisons and definitive conclusions difficult. There were few studies that compared a progressive outpatient physical therapy program against an active placebo group in the three months after surgery, which is the time frame of interest for most surgeons.

Three high quality articles, one moderate quality article, and one low quality article showed that patients who underwent formal physiotherapy had a significant positive outcome on at least one of the following: Hip Disability and Osteoarthritis Outcome Score (HOOS), Short Form 12-Item Survey (SF-12), Western Ontario McMaster Universities Arthritis Index (WOMAC), 5-Level EuroQuol 5 Dimension self-report survey (EQ-5D), 6-Minute Walk Test, Stair Climb Test, Figure-of-Eight Test, Sit-to-Stand Test, range of motion (ROM), and strength when compared to unsupervised exercise, home-based therapy, or usual care. Specifically, Monaghan (2017) (high-quality) had significant positive results for the 6-Minute-Walk Test and self-reported function. Heiberg (2012) (high-quality) showed evidence of improved walking and stair climbing ability and these benefits persisted 1 year after surgery. Mikkelsen 2014 (high-quality) showed significant Stair Climb Test and maximal walking speed outcomes in the intervention group compared to the control group.

Two high quality articles and one moderate quality article showed no significant difference in outcomes between guided physiotherapy or unguided home exercises. It is important to note that one high quality article (Coulter 2017) only examined early recovery up to four weeks and the other high-quality article (Austin 2017) only evaluated self-reported outcome measures and the Harris Hip Score and did not include performance-based outcomes.

In reviewing the quantity of articles in favor of supervised physical therapy versus those that showed no difference, there was a slight favor for formal physical therapy after surgery. There were no studies that demonstrated unsupervised exercise was superior to supervised physical therapy. Additional research is warranted before a high strength of recommendation can be provided.

#### Benefits/Harms of Implementation

There is concern that recommending home exercise after surgery may limit the recovery of patients who need a more structured and supervised rehabilitation program to achieve optimal outcomes. At this point, there are no formal guidance measures to identify patients who may have an acceptable outcome with home exercise versus supervised physical therapy. A home program in which patients do not routinely interact with a health care professional after surgery may also result in delayed or missed negative sequalae after surgery.



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### Outcome Importance

The impact of exercise, mobility, and physical activity is an important aspect of postoperative recovery and should be a part of postoperative care, regardless of the manner in which it is implemented.

### Cost Effectiveness/Resource Utilization

While there is a cost associated with supervised physical therapy, these costs are a relatively small portion of the total course of peri- and postoperative care. Cost-benefit analyses that have not been conducted with regard to this recommendation are warranted in future research.

### Acceptability

Structured physical therapy is commonly prescribed for patients after THA. Some stakeholders may have concerns that there is no guidance as to which patients are likely to have equivalent outcomes with unsupervised exercise after total hip arthroplasty (THA).

### Feasibility

There are no major concerns related to the feasibility of implementing this recommendation.

### Future Research

Future research is warranted to obtain a better understanding of the benefit of physical therapy after THA. Current evidence is mixed, showing either a benefit to physical therapy or no difference when compared to unsupervised home exercise. Future studies should include intervention groups with an individualized plan of care and progressive rehabilitation programs, and study outcomes should include both short- and long-term performance-based and self-reported measures. Studies that provide evidence as to which patients are likely to succeed without formal physical therapy are needed.

## PHYSICAL THERAPY AS CONSERVATIVE TREATMENT

**Physical therapy could be considered as a treatment for patients with mild to moderate symptomatic osteoarthritis of the hip to improve function and reduce pain.**

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate  (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*

### Rationale

The strength of recommendation was downgraded to moderate for several reasons including heterogeneity in the types of modalities and interventions provided in intervention groups and heterogeneity in the frequency, duration, and intensity of interventions.

Fifteen articles (thirteen high-quality, one moderate-quality, and one low-quality) disagreed whether physical therapy in patients with osteoarthritis of the hip (OAH) had statistically significant positive outcomes when compared to a control group. Eight articles concluded there was either no significant difference in primary outcomes, or slight non-significant improvements in the intervention group (mainly with patient reported outcomes) (Bennell 2014, Beselga 2016, Pisters 2010, Steinhilber 2017, Svege 2016, Teirlinck 2016, Thompson 2020) while the other seven articles concluded that physical therapy significantly improved outcomes when compared to a control group (Fernandes 2010, French 2013, Koybasi 2010, Olsen 2022, Poulsen 2013, Svege 2015, Tak 2005).

In the high and moderate quality studies that found physical therapy was beneficial, there were significant improvements in hip flexion, Patient Global Assessment, Visual Analogue Scale (VAS) Pain, and Western Ontario McMaster Arthritis Index (WOMAC) in more than one article. There were also improvements to 5m Walking Test, range of motion (ROM), Balance Step Test, Body Awareness Rating Scale Movement Quality and Experience (BARS-MQE), Chair Stand Test, 15m Walking Test, Harris Hip Score (HHS), Hip Abduction, Hip Adduction, Hip Extension, Hip Internal Rotation, Hip Disability and Osteoarthritis Outcome Score (HOOS), Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP), Patient-Oriented Physical Function McMaster Toronto Arthritis Patient Preference Questionnaire (MACTAR), Physiotherapy Outpatient Survey, Reported Recovery, Self-Paced 40m Walk, Sickness Impact Profile, and Timed-Up-and-Go-Test were illustrated in at least one of the articles.

While there was disagreement among the studies as to whether supervised physical therapy was superior to control groups, there were no studies that found that physical therapy resulted in worse outcomes.

Most studies failed to stratify results or subject selection based on osteoarthritis severity, which may have contributed to the overall disagreement among studies as to whether physical therapy was effective. Few studies compared a comprehensive physical therapy program to a placebo group, instead many studies focused on a singular intervention (e.g., core strengthening, ultrasound, mobilizations, etc.).

### Benefits/Harms of Implementation

Patients who are candidates for conservative treatment may benefit from physical therapy to improve range of motion, reduce pain, and improve function. Most studies did not stratify participants based on Kellgren-Lawrence grade or structural severity of osteoarthritis, making it unclear if physical therapy is beneficial for all patients, or



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just those earlier in the course of osteoarthritis. It is possible that patients with end-stage disease may not receive functional benefit from physical therapy, despite the cost and time associated with rehabilitation.

### Outcome Importance

Participation in physical therapy may improve a wide range of outcomes, including range of motion, pain, functional performance, walking speed, and self-reported functional ability.

### Cost Effectiveness/Resource Utilization

There is limited comparative data on the cost effectiveness of physical therapy for patients with osteoarthritis of the hip as part of conservative management.

### Acceptability

This recommendation should be readily implemented as it does not reflect a major change in clinical practice. Physical therapy is commonly recommended for patients with mild to moderate hip osteoarthritis and physical therapists should be familiar with the condition and appropriate interventions to address physical impairments and functional deficits associated with hip OA.

### Feasibility

Physical therapy as an option for conservative management should be feasible for most stakeholders.

### Future Research

Future research is necessary to draw stronger conclusions about the benefit of physical therapy for patients with hip osteoarthritis. Future studies should stratify results based on osteoarthritis. Future studies also need to compare comprehensive physical therapy programs that include a formal evaluation and individualized treatment plan to a placebo group.

## INTRAARTICULAR CORTICOSTEROID INJECTION

**Intraarticular corticosteroids could be considered to improve function and reduce pain in the short-term for patients with symptomatic osteoarthritis of the hip.**

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate  (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*

### Rationale

This strength of recommendation was downgraded to moderate for several reasons including heterogeneity in study design and corticosteroid dosing as well as a lack of reporting of adverse events (e.g., infection, rapidly progressive osteoarthritis of the hip).

Four high quality studies (Qvistgaard et al, Lambert et al, Atchia et al Paskins et al) compared intraarticular corticosteroid with placebo and showed improvement in pain and function scores in the short-term with intraarticular corticosteroids. Paskins (2022) found superior Western Ontario McMaster Arthritis Index (WOMAC) Total Scores, and 5-Level EuroQuol 5 Dimension self-report survey (EQ5D-5L) Scores at two and four month follow ups. Similarly, Atchia (2011) reported superior WOMAC function with corticosteroid injection at one, four, and eight week follow ups. Lambert (2007) reported superior WOMAC Stiffness, WOMAC Function Scores, and 36-Item Short Form Survey (SF-36) Scores (Social Functioning, Physical Functioning, and PCS) at one and two months as well. Pain outcomes (WOMAC Pain, SF-36 Bodily Pain, Visual Analogue Score / Numerical Rating Score for Pain) were superior for corticosteroid groups at short term follow ups up to eight weeks (Atchia 2011, Qvistgaard 2006, Lambert 2007, Paskins 2022).

### Benefits/Harms of Implementation

While intraarticular corticosteroids can improve pain and function in the short-term for patients with symptomatic osteoarthritis of the hip there are risks with their use. The most common risks are infection as well as rapidly progressive osteoarthritis after an intraarticular corticosteroid injection, which should be considered.

### Outcome Importance

Intra-articular corticosteroids injections of the hip may not only improve pain and function of the hip, but also may improve patient activity levels, patient satisfaction, and quality of life.

### Cost Effectiveness/Resource Utilization

There is limited comparative data on the cost-effectiveness of intraarticular corticosteroid injections of the hip compared to other nonoperative treatments of osteoarthritis of the hip. Intraarticular corticosteroid injections of the hip are often performed with image guidance, such as ultrasound or fluoroscopy, which increase cost and resource utilization.

### Acceptability

This recommendation should be readily implemented as it does not influence a major change in clinical practice. Intraarticular injections of the hip are commonly performed. It provides further evidence to support and guide this clinical practice.



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## Feasibility

Intraarticular corticosteroid injections of the hip are feasible for most, however they are often performed with image-guidance, such as fluoroscopy or ultrasound. Thus, patients who do not have access to clinicians with those imaging technologies may not have access to intraarticular corticosteroid injections in the hip.

## Future Research

Future research is warranted to better understand the adverse events with intraarticular corticosteroid use, particularly infection and rapidly progressive osteoarthritis of the hip. Further studies are also needed with consistent dosing of corticosteroids as well as delivery methods.

