PHYSICAL THERAPIST MANAGEMENT OF GLENOHUMERAL JOINT OSTEOARTHRITIS: A CLINICAL PRACTICE GUIDELINE FROM THE AMERICAN PHYSICAL THERAPY ASSOCIATION

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Disclaimer

This clinical practice guideline was developed by an American Physical Therapy (APTA) volunteer guideline development group consisting of physical therapists, an occupational therapist, and a physician. It was based on systematic reviews of current scientific literature, clinical information, and accepted approaches to the physical therapist management of glenohumeral joint osteoarthritis. This clinical practice guideline is not intended to be a fixed protocol, as some patients may require more or less treatment. Clinical patients may not necessarily be the same as participants in a clinical trial. Patient care and treatment should always be based on a clinician's independent medical judgment, given the individual patient's clinical circumstances.

Disclosure Requirement

In accordance with APTA policy, all individuals whose names appear as authors or contributors to this 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.

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TABLE 1. SUMMARY OF RECOMMENDATIONS

DIAGNOSIS: HISTORY, PHYSICAL EXAM, RADIOGRAPHS, MRI

Diagnosis Recommendation #1: History, physical exam, and radiographs can be useful to differentially diagnose glenohumeral joint osteoarthritis (GHOA); specifically, critical shoulder angle on radiographs and age is predictive of the diagnosis.

Evidence quality: Moderate

Recommendation Strength: Moderate

Diagnosis Recommendation #2: Advanced imaging of MRI is beneficial in the differential diagnosis of GHOA. MRI is helpful to confirm the diagnosis; but is less useful to rule out the diagnosis.

Evidence quality: High

Recommendation Strength: Strong

POST-OPERATIVE MANAGEMENT: SLING AND EXERCISE

Physical therapists should implement the use of a sling with the shoulder in a neutral position and progressive exercises for ROM and strengthening to improve patient-reported outcomes, and ROM in patients with GHOA who have undergone total shoulder arthroplasty (TSA).

Evidence quality: High

Recommendation Strength: Strong

POST-OPERATIVE PHYSICAL THERAPY DIRECTED PAIN MANAGEMENT

Physical therapists should implement the use of a sling with the shoulder in a neutral position for pain management in patients with GHOA who have undergone TSA.

Evidence quality: Moderate

Recommendation Strength: Moderate

POST-OPERATIVE PHYSICAL THERAPY TIMING

The timing of the introduction of shoulder ROM exercises by physical therapists may be delayed up to 4 weeks without negatively impacting patient-reported outcomes in patients with GHOA who have undergone TSA.

Evidence quality: Moderate

Recommendation Strength: Moderate

SUMMARY OF BEST PRACTICE STATEMENTS

The following recommendations are consensus statements by the guideline development group (GDG) based on current clinical practice norms and clinical expertise.

PRE-OPERATIVE PHYSICAL THERAPY FOR PATIENTS SCHEDULED FOR TSA

In the absence of reliable evidence, the opinion of the GDG is that physical therapist services delivered preoperatively may benefit postoperative outcomes in patients with GHOA who are undergoing TSA.

Evidence quality: Insufficient

Recommendation Strength: Best Practice

NONOPERATIVE PHYSICAL THERAPY COMPARISON TO OTHER MANAGEMENT STRATEGIES

In the absence of reliable evidence, the opinion of the GDG is that physical therapist services may benefit patients with GHOA who have not undergone TSA.

Evidence quality: Insufficient

Recommendation Strength: Best Practice

NONOPERATIVE PHYSICAL THERAPY INTERVENTION OPTIONS

In the absence of reliable evidence, the opinion of the GDG is that no one specific intervention performed by a physical therapist is superior to another for patients with GHOA.

Evidence quality: Insufficient

Recommendation Strength: Best Practice

POST-OPERATIVE PHYSICAL THERAPY OUTCOMES

In the absence of reliable evidence, the opinion of the GDG is that physical therapist services delivered postoperatively may benefit patient-rated functional outcomes in the management of patients who have undergone TSA for GHOA.

Evidence quality: Insufficient

Recommendation Strength: Best Practice

POST-OPERATIVE PHYSICAL THERAPY EDEMA MANAGEMENT

In the absence of reliable evidence, the opinion of the GDG is that physical therapist interventions for edema in patients with GHOA who have undergone TSA should be based on best available evidence, clinical expertise, and patient values.