## INTRAARTICULAR HYALURONIC ACID

**Intraarticular hyaluronic acid should not be considered for treatment of symptomatic osteoarthritis of the hip as it does not improve function or reduce pain better than placebo.**

**Quality of Evidence:** High

**Strength of Recommendation:** Strong ★★★★

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Also requires no reasons to downgrade from the EtD framework.*

### Rationale

Five high quality studies (Nouri 2022, Brander 2019, Qvistgaard 2006, Richette 2009, Atchia 2011) compared intraarticular (IA) hyaluronic acid (HA) with placebo. All five showed no improvement in pain or function with IA hyaluronic acid compared to placebo. Specifically, Nouri (2022), Qvistgaard (2006), and Richette (2009) reported no difference in Western Ontario McMaster Arthritis Index (WOMAC) Total scores at follow up times leading up to and including six months. Pain outcomes reported via WOMAC Pain Scale, Visual Analogue Scale for Pain, and Lequesne Pain Scale showed no difference between HA and placebo at similar follow-up. Brander (2019) reported no significant differences between a variety of adverse event rates between HA and placebo.

### Benefits/Harms of Implementation

There are no harms, known or anticipated, associated with implementing this recommendation.

### Outcome Importance

Intra-articular injections of the hip may not only improve pain and function of the hip, but also may improve patient activity levels, patient satisfaction, and quality of life.

### Cost Effectiveness/Resource Utilization

There is limited comparative data on the cost-effectiveness of intraarticular hyaluronic acid injections of the hip with other nonoperative treatments of osteoarthritis of the hip. Intraarticular injections of the hip are often performed with image guidance, such as ultrasound or fluoroscopy, which increase cost and resource utilization.

### Acceptability

This recommendation should be readily implemented as it does not influence a major change in clinical practice. Intraarticular injections of the hip are commonly performed. It provides further evidence to support and guide this clinical practice.

### Feasibility

These recommendations do not interfere with other interventions or clinical practice therefore it is deemed very feasible in patients with symptomatic osteoarthritis of the hip.

### Future Research

Given the increased cost associated with their use, future cost-effectiveness research is warranted on the use of intraarticular hyaluronic acid injections. There is also a paucity of data on adverse events with their use. Future research would also be beneficial looking at different subgroups of patients based on patient related factors or disease related factors that may benefit from one nonoperative treatment over another.



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## PHARMACOLOGICAL MANAGEMENT: NSAIDs

**When not contraindicated, oral nonsteroidal anti-inflammatories (NSAIDs) should be used to reduce pain and improve function in the treatment of symptomatic hip osteoarthritis.**

**Quality of Evidence:** High

**Strength of Recommendation:** Strong ★★★★

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Also requires no reasons to downgrade from the EtD framework.*

### Rationale

Five studies (three moderate quality and two high quality) compared oral nonsteroidal anti-inflammatories (NSAIDs) with placebo for treatment of symptomatic osteoarthritis of the hip and showed improvement in pain and function scores with NSAIDs (Baerwald 2010, Kivitz 2001, Makarowski 2002, Schnitzer 2011, Svensson 2006). Compared to placebo, all five studies reported on pain and uniformly reported improvement in pain with the use of oral NSAIDs. The Western Ontario McMaster Arthritis Index (WOMAC) score was reported in all studies, all of which reported improvement in WOMAC function with NSAIDs compared to placebo. Three articles compared efficacy of a NSAIDs against each other: Schnitzer (2011) found that lumiracoxib showed similar efficacy to celecoxib; Kivitz (2001) found that celecoxib 200mg/day and 400mg/day showed similar efficacy to naproxen; Makarowski (2002) reported similar efficacy between valdecoxib 10mg and naproxen.

### Benefits/Harms of Implementation

Although oral NSAIDs are widely utilized to treat osteoarthritis of the hip, there are contraindications to their use. Contraindications that should be considered include, but are not limited to, patients with chronic kidney disease or patients with significant cardiac conditions that may be at an elevated risk of myocardial infarction.

### Outcome Importance

The use of non-opioid medications such as NSAIDs for nonoperative treatment of symptomatic osteoarthritis of the hip is extremely important to minimize the use of opioids.

### Cost Effectiveness/Resource Utilization

NSAIDs are widely available and an extremely cost-effective treatment for symptomatic osteoarthritis. However, there is limited comparative data on the cost-effectiveness of oral NSAIDs compared to other nonoperative treatments of osteoarthritis of the hip.

### Acceptability

This recommendation should be readily implemented as it does not influence a major change in clinical practice. Oral NSAIDs are commonly used to treat symptomatic osteoarthritis of the hip. It provides further evidence to support and guide this clinical practice.

### Feasibility

Oral NSAIDs are widely available. Thus, this recommendation should be easily implemented with no apparent barriers to adoption.

**Future Research**

Future research is warranted to better understand the adverse events with oral NSAID use, particularly in patients at higher risk. Further studies are also needed to compare the different types of oral NSAIDs as well as dosing and duration of treatment. Future studies are needed to establish efficacy within certain subgroups and populations.



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## CEMENTED VS. CEMENTLESS FEMORAL FIXATION

**Low quality evidence suggests in older adult patients undergoing total hip arthroplasty for symptomatic osteoarthritis, cemented femoral stems could be considered as they are associated with a lower risk of periprosthetic fracture.**

**Quality of Evidence:** Low

**Strength of Recommendation:** Moderate  (Upgraded)

*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Recommendation was upgraded based on EtD framework.*

### Rationale

This recommendation was upgraded from limited to moderate due to the risks of periprosthetic fracture, risks to acceptability as the vast majority of femoral stems implanted are cementless, as well as the importance of training surgeons on cement technique. Eleven low quality studies compared outcomes of cemented femoral stems versus cementless femoral stems in total hip arthroplasty for symptomatic osteoarthritis (Bloemheuvel 2022, Cnudde 2017, Dybvik 2020, Ekman 2019, Ennin 2021, Gandhi 2010, Havelin 1994, Jamsen 2014, Kelly 2022, Makela 2014, Pedersen 2021).

Bloemheuvel (2022), suggested that cemented femoral fixation had significantly positive effects on revision rates after 1, 3, and 5 years compared to cementless. Jamsen (2014) found that cementless femoral fixation had significantly positive effects on the risk of revision after 1 year compared to cemented. Makela (2014) indicated that cementless femoral fixation had significantly positive effects on revisions after 6 months and 15 years, deep infection at 6 months, and dislocation at 6 months for patients between the ages 65-74 compared to cemented. However, it also suggested that cemented femoral fixation had significantly positive effects on aseptic loosening and periprosthetic fracture at 6 months for patients between the ages of 65-74 compared to cementless. For patients over 75, this low-quality article indicated that cementless femoral fixation had significantly positive effects on revision after 15 years, deep infection at 6 months, and dislocation at 6 months compared to cemented. However, cemented femoral fixation had significantly positive effects on aseptic loosening at 6 months and periprosthetic fracture at 6 months for the same age group compared to cementless. Kelly (2022) found cementless femoral fixation had significantly positive effects on septic revision and loosening at 10 years compared to hybrid. However, it also suggested that cemented femoral fixation had significantly positive effects on periprosthetic fracture at 10 years compared to cementless.

### Benefits/Harms of Implementation

Cemented femoral stems in total hip arthroplasty are associated with lower risk of periprosthetic fracture particularly in older patients. However, there is a risk of bone cement implantation syndrome with the use of cement during total hip arthroplasty particularly in patients with poor renal, cardiac, or pulmonary function (Rassir 2021). The decision to use cemented or cementless femoral fixation should be individualized to each patient as it may be influenced by individual patient circumstances.

### Outcome Importance

As the number of older patients undergoing total hip arthroplasty increases annually, the risk of periprosthetic fractures has continued to rise. Mortality rates after periprosthetic fractures are as high as 18% so mitigating this

risk is important (Shields 2014). This recommendation was upgraded from limited to moderate to emphasize the importance of mitigating the risk of periprosthetic fractures in total hip arthroplasty.

### Cost Effectiveness/Resource Utilization

While cementless fixation is widely utilized in total hip arthroplasty, bone cement is widely available as it is the most common fixation method for total knee arthroplasty. The cost-effectiveness of cemented versus cementless femoral fixation is complex and must take into account multiple factors including direct costs, including the costs of the prostheses and cement, as well as indirect costs, operating room and anesthesia time, and the cost of adverse events associated with their use.

### Acceptability

In the United States, 95.2% of femoral stems implanted are cementless (AJRR 2022 Annual Report). The high utilization rates of cementless femoral fixation are multifactorial including longevity due to biologic ingrowth fixation, reduced operative time, lower risk of embolic debris, as well as lack of training on cement technique. Given this, there is a risk that this recommendation is not widely accepted. As a result, this recommendation was upgraded to a moderate strength recommendation due to this risk.

### Feasibility

While cemented femoral fixation is less utilized in the United States, it is widely utilized internationally with utilization of cemented stems reported up to 98% in some countries (Bunyoz 2020). Clinically, cemented fixation is sustainable and an effective method of femoral fixation. However, a major barrier to implementation of this recommendation is lack of surgical training on cement technique. As a result, this recommendation was upgraded to a moderate strength recommendation to emphasize the importance of surgical training incorporating cemented femoral fixation.

### Future Research

The decision to utilize a cemented versus cementless femoral stem should be individualized to each patient and should take into account bone quality. There is not a widely available and adopted preoperative assessment for bone quality. Resultantly, age is often utilized as a surrogate. Future research is warranted to identify additional patient related factors beyond age that inform the decision to use cemented or cementless fixation and avoid complications, such as periprosthetic fractures. While cementless and cemented fixation are broad terms to describe fixations strategies in total hip arthroplasty, there are a variety of implant related differences (e.g., geometry, coatings) between implants in each group that should be considered. Future comparative research is warranted to investigate the unique differences in implants and technologies in each group. Long-term studies and registry data are important to assess the reliability and durability of current and future cemented and cementless femoral stems. Comparative cost-effectiveness data is also important and should be an area of future research.



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## EXPOSURE APPROACH

**High quality evidence supports that there are specific risks and benefits to each surgical approach and that there is not a preferred surgical approach for patients with symptomatic osteoarthritis of the hip undergoing total hip arthroplasty.**

**Quality of Evidence:** High

**Strength of Recommendation:** Moderate  (Downgraded)

*Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention. Recommendation was downgraded based on EtD framework.*

### Rationale

This strength of recommendation was downgraded from strong to moderate for several reasons including the heterogeneity in the data, indirectness of comparative studies, and the potential for future research to alter the recommendation.

Several high-quality and three moderate-quality studies are included in this review. Each of the studies compares one specific approach against another. None of the studies compare multiple approaches. The definition of each approach was also not well defined in a majority of studies. Taunton (2014) indicated that direct anterior approach had significantly positive effects on Western Ontario McMaster Arthritis Index (WOMAC) Total scores and days discontinued all walking aids compared to the mini-posterior approach, but other high-quality papers by Barrett (2019), Parvizi (2016), and Xie (2017) suggests excellent results utilizing other approaches. There is no one definitive study comparing prospectively all approaches regarding activity, complications, and patient satisfaction.

### Benefits/Harms of Implementation

Each surgical approach in total hip arthroplasty is associated with specific risks and benefits. Certain risks or benefits may be more associated with one approach over another. For example, a posterior approach is associated with an increased risk of dislocation and an anterior approach associated with an increased risk of wound complications. The decision to use a specific approach should be based on a surgeon's training and experience with the approach and should be individualized to each patient. The decision to proceed with a particular approach should be made by each individual patient and surgeon after an informed decision-making process where the risks and benefits of each approach for that individual patient are discussed.

### Outcome Importance

As the incidence and prevalence of osteoarthritis of the hip continues to rise, the number of total hip arthroplasty procedures performed is increasing as well.

### Cost Effectiveness/Resource Utilization

No studies specifically addressed associated costs and resource utilization in a cost comparative approach. The approach in total hip arthroplasty does not incur any direct costs. Some approaches may be performed with special instrumentation or equipment that may be associated with an increase in cost. However, there is limited comparative data on the cost-effectiveness of the different approaches in total hip arthroplasty.

### Acceptability

This recommendation should be readily implemented as it does not influence a major change in clinical practice. A variety of approaches are utilized in total hip arthroplasty.

**Feasibility**

All approaches to the hip are feasible for most surgeons. Thus, this recommendation should be easily implemented with no apparent barriers to adoption.

**Future Research**

Future studies level I prospective randomized controlled trials are needed to compare the different approaches in total hip arthroplasty. Future studies are also needed to establish differences in adverse events or clinical outcomes within certain subgroups and populations.



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# OPTIONS

Low quality evidence, no evidence, or conflicting supporting evidence have resulted in the following statements for patient interventions to be listed as options for the specified condition. Future research may eventually cause these statements to be upgraded to strong or moderate recommendations for treatment.

## BMI: ADVERSE EVENTS

**Limited evidence suggests that elevated BMI may increase the risk of adverse events in patients undergoing total hip arthroplasty for symptomatic hip osteoarthritis.**

**Quality of Evidence:** Low

**Strength of Option:** Limited 

*Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

### Rationale

Numerous studies have evaluated the association between patient weight ranges and adverse events following total hip arthroplasty (THA). The available data are of limited quality with considerable heterogeneity. However, it is not feasible to perform a randomized controlled trial since body mass index (BMI) is not easily modifiable. Therefore, it is unknown if, in the existing literature, patients with elevated BMI were otherwise medically optimized and if all potentially confounding factors were adequately controlled.

Most studies find either no significant difference or increased complications after THA when comparing overweight or obese subjects to normal weight individuals. With higher obesity classes, the current evidence seems to more clearly establishes an association with increased risk of postoperative complications. These medical adverse events include mortality, cardiac complications, acute renal failure, deep venous thrombosis, and allogeneic blood transfusion. Patients with elevated BMI are also at increased risk of surgical adverse events such as periprosthetic fracture, dislocation, periprosthetic joint infection/superficial infection/wound dehiscence, femoral component subsidence/loosening/revision, increased polyethylene wear, reoperation/revision for any reason, and increased intraoperative blood loss (Lung 2023, Bowditch 1999, Tohidi 2019, Mouchti 2018, Davis 2011, Bourget-Murray 2021, Peters 2020, Sayed-Noor 2019, Burn 2019). It is important to note that while the complication rates of postoperative adverse events are significantly higher in patients with elevated BMI, absolute rates of adverse events remain relatively low. The decision to proceed with THA in properly optimized patients with elevated BMI should remain at the discretion of the operating surgeon.

### Benefits/Harms of Implementation

If elevated BMI is assumed to be a modifiable risk factor, there is value in identifying any association between BMI and adverse events after total hip arthroplasty (THA). While current evidence demonstrates an increased risk of postoperative adverse events in patients with elevated BMI, the quality of evidence is low. THA is a highly successful and cost-effective treatment that improves quality of life for patients with symptomatic hip arthritis. It is important that access to THA be preserved for medically optimized patients with elevated BMI. However, extremes of BMI are likely associated with a prohibitively high risk of postoperative adverse events.

### Outcome Importance
Adverse events following THA can be catastrophic for both the patient and costly to the health care system.

### Cost Effectiveness/Resource Utilization
THA has been demonstrated to be cost effective. Understanding the complication profile of patients with different BMIs may help surgeons make decisions on cost-effectiveness of THA in different patient populations.

### Acceptability
It is accepted that BMI may increase the risk of adverse events following total joint arthroplasty.

### Feasibility
It is feasible to determine pre-operative BMI and use this information to help risk stratify patients.

### Future Research
Future prospective research should focus on how to properly select and optimize patients with elevated BMI to minimize the risk of postoperative adverse events. In addition, future research is needed to definitively determine if losing weight and lowering BMI reduces the risk of complications after THA. Further research into the varying ways weight loss strategies t is necessary to determine if certain strategies are more effective at reducing risks after THA than others.



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## BMI: CLINICAL OUTCOMES

**Limited evidence supports that patients with elevated BMI and symptomatic osteoarthritis of the hip may achieve lower absolute patient reported outcome scores but a similar degree of improvement in patient satisfaction, pain, function, and quality of life after total hip arthroplasty.**

**Quality of Evidence:** Low

**Strength of Option:** Limited 

*Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

### Rationale

The majority of evidence demonstrates that patients of all body mass index (BMI) categories clinically improve following total joint arthroplasty. Patients with elevated BMI may recover more slowly, have less post operative physical activity (Paxton 2016), lower gait speed, less effective hip biomechanics, and achieve lower overall levels of satisfaction and function with total hip arthroplasty (THA) (McCalden 2011, Mukka 2020, Shadyab 2018, Davis 2011, Skutek 2016, Jackson 2009). However, despite lower total post operative outcome scores, the magnitude of improvement in these scores in patients with elevated BMI is equivalent to those of patients with normal BMI (Cleveland Clinic 2020, Liljensoe 2019, McLawhorn 2017). It should be noted that in many studies, elevated BMI was considered greater than 30. While studies of patients with higher BMIs (e.g., > 40) showed similar results, the available data is more limited in this population.

### Benefits/Harms of Implementation

There are no harms associated with the implementation of this option.

### Outcome Importance

It is important to understand that total hip arthroplasty patients show dramatic increases in their quality of life at all BMI levels.

### Cost Effectiveness/Resource Utilization

Total hip arthroplasty has been shown to be cost- effective. Understanding that patients of all BMI levels have improved quality of life and patient- reported outcomes may expand access to this cost- effective surgical intervention.

### Acceptability

It is accepted that BMI may influence the outcome of total hip arthroplasty.

### Feasibility

It is feasible to determine BMI and educate patients preoperatively on its impact on post operative outcomes.

### Future Research

Future research is warranted to determine the levels of improvement in patient reported outcomes after total hip arthroplasty based on BMI classes. Further research is also warranted to determine if certain patient reported outcomes improve more over others in patients with an elevated BMI. It is also necessary to determine if patient reported outcomes improve if BMI is reduced with preoperative weight loss before proceeding with THA.

## PRESCRIPTION OPIOID AS CONSERVATIVE TREATMENT

**In the absence of sufficient evidence, it is the opinion of the workgroup that oral opioids not be utilized for nonoperative treatment of symptomatic osteoarthritis of the hip.**

**Quality of Evidence:** Consensus
**Strength of Option:** Consensus ★☆☆☆

*Description: Evidence there is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of reliable evidence, the guideline work group is making a recommendation based on their clinical opinion.*

### Rationale
The systematic literature review yielded no studies that met inclusion criteria for this option. Outside the inclusion criteria, there is high quality evidence that oral opioids, including tramadol, result in a significant increase of adverse events and are not effective at improving pain or function for treatment of osteoarthritis of the knee. This led to a strong recommendation against the use of oral opioids for treatment of osteoarthritis of the knee in the AAOS Osteoarthritis of the Knee 3 Guideline. In addition to the risks associated with their use, preoperative opioid use is associated with increased risks of adverse events, complications, and revision in total hip arthroplasty. Patients who wean their opioid use before total hip arthroplasty have significant improvements in clinical outcomes after surgery compared to patients who continue their opioid use up until surgery.

### Benefits/Harms of Implementation
Opioids have limited clinical benefit and are associated with significant adverse events. In addition, they increase the risk of complications after total hip arthroplasty.

### Outcome Importance
The most important consideration will be removal of oral opioids from the medications prescribed in the treatment of osteoarthritis of the hip. This becomes particularly significant due to the rise of the opioid epidemic in the United States.

### Cost Effectiveness/Resource Utilization
The optimal nonoperative treatment of osteoarthritis of the hip should reduce pain and improve function. It is the opinion of the workgroup that opioids do not lead to improvements in pain and function and increase the risk of adverse events. Thus, there are significant clinical risks and cost-associated risks with their use.

### Acceptability
For most patients, this option should be readily implemented as it does not influence a major change in clinical practice. However, for patients who fail other nonoperative treatments, such as NSAIDs, acetaminophen or injections, there may be some resistance to this option. Importantly, these patients should be counseled on the significant risks associated with opioid use as well as their lack of efficacy.

### Feasibility
This option should be easily implemented with no apparent barriers to adoption.



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## Future Research

Future research is needed investigating alternative non-opioid nonoperative treatments of osteoarthritis of the hip. For patients who present with chronic opioid use, future research is warranted to investigate ways to assist patients in weaning off opioids prior to total hip arthroplasty.

## DIABETES: ADVERSE EVENTS

**Limited evidence suggests that patients with symptomatic osteoarthritis of the hip and poorly controlled diabetes may be at a higher risk for adverse events after total hip arthroplasty.**

**Quality of Evidence:** Low

**Strength of Option:** Limited 

*Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

### Rationale

There are very few articles in literature comparing diabetic and non-diabetic patients and their outcomes after total hip arthroplasty. Approximately 30 articles were identified on initial literature search; three low quality articles were included (Cancienne 2017, McVey 2020, Na 2020).

McVey (2020) retrospectively compared outcomes after THA between diabetic patients and a control group and found no difference in outcomes between groups. The diabetic group had an average A1c of 6.0% while only 27% patients had A1c more than 7.5%. While Cancienne (2017) found that patients with controlled diabetes had significantly fewer deep infections, McVey (2020) did not report significantly different rates of any adverse events, including deep infection. This cohort of patients had relatively well controlled diabetes which may be the reason for a nonsignificant increase in complication. Na (2020) divided the patients into four groups: uncontrolled diabetes, controlled diabetes with complications, controlled diabetes without complications, and no diabetes. The results show that patients without diabetes or with controlled diabetes without complications had more favorable outcomes than patients with uncontrolled diabetes or controlled diabetes with complications. These outcomes include overall complications, acute myocardial infarction, pulmonary embolism, pneumonia, sepsis/septicemia/shock, surgical site bleeding, and joint/wound infection.

### Benefits/Harms of Implementation

There is no consensus on acceptable HbA1c level considered safe for surgery. Patients with uncontrolled diabetes are at an increased risk of adverse events after THA, but there is no consensus on the best determinant of diabetes control and a cutoff by which the risks of surgery outweigh the benefits. The decision to proceed with surgery should be made by each individual patient and surgeon after an informed decision-making process where the risks and benefits of the procedure for that individual patient are discussed.

### Outcome Importance

Infection and renal injury could lead to significant morbidity and possibly mortality in patients.

### Cost Effectiveness/Resource Utilization

This option would not result in a change in resource utilization.

### Acceptability

This option should be widely accepted as it does not mandate a change in clinical practice.



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### Feasibility

There is no barrier to acceptance of the option.

### Future Research

Future research is needed to determine the optimal measure of diabetes control. In addition, more clarity in terms of risks at different severities of diabetes is needed. Future studies should stratify patients based on their A1c level or perioperative blood sugar level with sufficient power to see if there is any unsafe diabetes control for hip arthroplasty.

## SOCIAL DETERMINANTS OF HEALTH

**Limited evidence suggests that social determinants of health (e.g., education, income level, food desert, insurance type) may negatively impact length of stay, total cost of care, and mortality after total hip arthroplasty.**

**Quality of Evidence:** Low

**Strength of Option:** Limited ★★☆☆

*Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

### Rationale

Twenty-one low quality articles were included and analyzed for this option.

Ten of these articles (Delanois 2022, Edwards 2021, Edwards 2022 (a), Edwards 2022 (b), Hoelen 2023, Peltola 2014, Rubenstein 2020, Tram 2022, Weiner 2020, and Weiss 2019) observed how factors contributing to economic well-being affect outcomes in osteoarthritis of the hip (OAH) patients who underwent total hip arthroplasty (THA). The results show that higher income, greater amounts of financial liquid assets, and elevated socioeconomic status contribute to significantly lower rates of mortality, readmission, length of stay, revision surgery, infection, fracture, and dislocation. These factors also significantly improve VAS Pain, WOMAC, and Oxford Hip Scores.

Eleven articles (Cnudde 2017, Edwards 2021, Edwards 2022 (a), Edwards 2022 (b), Goodman 2018, Judge 2011, Leichtenberg 2016, MacKay 2017, Rubenstein 2020, Weiner 2020, and Weiss 2019) investigated the impact of education levels on outcomes in OAH patients who underwent THA. Mortality and readmission rates were significantly reduced in patients with higher education levels. Those with a college-level education demonstrated improved WOMAC Total scores.

Five articles (Cnudde 2017, Tram 2022, Weiner 2020, Weiss 2019, and Yang 2022) examined hospital-related factors, including the hospital's type, bed size, and volume, and their correlation with outcomes for OAH patients who underwent THA. Weiner (2020) concluded that hospitals with low patient volumes exhibit significantly reduced length of stay and discharge times. Tram (2022) and Yang (2022) observed that hospitals with smaller bed sizes experienced significant reductions in readmission rates and hospital-acquired pressure ulcers.

Cnudde (2017), Tram (2022), and Weiss (2019), however, reported mixed findings. They found that county and private hospitals demonstrate significantly improved survival rates compared to university hospitals, government hospitals exhibit significantly lower readmission rates than for-profit hospitals, and private and university hospitals experience significantly lower mortality rates than county hospitals.

Seven articles (Benes 2023, Goodman 2018, Koressel 2022, Sirignano 2023, Tram 2023, Weiner 2020, and Yang 2022) investigated the effects of insurance type on patient outcomes. Koressel (2022) showed that patients on Medicaid had significantly lower length of hospital stay and significantly higher rates of home discharge when compared to patients with dual eligibility. Goodman (2018), Koressel (2022), and Tram (2022) showed that patients on Medicare have significantly better outcomes in WOMAC Pain and Function, significantly increased



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rates of home discharge, and significantly reduced rates of return to emergency department/readmission when compared to patients with dual eligibility, patients on Medicaid, and patients with private insurance. Weiner (2020) showed that patients with other forms of insurance had a significantly lower hospital length of stay and significantly higher rates of non-home discharge when compared to Medicaid/uninsured patients. Benes (2023) showed significantly lower rates of revision in private insurance patients when compared with public insurance patients.

Sirigano (2023) and Yang (2022) conversely reported that outcomes in dislocation, revision, and hospital acquired pressure ulcers were significantly lower in patients with private insurance, and those without Medicare, when compared to patients with Medicare.

Seven articles (Benes 2023, Goodman 2018, Koressel 2022, Sirignano 2023, Tram 2023, Weiner 2020, and Yang 2022) delved into the impact of insurance type on patient outcomes. Koressel (2022) revealed that patients on Medicaid experienced significantly shorter hospital stays and higher rates of home discharge compared to patients with dual eligibility. Goodman (2018), Koressel (2022), and Tram (2022) demonstrated that patients on Medicare exhibited significantly improved WOMAC Pain and Function scores, higher rates of home discharge, and reduced rates of emergency department visits and readmissions in comparison to patients with dual eligibility, patients insured with Medicaid, and those with private insurance. Weiner (2020) showed that patients with other forms of insurance had significantly shorter hospital stays and increased rates of non-home discharge when compared with Medicaid/uninsured patients. Benes (2023) observed significantly lower revision rates in patients with private insurance when compared to those with public insurance.

However, Sirignano (2023) and Yang (2022) showed that patients with private insurance and those without Medicare experienced significantly fewer cases of dislocation, revision, and hospital-acquired pressure ulcers when compared to patients with Medicare.

Seven articles (Broggi 2022, Delanois 2022, Edwards 2021, Edwards 2022 (a), Edwards 2022 (b), Tram 2022, and Weiss 2019) investigated how living conditions influence the outcomes of patients with OAH who underwent THA. Edwards (2021) and Edwards (2022b) observed that patients who were cohabiting exhibited significantly reduced rates of revision, infection, pneumonia, fracture, dislocation, and mortality in comparison to those who were not cohabiting. Delanois (2022) demonstrated that costs of care were significantly lower in regions without food deserts than in those with food deserts. Broggi (2022) indicated that rates of dislocation, periprosthetic joint infection, readmission, and extended length of stay were significantly lower among urban patients when compared to rural patients.

Conversely, Tram (2022) showed significantly lower rates of readmission among rural patients compared to non-rural patients. Weiss (2019) also indicated significantly lower rates of mortality and readmission in patients who were not cohabiting, in comparison to those who were cohabiting.

Three articles (Brembo 2017, Delanois 2022, and Rubenstein 2020) observed how social support influences the outcomes of patients with OAH who underwent THA. Brembo (2017) found that patients who had perceived social support, reliable alliances, reassurances of worth, and self-efficacy had significantly higher WOMAC Total scores when compared to patients without those factors.

### Benefits/Harms of Implementation

Reducing the negative impact of social determinants of health on outcomes of total hip arthroplasty is an important societal goal without significant risk of harm.

### Outcome Importance
Low quality studies suggest that social determinants of health impact outcomes after total hip arthroplasty. Given the frequency of negative social determinants of health and the impact on equity, this is an area of high importance.

### Cost Effectiveness/Resource Utilization
Social determinants of health may significantly impact cost of care and resource utilization through variation in length of stay, and complication rates and increased post-discharge resource needs.

### Acceptability
This option should be widely accepted as it does not lead to a major change in practice.

### Feasibility
While there are no specific consistent recommendations to limit the negative impact of social determinants of health in the literature reviewed, it will likely require significant societal and governmental commitment including improved pre-operative health status, structural changes in post-discharge service availability and increased financial resources to improve outcomes.

### Future Research
Higher quality research is necessary focusing on the impact of specific societal determinants of health on total hip arthroplasty outcomes. In addition, research on identified, innovative measures to reduce the negative impact of social determinants of health would be valuable.



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## PHARMACOLOGICAL MANAGEMENT: ACETAMINOPHEN

**In the absence of sufficient evidence, it is the opinion of the workgroup that when not contraindicated, oral acetaminophen may be considered to improve pain and function in the treatment of symptomatic osteoarthritis of the hip.**

**Quality of Evidence:** Consensus
**Strength of Option:** Consensus ★☆☆☆

*Description: Evidence there is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of reliable evidence, the guideline work group is making a recommendation based on their clinical opinion.*

### Rationale

The systematic literature review yielded no studies that met inclusion criteria for this option. Outside the inclusion criteria, there is high quality evidence that oral acetaminophen improves pain and function for patients with osteoarthritis of the knee. This led to a strong recommendation supporting the use of oral acetaminophen for treatment of osteoarthritis of the knee in the AAOS Osteoarthritis of the Knee 3 Guideline.

### Benefits/Harms of Implementation

Although oral acetaminophen is widely utilized to treat osteoarthritis of the hip, there are contraindications to its use. Contraindications that should be considered include, but are not limited to, patients with preexisting liver disease.

### Outcome Importance

The use of non-opioid medications such as acetaminophen for nonoperative treatment of symptomatic osteoarthritis of the hip is extremely important to minimize the use of opioids.

### Cost Effectiveness/Resource Utilization

Acetaminophen is widely available and an extremely cost-effective treatment for symptomatic osteoarthritis of the hip. However, there is limited comparative data on the cost-effectiveness of oral acetaminophen compared to other nonoperative treatments of osteoarthritis of the hip.

### Acceptability

This option should be readily implemented as it does not influence a major change in clinical practice. Oral acetaminophen is commonly used to treat symptomatic osteoarthritis of the hip. This option further supports this clinical practice.

### Feasibility

Oral acetaminophen is widely available. Thus, this option should be easily implemented with no apparent barriers to adoption.

### Future Research

Future research is warranted to better understand the adverse events with oral acetaminophen use, particularly in patients at higher risk. Further studies are also needed to compare the different dosages and durations of treatment. Future studies are needed to establish efficacy within certain subgroups and populations.

## HIP-SPINE RELATIONSHIP

**In the absence of sufficient evidence, it is the opinion of the workgroup that patients with osteoarthritis of the hip and stiff spine syndrome may be at increased risk of dislocation after total hip arthroplasty compared to patients without stiff spine syndrome.**

**Quality of Evidence:** Low
**Strength of Option:** Consensus ★☆☆☆ (Downgraded)

*Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Option was downgraded based on EtD framework.*

### Rationale
The strength of this option was downgraded to consensus for several reasons including the heterogeneity of the data reported and the timepoints they were reported as well as the fact that future research will have a strong influence on this option in the future. Five low quality articles (Del Sole 2017, Barry 2017, Huang 2019, Salib 2019, Mohamed 2022) that investigated the relationship between osteoarthritis of the hip and stiff spine syndrome met inclusion criteria. While all five articles reported no significant association with dislocation, one article (Barry 2017) showed stiff spine syndrome was associated with more complications and higher reoperation rates.

### Benefits/Harms of Implementation
Dislocation remains one of the leading complications after total hip arthroplasty. The hip spine relationship has the potential to increase the risk of this complication, but there is a lack of concrete data. The spine has potential of negatively affecting total hip arthroplasty outcome, but it's not proven by robust data. Dislocation could be a devastating complication. However, patients with stiff spines should not be denied total hip arthroplasty. There should be open discussion between surgeon and patient about potential complications.

### Outcome Importance
Dislocations after total hip arthroplasty are a devastating complication. Factors that may increase this risk, such as a stiff spine, should be considered in total hip arthroplasty. Specific changes in implant choices or implant position may be considered in these patients.

### Cost Effectiveness/Resource Utilization
To mitigate the risk of dislocations, the use of dual mobility constructs and large femoral heads has increased, both of which increase the costs of surgery. In addition, there has been an increased adoption of technology in total hip arthroplasty to mitigate the risk of dislocation particular in high-risk patients such as those with stiff spines, which increases both the resource utilization and costs in total hip arthroplasty.

### Acceptability
The effect of stiff spine on total hip arthroplasty is relatively well appreciated by arthroplasty surgeons. There should not be any impediments in accepting the option.



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### Feasibility

This option is easy to implement the practice. There is no barrier in the implementation of such a option. Larger heads and dual mobility articulations are readily available.

### Future Research

There needs to be a prospective randomized trial to explore the effect of stiff spine on total hip arthroplasty. Future studies should also qualify the critical stiffness of the lumbar spine which would lead to adverse outcome of total hip arthroplasty. It will be important to know whether one- or two-level spinal fusion has any significant effect on hip dislocation. Furthermore, it is important to differentiate the effect of posterior pelvic tilt versus anterior pelvic tilt on total hip arthroplasty.

## NEURAXIAL VS. GENERAL ANESTHESIA

**Limited evidence suggests that neuraxial anesthesia may be used to reduce adverse events in patients with symptomatic osteoarthritis of the hip undergoing total hip arthroplasty.**

**Quality of Evidence:** Low

**Strength of Option:** Limited 

*Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

### Rationale

One high moderate quality (Liang 2017) and four low-quality (Basques 2015, Bourget 2022, Hunt 2013, Matharu 2020) were included. The moderate quality prospective randomized study by Liang 2017 showed shorter operative time, shorter duration of anesthesia, lower Visual Analogue Score for pain and high Minimum Metal State Examination Score (MME) with reginal anesthesia as compared to general anesthesia. Patients were followed for up to five days after surgery. There was no statistically significant difference in postoperative adverse effects, including pulmonary embolism, pneumonia, hypertension, renal failure, cardiac infarction, blood transfusion and mechanical ventilation. However, cardiac infarction, blood transfusion and mechanical ventilation numbers were twice in the general anesthesia group.

Two low-quality studies (Basques 2015, Matharu 2020) showed that there are lower blood transfusion rates with regional anesthesia. Another two low quality studies (Matharu 2020, Bourget 2022) reported shorter length of stay with reginal anesthesia. Three low-quality studies (Matharu 2020, Hunt 2013, Basques 2015) have reported lower overall complications.

Matharu (2020) showed lower 90-days any complication, readmission, renal failure, surgical site infection (SSI), deep vein thrombosis / pulmonary embolism (DVT/PE), blood transfusion and length of stay with regional anesthesia. Hunt (2013) reported lower 3-month mortality with regional anesthesia. Bourget (2022) had lower blood transfusion with reginal anesthesia but shorter length of stay with general anesthesia. Basques (2015) article favored reginal anesthesia for overall any complication, cardiac arrest, blood transfusion and operative time.

### Benefits/Harms of Implementation

Both general and neuraxial anesthesia in total hip arthroplasty is associated with specific risks and benefits. While neuraxial anesthesia is associated with lower rates of adverse events in most patients, the choice of anesthesia should be individualized to each patient based on their medical comorbidities. The decision to proceed with a particular type of anesthesia should be made by each individual patient and anesthesiologist after an informed decision-making process where the risks and benefits of each anesthetic for that individual patient are discussed.

### Outcome Importance

As the incidence and prevalence of osteoarthritis of the hip continues to rise, the number of total hip arthroplasty procedures performed is increasing as well.



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### Cost Effectiveness/Resource Utilization

No studies specifically addressed associated costs and resource utilization in a cost comparative approach between neuraxial and general anesthesia. Neuraxial anesthesia is performed by most anesthesiologists, but specialized training is required.

### Acceptability

This option should be readily implemented as it does not influence a major change in clinical practice. Both neuraxial and general anesthesia are widely utilized in total hip arthroplasty.

### Feasibility

General anesthesia and neuraxial anesthesia is available to most patients. Thus, this option should be easily implemented with no apparent barriers to adoption.

### Future Research

Future studies level I prospective randomized controlled trials are needed to compare general versus neuraxial anesthesia. Future studies should focus on the patient reported outcomes, functional outcomes, opioid consumption, recovery, as well as adverse events and costs. Future studies are also needed to establish differences in adverse events or clinical outcomes within certain subgroups and populations.

## TOBACCO

**Limited evidence suggests that patients with symptomatic osteoarthritis of the hip who use tobacco products may be at an increased risk for adverse events after total hip arthroplasty.**

**Quality of Evidence:** Low

**Strength of Option:** Limited 

*Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.*

### Rationale

Eleven low quality studies (Burn 2019, Sali 2020, Sadr Azodi 2006, Peters 2020, Huddleston 2012, Gonzalez 2018, Sirignano 2023, Lung 2023, Peters 2021, Benes 2023, Goh 2022) were reviewed. There is a lack of clarity in the literature regarding different forms of tobacco use. Smoking is widely considered to be more significant than other forms of tobacco use. Most of the studies have investigated the effect of smoking on surgical outcome. One low quality study (Sadr Azodi 2006) showed increased systemic complications in both current and former smokers, while another prospective study (Gonzalez 2018) showed increased PJI in current and former smokers. There is a lack of clarity in literature regarding different forms of tobacco use. Lung (2023) reported that smoking is an independent risk factor for sustaining periprosthetic fracture.

### Benefits/Harms of Implementation

There could be significant potential harm due to systemic complications and increased periprosthetic joint infections in smokers after total hip arthroplasty. It will result in significant financial burden and medical comorbidities. There is no benefit of smoking in patients undergoing total hip arthroplasty however, in absence of strong data, there is a concern about denial of care impatience with the smoking.

### Outcome Importance

Future research will help us understand the impact of smoking on total hip arthroplasty. Postoperative complications could have a significant impact on the patient under community.

### Cost Effectiveness/Resource Utilization

Any postoperative complication after total hip arthroplasty requires intense resource utilization and leads to increased cost of care.

### Acceptability

There is no barrier to the acceptability of this option. Physicians should have open discussions with patients about potential downside.

### Feasibility

This option does not contradict the current standard of care.



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## Future Research

Future well designed studies examining the effects of different forms of tobacco on the postoperative short- and long-term outcomes after total hip arthroplasty are needed. Stratification into the amount of tobacco use and those effects on outcomes are also needed. Future healthcare costs studies are also needed to determine the financial impact of tobacco use and complications after total hip arthroplasty.

# APPENDICES

## Appendix I: References

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## Appendix II: PICO Questions and Inclusion Criteria Used to Define Literature Search

PICO Questions

1. In patients with symptomatic OA of the hip undergoing arthroplasty, does BMI affect patient adverse events post-surgery?
2. In patients with symptomatic OA of the hip undergoing arthroplasty, does BMI affect patient clinical outcomes post-surgery?
3. In patients with osteoarthritis undergoing THA and with no known contraindications to the use of tranexamic acid, does the use of topical or intravenous tranexamic acid reduce complications and / or improve outcomes compared to not using tranexamic acid?
4. In patients with symptomatic hip OA, who have undergone total hip replacement, does postoperative physical therapy lead to better outcomes compared with patients who do not undergo PT or undergo comparison PTs?
5. In patients with symptomatic hip OA, not scheduled for total hip replacement, does physical therapy lead to better outcomes compared with patients without treatment?
6. In patients with symptomatic Hip OA, does use of IA corticosteroid or HA improve pain, stiffness, quality of life, and/or function?
7. In patients with symptomatic Hip OA who are being conservatively treated, does use of prescription opioids improve pain, stiffness, quality of life, and/or function, or lead to adverse events?
8. In patients with poorly controlled diabetes and symptomatic OA of the Hip undergoing hip surgery (THA), is there a difference in short term adverse events and functional recovery compared to patients with well controlled diabetes or no diabetes?
9. In patients with symptomatic OA of the Hip undergoing THA, does socioeconomic status, social comorbidities, and/or lack of social support affect outcomes?
10. In patients with symptomatic Hip OA, does NSAID pharmacologic management improve pain, stiffness, quality of life, and/or function?
11. In patients with symptomatic Hip OA, does acetaminophen pharmacologic management improve pain, stiffness, quality of life, and/or function?
12. In elderly patients with symptomatic Hip OA undergoing THA, is there a difference in clinical outcomes between those who receive cemented femoral fixation and cementless femoral fixation?
13. Among patients undergoing THA, is there a difference in adverse events, reoperations, or revisions in patients with stiff spine syndrome versus those without?
14. Do different anesthesia types affect outcomes of patients with symptomatic hip OA undergoing THA?

## Inclusion Criteria

To be included in our systematic reviews (and hence, in this guideline) an article had to meet the following criteria:

- Study must be of OAH or prevention thereof.
- Study must be published in or after 1966 for surgical treatment, rehabilitation, bracing, prevention, and MRI.
- Study must be published in or after 1966 for x rays and non-operative treatment.
- Study must be published in or after 1966 for all others non specified.
- Study should have 10 or more patients per group.
- For surgical treatment a minimum of 3 months follow up duration.
- Antibiotic prophylaxis, anti-coagulations, mode of anesthesia: all follow-ups
- For non-operative treatment a minimum of 1 month.

Standard Criteria for all CPGs:

- The article must be a full article report of a clinical study.
- Retrospective non-comparative case series, medical records review, meeting abstracts, historical
- articles, editorials, letters, and commentaries are excluded.
- Confounded studies (i.e., studies that give patients the treatment of interest AND another treatment)
- are excluded.
- Case series studies that have non-consecutive enrollment of patients are excluded.
- Controlled trials in which patients were not stochastically assigned to groups AND in which there was either a difference in patient characteristics or outcomes at baseline AND where the authors did not statistically adjust for these differences when analyzing the results are excluded.
- All studies of “Very Low” Quality of evidence are excluded.
- All studies evaluated as Level V will be excluded.
- Composite measures or outcomes are excluded even if they are patient oriented.
- Study must appear in a peer-reviewed publication.
- For any included study that uses “paper-and-pencil” outcome measures (e.g., SF-36), only those outcome measures that have been validated will be included.
- For any given follow-up time point in any included study, there must be ≥ 50% patient follow-up (if the follow-up is >50% but <80%, the study quality will be downgraded by one Level)
- Study must be of humans.
- Study must be published in English.
- Study results must be quantitatively presented.
- Study must not be an in vitro study.
- Study must not be a biomechanical study.
- Study must not have been performed on cadavers.

We will only evaluate surrogate outcomes when no patient-oriented outcomes are available.

Best Available Evidence

When examining primary studies, we will analyze the best available evidence regardless of study design. We will first consider randomized controlled trials identified by the search strategy. In the absence of two or more RCTs, we will sequentially search for prospective controlled trials, prospective comparative studies, retrospective comparative studies, and prospective case-series studies. Only studies of the highest level of available evidence are included, assuming that there were 2 or more 100 studies of that higher level. For example, if there are two Level II studies that address the recommendation, Level III and IV studies are not included.

We will only evaluate surrogate outcomes when no patient-oriented outcomes are available. We did not include systematic reviews or meta-analyses compiled by others or guidelines developed by other organizations. These documents are developed using different inclusion criteria than those specified by the AAOS work group. Therefore, they may include studies that do not meet our inclusion criteria. We recalled these documents, if the abstract suggested they might provide an answer to one of our recommendations and searched their bibliographies for additional studies to supplement our systematic review *2022 literature search for all PICOs will be performed from last search date of 2017 CPG.



View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

## Appendix III: Literature Search Strategy

| | |
|---|---|
| **Database:** | MEDLINE |
| **Interface:** | Ovid MEDLINE® and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions ® 1946 to October 3, 2022 |
| **Date of Original Guideline Search:** | 6/2/2015 |
| **Date of Initial Search:** | 10/4/2022 |
| **Date of Updated Search:** | 5/2/2023 |
| **Search** | OA Hip 2022 |
| **Line** | **Search Strategy** |
| **1** | English.lg. |
| **2** | (exp Animals/ NOT Humans/) OR exp Cadaver/ OR cadaver*.ti,ab. OR in-vitro.ti. OR ((comment OR editorial OR letter OR historical article) NOT clinical trial).pt. OR address.pt. OR news.pt. OR newspaper article.pt. OR pmcbook.af. OR case reports.pt. OR (case report? OR abstracts OR editorial OR reply OR comment? OR commentary OR letter).ti. OR (animal* OR dog OR dogs OR sheepdog OR canine OR cats OR feline OR horse* OR equine OR donkey* OR **mouse** OR mice OR murin?e OR woodmouse OR rat OR rats OR cottonrat* OR rodent* OR hamster* OR squirrel* OR chipmunk* OR otter* OR weasel* OR badger* OR beaver* OR llama* OR alpaca* OR rabbit* OR hare OR hares OR sheep OR ovine OR lamb* OR goat* OR porcine OR **swine*** OR pig OR pigs OR piglet* OR boar OR boars OR hog OR hogs OR cow OR cows OR cattle* OR bull OR bulls OR bovine OR bison* OR buffalo* OR monkey* OR ape OR apes OR baboon* OR gibbon* OR bonobo* OR gorilla* OR lemur* OR chimp* OR orangutan* OR macaque* OR marmoset* OR primate* OR bear OR bears OR **avian OR bird*** OR hen OR hens OR **chicken*** OR duck? OR goose OR geese OR **poultr*** OR fowl? OR turkey* OR deer OR doe OR reindeer OR dolphin OR (fish* NOT fisher*) OR pisces OR trout* OR zebrafish* OR catfish* OR goldfish* OR seahorse* OR shark* OR salmon* OR whitefish* OR reptil* OR snake* OR lizard* OR alligator* OR crocodile* OR turtle* OR amphibian* OR frog* OR toad* OR eel? OR salamander* OR veterinar*).ti. |
| **3** | 1 NOT 2 |
| **4** | Osteoarthritis-Hip/ OR ((Hip/ OR exp Hip-Joint/ OR (hip OR hips).tw,kf.) and (exp Osteoarthritis/ OR (osteoarthr* OR osteo-arthr* OR arthrosis OR arthroses).tw,kf.)) OR (coxarthros* OR malum-coxae-senilis).tw,kf. |
| **5** | 3 AND 4 |
| **6** | limit 5 to yr=2015-Current |
| **7** | Arthroplasty-Replacement-Hip/ OR Arthroplasty-Replacement/ OR Hip-Prosthesis/ OR Hip-Joint/su OR (arthroplast* OR replacement? OR THA OR THR).tw. |

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| **8** | Body-Mass-Index/ OR exp Body-Weight/ OR Adiposity/ OR ((body ADJ (mass OR fat)) OR BMI OR obes* OR (weight ADJ2 (body OR loss OR management OR control OR reduction OR counselling OR advice)) OR overweight OR underweight).tw. |
| **9** | 6 AND 7 AND 8 |
| **10** | Tranexamic Acid/ OR tranexamic.tw. |
| **11** | 6 AND 7 AND 10 |
| **12** | exp Physical-Therapy-Modalities/ OR Conservative-Treatment/ae OR (((physical OR physio OR exercis* OR manual OR spa OR occupational) ADJ3 therap*) OR physiotherap* OR **physical-activit*** OR ((resistance OR strength) ADJ training) OR rehab* OR prehab* OR telerehab* OR telehealth OR (web-based ADJ3 (program* OR intervention*)) OR (exercis* ADJ4 (train* OR program* OR intervention* OR strength* OR supervis* OR unsupervis* OR based OR educat* OR medicine)) OR hydrotherap* OR (thermal ADJ2 water?) OR cryotherap* OR acupuncture OR (electr*8 ADJ5 stimulat*) OR Tai-Chi OR cycling OR self-manag* OR (dr ADJ2 Bart)).tw. |
| **13** | 6 AND 12 |
| **14** | exp Adrenal-Cortex-Hormones/ OR (corticosteroid* OR (steroid* NOT (non-steroid*)) OR prednisone OR prednisolone OR methylprednisolone OR triamcinolone OR dexamethasone OR glucocorticoid*).tw. |



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| **15** | Viscosupplements/ OR Viscosupplementation/ OR Hyaluronic-Acid/ OR (hyal* OR hylan OR viscosupplement* OR (HA ADJ2 deriv*)).tw. |
| **16** | Injections-Intra-Articular/ OR ((intraarticular OR intra-articular) AND (delivery OR administration OR inject*)).tw. |
| **17** | 6 AND (14 OR 15 OR 16) |
| **18** | exp Narcotics/ OR Tramadol/ OR (narcotic* OR opioid* OR opiate* OR fentanyl OR morphine OR oxycodone OR codeine OR tramadol).tw. |
| **19** | 6 AND 18 |
| **20** | exp Diabetes-Mellitus/ OR diabet*.tw. |
| **21** | 6 AND 7 AND 20 |

| | |
|---|---|
| **22** | Healthcare-Disparities/ OR exp Sociological-Factors/ OR exp Socioeconomic-Factors/ OR exp Insurance-Coverage/ OR exp *Health-Facilities/ OR exp Population/ OR exp Population-Groups/ OR Demography/ OR ((race OR racial OR ethnic* OR social OR socio* OR psychosoci* OR insurance OR insured OR uninsured OR geograph* OR communit*) ADJ5 (difference? OR disparit* OR impact* OR outcome? OR effect? OR predict* OR factor? OR prognos* OR risk? OR correlat* OR related OR relationship? OR determinant* OR associat* OR parameter?)).tw. OR ((social ADJ (support OR isolation)) OR (education* ADJ3 (level? OR lower OR higher)) OR (pay#r* ADJ status) OR employment OR ((household OR quintile) ADJ1 income) OR deprivation).tw. |
| **23** | 6 AND 7 AND 22 |
| **24** | exp Anti-Inflammatory Agents-Non-Steroidal/ OR (NSAID* OR non-steroidal OR nonsteroidal OR ketorolac OR COX-2-inhibitor* OR COX2-inhibitor* OR celecoxib OR diclofenac OR aspirin).tw. |
| **25** | 6 AND 24 |



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| | |
|---|---|
| **26** | Acetaminophen/ OR (acetaminophen OR paracetamol).tw. |
| **27** | 6 AND 26 |
| **28** | *Bone-Cements/ OR *Cementation/ OR exp *Methylmethacrylates/ OR (((cement? OR cemented OR cementation) AND (cementless OR uncement* OR noncement* OR press-fit* OR (thread* ADJ2 (cup? OR component?)))) OR (hybrid ADJ3 (arthroplast* OR replacement? OR resurfac* OR THR? OR THA?)) OR polymethylmethacrylate* OR methylmethacrylate* OR methyl-methacrylate* OR ((mode? OR method?) ADJ3 fixat*) OR **((with ADJ3 cement*) AND (without ADJ3 cement*))**).tw. |
| **29** | 5 AND 7 AND 28 |

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|---|---|
| **30** | exp Spinal-Disease/ OR exp Back-Pain/ OR (((stiff* OR mobility OR motion OR hypermobil* OR alignment OR malalignment OR imbalance OR balance OR parameter? OR orientation OR tilt OR position* OR mechanic* OR indices OR inclination OR morpholog* OR obliquit* OR stability OR instability OR control) ADJ3 (spine OR spinal OR spinopelvic OR pelvic OR postur* OR lumbar OR whole-body OR neuromuscular)) OR sacral-slope OR ((hip OR spine) ADJ (syndrome* OR relation*)) OR postural-recovery OR spondylitis OR spondylosis OR spondyloarthr* OR spondylo-arthr* OR ankly* OR ((spine OR spinal OR lumbar OR interbody) ADJ2 fusion?) OR (back ADJ5 pain?) OR lower-back).tw. |
| **31** | 5 AND 7 AND 30 |
| **32** | exp Anesthesia-and-Analgesia/ OR exp Anesthetics/ OR Analgesics/ OR (an?esthesia OR an?esthetic? OR analges*).tw. |
| **33** | 6 AND 7 AND 32 |
| **34** | Tobacco/ OR exp Tobacco-Use/ OR Tobacco-Use-Disorder/ OR exp Smoking/ OR (tobacco OR nicotine OR smoking OR smoker? OR smoke).tw. |
| **35** | 6 AND 7 AND 34 |
| **36** | (((anterior OR anterolateral OR lateral OR posterolateral OR posterior OR miniposterior OR superior OR classic OR invasive) ADJ4 approach*) OR ((surgical OR operative) ADJ approach*)).tw. |
| **37** | 6 AND 7 AND 36 |
| **38** | randomized-controlled-trial.pt. OR exp Randomized-Controlled-Trials-as-Topic/ OR Random-Allocation/ OR random*.ti,ab. |
| **39** | (MEDLINE OR (systematic* AND review*) OR meta-analys*).ti,ab. OR (meta-analysis OR systematic-review).pt. |
| **40** | (17 OR 25 OR 37) AND (38 OR 39) |
| **41** | 40 OR (9 OR 11 OR 13 OR 19 OR 21 OR 23 OR 27 OR 29 OR 31 OR 33 OR 35) |
| | |
| **50** | 46 OR 49 |



View background material via the CPG eAppendix 1
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| | |
|---|---|
| **Database:** | Embase |
| **Interface:** | Elsevier (https://embase.com) |
| **Date or Original Guideline Search:** | 6/3/2015 |
| **Date of Initial Search:** | 10/4/2022 |
| **Date of Updated Search:** | 5/2/2023 |
| **Search** | OA Hip 2022 |
| **Line** | **Search Strategy** |
| **1** | [english]/lim |
| **2** | abstract-report/de OR book/de OR editorial/de OR editorial:it OR note/de OR note:it OR letter/de OR letter:it OR case-study/de OR case-report/de OR chapter:it OR conference-paper/exp OR conference-paper:it OR conference-abstract:it OR conference-review:it OR (abstracts OR editorial OR reply OR comment$ OR commentary OR letter):ti OR cadaver/de OR in-vitro-study/exp OR cadaver*:ti,ab OR in-vitro:ti OR animal-experiment/exp OR **veterinary-study/exp** OR **(nonhuman/de NOT human/exp)** OR (animal* OR dog OR dogs OR sheepdog OR canine OR cats OR feline OR horse* OR equine OR donkey* OR **mouse** OR mice OR murin$e OR woodmouse OR rat OR rats OR cottonrat* OR rodent* OR hamster* OR squirrel* OR chipmunk* OR otter* OR weasel* OR badger* OR beaver* OR llama* OR alpaca* OR rabbit* OR hare OR hares OR sheep OR ovine OR lamb* OR goat* OR porcine OR **swine*** OR pig OR pigs OR piglet* OR boar OR boars OR hog OR hogs OR cow OR cows OR cattle* OR bull OR bulls OR bovine OR bison* OR buffalo* OR monkey* OR ape OR apes OR baboon* OR gibbon* OR bonobo* OR gorilla* OR lemur* OR chimp* OR orangutan* OR macaque* OR marmoset* OR primate* OR bear OR bears OR **avian OR bird*** OR hen OR hens OR **chicken*** OR duck$ OR goose OR geese OR **poultr*** OR fowl$ OR turkey* OR deer OR doe OR reindeer OR dolphin OR (fish* NOT fisher*) OR pisces OR trout* OR zebrafish* OR catfish* OR goldfish* OR seahorse* OR shark* OR salmon* OR whitefish* OR reptil* OR snake* OR lizard* OR alligator* OR crocodile* OR turtle* OR amphibian* OR frog* OR toad* OR eel$ OR salamander* OR veterinar*):ti |
| **3** | #1 NOT #2 |
| **4** | hip-osteoarthritis/exp OR ((hip/exp OR (hip OR hips):ti,ab) AND (osteoarthritis/exp OR (osteoarthr* OR osteo-arthr* OR arthrosis OR arthroses):ti,ab)) OR (coxarthros* OR malum-coxae-senilis):ti,ab |
| **5** | #3 AND #4 |
| **6** | #3 AND #4 AND [2015-2023]/py |
| **7** | hip-arthroplasty/exp OR replacement-arthroplasty/de OR total-arthroplasty/de OR hip-prosthesis/exp OR (arthroplast* OR replacement$ OR THA OR THR):ti,ab |
| **8** | body-mass/de OR body-weight/exp OR ((body NEAR/1 (mass OR fat)) OR BMI OR obes* OR (weight NEAR/2 (body OR loss OR management OR control OR reduction OR counselling OR advice)) OR overweight OR underweight):ti,ab |
| **9** | #6 AND #7 AND #8 |
| **10** | tranexamic-acid/de OR tranexamic:ti,ab |
| **11** | #6 AND #7 AND #10 |

| | |
|---|---|
| **12** | physiotherapy/exp OR kinesiotherapy/exp OR (((physical OR physio OR exercis* OR manual OR spa OR occupational) NEAR/3 therap*) OR physiotherap* OR **physical-activit*** OR ((resistance OR strength) NEAR/1 training) OR rehab* OR prehab* OR telerehab* OR telehealth OR (web-based NEAR/3 (program* OR intervention*)) OR (exercis* NEAR/4 (train* OR program* OR intervention* OR strength* OR supervis* OR unsupervis* OR based OR educat* OR medicine)) OR hydrotherap* OR (thermal NEAR/2 water$) OR cryotherap* OR acupuncture OR (electr* NEAR/5 stimulat*) OR Tai-Chi OR cycling OR self-manag* OR (dr NEAR/2 Bart)):ti,ab |
| **13** | #6 AND #12 |
| **14** | corticosteroid/exp OR (corticosteroid* OR (steroid* NOT (non-steroid*)) OR prednisone OR prednisolone OR methylprednisolone OR triamcinolone OR dexamethasone OR glucocorticoid*):ti,ab |
| **15** | viscosupplement/de OR viscosupplementation/de OR hyaluronic-acid/de OR (hyal* OR hylan OR viscosupplement* OR (HA NEAR/2 deriv*)):ti,ab |
| **16** | intraarticular-drug-administration/exp OR ((intraarticular OR intra-articular) AND (delivery OR administration OR inject*)):ti,ab |
| **17** | #6 AND (#14 OR #15 OR #16) |
| **18** | narcotic-agent/exp OR narcotic-analgesic-agent/exp OR tramadol/de OR (narcotic* OR opioid* OR opiate* OR fentanyl OR morphine OR oxycodone OR codeine OR tramadol):ti,ab |
| **19** | #6 AND #18 |
| **20** | diabetes-mellitus/exp OR diabet*:ti,ab |
| **21** | #6 AND #7 AND #20 |
| **22** | health-care-disparity/de OR social-aspects-and-related-phenomena/exp OR insurance/exp OR population/exp OR population-group/exp OR population-parameters/exp OR population-reserach/de OR demography/exp OR ethnic-or-racial-aspects/exp OR ((race OR racial OR ethnic* OR social OR socio* OR psychosoci* OR insurance OR insured OR uninsured OR geograph* OR communit*) NEAR/5 (difference$ OR disparit* OR impact* OR outcome$ OR effect$ OR predict* OR factor$ OR prognos* OR risk$ OR correlat* OR related OR relationship$ OR determinant* OR associat* OR parameter$)):ti,ab OR ((social NEAR/1 (support OR isolation)) OR (education* NEAR/3 (level$ OR lower OR higher)) OR (pay?r* NEAR/1 status) OR employment OR ((household OR quintile) NEAR/1 income) OR deprivation):ti,ab |
| **23** | #6 AND #7 AND #22 |
| **24** | nonsteroid-antiinflammatory-agent/exp OR cyclooxygenase-2-inhibitor/exp OR (NSAID* OR non-steroidal OR nonsteroidal OR ketorolac OR ((COX-2 OR COX2) NEAR/1 inhibitor*) OR celecoxib OR diclofenac OR aspirin):ti,ab |
| **25** | #6 AND #24 |
| **26** | paracetamol/de OR (acetaminophen OR paracetamol):ti,ab |
| **27** | #6 AND #26 |
| **28** | bone-cement/exp OR (((cement$ OR cemented OR cementation) AND (cementless OR uncement* OR noncement* OR press-fit* OR (thread* NEAR/2 (cup$ OR component$)))) OR (hybrid NEAR/3 (arthroplast* OR replacement$ OR resurfac* OR THR$ OR THA$)) OR polymethylmethacrylate* OR methylmethacrylate* OR |



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| | |
|---|---|
| | methyl-methacrylate* OR ((mode$ OR method$) NEAR/3 fixat*) OR **((with NEXT/3 cement*) AND (without NEXT/3 cement*))**:ti,ab |
| **29** | #5 AND #7 AND #28 |
| **30** | spine-disease/exp OR (((stiff* OR mobility OR motion OR hypermobil* OR alignment OR malalignment OR imbalance OR balance OR parameter$ OR orientation OR tilt OR position* OR mechanic* OR indices OR inclination OR morpholog* OR obliquit* OR stability OR instability OR control) NEAR/3 (spine$ OR spinal OR spinopelvic OR pelvic OR postur* OR lumbar OR whole-body OR neuromuscular)) OR sacral-slope OR ((hip OR spine) NEAR/1 (syndrome* OR relation*)) OR postural-recovery OR spondylitis OR spondylosis OR spondyloarthr* OR spondylo-arthr* OR ankly* OR ((spine OR spinal OR lumbar OR interbody) NEAR/2 fusion$) OR (back NEAR/5 pain$) OR lower-back):ti,ab |
| **31** | #5 AND #7 AND #30 |
| **32** | anesthesiological-procedure/exp OR anesthetic-agent/exp OR analgesic-agent/exp OR (an$esthesia OR an$esthetic$ OR analges*):ti,ab |
| **33** | #6 AND #7 AND #32 |
| **34** | tobacco-use/exp OR (tobacco OR nicotine OR smoking OR smoker$ OR smoke):ti,ab |
| **35** | #6 AND #7 AND #34 |
| **36** | (((anterior OR anterolateral OR lateral OR posterolateral OR posterior OR miniposterior OR superior OR classic OR invasive) NEAR/4 approach*) OR ((surgical OR operative) NEAR/1 approach*)):ti,ab |
| **37** | #6 AND #7 AND #36 |
| **38** | randomized-controlled-trial/exp OR randomized-controlled-trial-topic/exp OR randomization/de OR random*:ti,ab,kw |
| **39** | systematic-review/exp OR meta-analysis/exp OR ((systematic* NEAR/2 review*):ti,ab,kw) OR meta-analys*:ti,ab,kw |
| **40** | (#17 OR #25 OR #37) AND (#38 OR #39) |
| **41** | #40 OR (#9 OR #11 OR #13 OR #19 OR #21 OR #23 OR #27 OR #29 OR #31 OR #33 OR #35) |
| | |
| **50** | #46 OR #49 |

| Database: | Cochrane Library |
|---|---|
| Interface: | wiley.com |
| Date or Original Guideline Search: | 6/5/2015 |
| Date of Initial Search: | 10/4/2022 |
| Date of Updated Search: | 5/2/2023 |
| Search | OA Hip 2022 |
| **Line** | **Search Strategy** |
| 1 | ((hip OR hips):ti,ab AND (osteoarthr* OR osteo-arthr* OR arthrosis OR arthroses):ti,ab) OR (coxarthros* OR malum-coxae-senilis):ti,ab |
| 2 | (arthroplast* OR replacement? OR THA OR THR):ti,ab |
| 3 | ((body NEAR/1 (mass OR fat)) OR BMI OR obes* OR (weight NEAR/2 (body OR loss OR management OR control OR reduction OR counselling OR advice)) OR overweight OR underweight):ti,ab |
| 4 | #1 AND #2 AND #3 |
| 5 | tranexamic:ti,ab |
| 6 | #1 AND #2 AND #5 |
| 7 | (((physical OR physio OR exercis* OR manual OR spa OR occupational) NEAR/3 therap*) OR physiotherap* OR **physical-activit*** OR ((resistance OR strength) NEAR/1 training) OR rehab* OR prehab* OR telerehab* OR telehealth OR (web-based NEAR/3 (program* OR intervention*)) OR (exercis* NEAR/4 (train* OR program* OR intervention* OR strength* OR supervis* OR unsupervis* OR based OR educat* OR medicine)) OR hydrotherap* OR (thermal NEAR/2 water?) OR cryotherap* OR acupuncture OR (electr* NEAR/5 stimulat*) OR Tai-Chi OR cycling OR self-manag* OR (dr NEAR/2 Bart)):ti,ab |
| 8 | #1 AND #7 |
| 9 | (corticosteroid* OR (steroid* NOT (non-steroid*)) OR prednisone OR prednisolone OR methylprednisolone OR triamcinolone OR dexamethasone OR glucocorticoid*):ti,ab |
| 10 | (hyal* OR hylan OR viscosupplement* OR (HA NEAR/2 deriv*)):ti,ab |
| 11 | ((intraarticular OR intra-articular) AND (delivery OR administration OR inject*)):ti,ab |
| 12 | #1 AND (#9 OR #10 OR #11) |
| 13 | (narcotic* OR opioid* OR opiate* OR fentanyl OR morphine OR oxycodone OR codeine OR tramadol):ti,ab |
| 14 | #1 AND #13 |
| 15 | diabet*:ti,ab |
| 16 | #1 AND #2 AND #15 |
| 17 | ((race OR racial OR ethnic* OR social OR socio* OR psychosoci* OR insurance OR insured OR uninsured OR geograph* OR communit*) NEAR/5 (difference? OR disparit* OR impact* OR outcome? OR effect? OR predict* OR factor? OR prognos* OR risk? OR correlat* OR related OR relationship? OR determinant* OR associat* OR parameter?)):ti,ab OR ((social NEAR/1 (support OR isolation)) OR (education* NEAR/3 (level? OR lower OR higher)) OR (pay?r* NEAR/1 status) OR employment OR ((household OR quintile) NEAR/1 income) OR deprivation):ti,ab |
| 18 | #1 AND #2 AND #17 |



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| | |
|---|---|
| **19** | (NSAID* OR non-steroidal OR nonsteroidal OR ketorolac OR ((COX-2 OR COX2) NEAR/1 inhibitor*) OR celecoxib OR diclofenac OR aspirin):ti,ab |
| **20** | #1 AND #19 |
| **21** | (acetaminophen OR paracetamol):ti,ab |
| **22** | #1 AND #21 |
| **23** | (((cement? OR cemented OR cementation) AND (cementless OR uncement* OR noncement* OR press-fit* OR (thread* NEAR/2 (cup? OR component?)))) OR (hybrid NEAR/3 (arthroplast* OR replacement? OR resurfac* OR THR? OR THA?)) OR polymethylmethacrylate* OR methylmethacrylate* OR methyl-methacrylate* OR ((mode? OR method?) NEAR/3 fixat*) OR **((with NEXT/3 cement*) AND (without NEXT/3 cement*))**):ti,ab |
| **24** | #1 AND #2 AND #23 |
| **25** | (((stiff* OR mobility OR motion OR hypermobil* OR alignment OR malalignment OR imbalance OR balance OR parameter? OR orientation OR tilt OR position* OR mechanic* OR indices OR inclination OR morpholog* OR obliquit* OR stability OR instability OR control) NEAR/3 (spine? OR spinal OR spinopelvic OR pelvic OR postur* OR lumbar OR whole-body OR neuromuscular)) OR sacral-slope OR ((hip OR spine) NEAR/1 (syndrome* OR relation*)) OR postural-recovery OR spondylitis OR spondylosis OR spondyloarthr* OR spondylo-arthr* OR ankly* OR ((spine OR spinal OR lumbar OR interbody) NEAR/2 fusion?) OR (back NEAR/5 pain?) OR lower-back):ti,ab |
| **26** | #1 AND #2 AND #25 |
| **27** | (an?esthesia OR an?esthetic? OR analges*):ti,ab |
| **28** | #1 AND #2 AND #27 |
| **29** | (tobacco OR nicotine OR smoking OR smoker? OR smoke):ti,ab |
| **30** | #1 AND #2 AND #29 |
| **31** | (((anterior OR anterolateral OR lateral OR posterolateral OR posterior OR miniposterior OR superior OR classic OR invasive) NEAR/4 approach*) OR ((surgical OR operative) NEAR/1 approach*)):ti,ab |
| **32** | #1 AND #2 AND #31 |
| **33** | (#4 OR #6 OR #8 OR #12 OR #14 OR #16 OR #18 OR #20 OR #22 OR #28 OR #30 OR #32) *with Publication Year from 2015 to 2022 (2023 on update), in Trials* |
| **34** | #24 OR #26 |
| **35** | #33 OR #34 |
| **36** | "conference abstract":pt OR (abstracts OR editorial OR reply OR comment? OR commentary OR letter):ti OR cadaver*:ti,ab OR "in vitro":ti OR (animal* OR dog OR dogs OR sheepdog OR canine OR cats OR feline OR horse* OR equine OR donkey* OR **mouse** OR mice OR murin?e OR woodmouse OR rat OR rats OR cottonrat* OR rodent* OR hamster* OR squirrel* OR chipmunk* OR otter* OR weasel* OR badger* OR beaver* OR llama* OR alpaca* OR rabbit* OR hare OR hares OR sheep OR ovine OR lamb* OR goat* OR porcine OR **swine*** OR pig OR pigs OR piglet* OR boar OR boars OR hog OR hogs OR cow OR cows OR cattle* OR bull OR bulls OR bovine OR bison* OR buffalo* OR monkey* OR ape OR apes OR baboon* OR gibbon* OR bonobo* OR gorilla* OR lemur* OR chimp* OR orangutan* OR macaque* OR marmoset* OR primate* OR bear OR bears OR **avian OR bird*** OR hen OR hens OR **chicken*** OR duck? OR goose OR geese OR **poultr*** OR fowl? OR turkey* OR deer OR doe OR reindeer OR dolphin OR (fish* NOT fisher*) OR pisces OR trout* OR zebrafish* OR catfish* OR goldfish* OR seahorse* |

| | |
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| | OR shark* OR salmon* OR whitefish* OR reptil* OR snake* OR lizard* OR alligator* OR crocodile* OR turtle* OR amphibian* OR frog* OR toad* OR eel? OR salamander* OR veterinar*):ti |
| **37** | **#35 NOT #36** |
| | |
| **48** | #44 OR #47 |



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## Appendix IV: Guideline Development Group Disclosures

Prior to the development of this clinical practice guideline, clinical practice guideline development group members disclose conflicts of interest (COI). They disclose COIs in writing to the American Academy of Orthopaedic Surgeons via a private on-line reporting database and also verbally at the recommendation approval meeting.

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Flexion Therapeutics: Research support ($0)
Microport Orthopedics, Inc.: Research support ($0)
Orthofix, Inc.: Research support ($100,000) we receive institutional support for a research project that we are conducting. I receive nothing.(Self)
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