Evidence quality: Insufficient

Recommendation Strength: Best Practice

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Introduction

Overview

This clinical practice guideline (CPG) is based on a systematic review of published studies involving the physical therapist management of patients with glenohumeral joint osteoarthritis (GHOA) and those undergoing total shoulder arthroplasty (TSA). In addition to providing practice recommendations, this guideline also highlights limitations in the literature; areas for future research; intentional vagueness; potential benefits, risks, harms, and costs to implementing each recommendation; and quality improvement activities.

This CPG is intended to be used by all qualified and appropriately trained physical therapists and physical therapist assistants involved in the management of individuals with GHOA and those undergoing TSA. It also is intended to be an information resource for decision makers, health care providers, and consumers.

Goals and Rationale

The purpose of this CPG is to help improve the physical therapist management of individuals with GHOA and those undergoing TSA. This CPG is based on the current best evidence and other elements of evidence-based practice, which is considered the integration of best available evidence, clinical expertise, and patient values and circumstances related to patient and client management, practice management, and health policy decision-making.[1] To assist clinicians, this CPG contains a systematic review of the available literature regarding the management of individuals with GHOA and those undergoing TSA. This review included randomized controlled trials and diagnostic studies, and identifies where there is evidence, where evidence is lacking, and topics that future research must target to improve the physical therapist management of individuals with GHOA and those undergoing TSA.

Physical therapist services are provided in diverse settings by many different providers. This CPG is an educational tool to guide qualified clinicians through a series of management decisions in an effort to improve quality and efficiency and reduce unwarranted variation of care. Recommendations guide evidence-based practice while considering the patient's wants and needs in the clinical decision-making process. This CPG should not be construed as including all proper methods of care or excluding methods of care reasonably directed at obtaining the same results. The ultimate judgment regarding the application of any specific procedure or treatment must be made by the physical therapist in light of all circumstances presented by the patient, including safety, preferences, and disease stage, as well as the needs and resources particular to the locality or institution.

Intended Users

This CPG is intended to be used by physical therapists, and physical therapist assistants under the direction of physical therapists, for the management of patients who have GH joint OA, pre and post TSA as well as those currently not planning to undergo a TSA. Physical therapists are health care professionals who help individuals maintain, restore, and improve movement, activity, and functioning to enable optimal performance and enhance health, well-being, and quality of life. Orthopedic surgeons, primary care clinicians, geriatricians, hospital-based adult medicine specialists, physiatrists, occupational therapists, nurse practitioners, physician assistants, emergency department clinicians, and other health care providers who routinely manage patients with GHOA, either operatively or nonoperatively, may benefit from this CPG. It should be used to guide the informed and shared decision-making with the

patient for management of GHOA. This guideline is not intended for use as an insurance benefit determination document.

Patient Population

This guideline addresses nonoperative, preoperative, and postoperative management of individuals with GHOA, who may or may not undergo TSA. This document is not intended to address management of TSA revision, partial or reverse shoulder arthroplasty, pediatric patients (under age 18), or patients with primary rheumatoid arthritis.

Burden of Disease

Osteoarthritis (OA) is one of the leading causes of pain, disability, and health care resource use in the United States, with over 54 million (23%) older adults diagnosed with OA and 24 million limited in performing daily activities.[2] One in four people with OA report severe pain that limits their ability to do daily tasks at work and at home, costing over $300 billion in health care costs and lost wages annually.[2] With the aging population, the incidence of OA is increasing, resulting in higher costs to the health care system and to the individual in both dollars and impact on quality of life. As the aging population increases, this societal impact also will continue to increase.

The incidence of glenohumeral (GH) joint OA is related to the high level of joint mobility and required use of the GH joint in daily tasks. In published large scale population studies, GHOA-associated degenerative changes have been seen radiographically in 17%-20% of adults over the age of 65 years.[3,4] Degenerative changes in the GH joint are found in up to 17% of patients with shoulder pain.[5] This condition occurs more frequently in women than in men, and more frequently in those who have had previous shoulder injuries, have occupations that require heavy lifting, and are active in sports requiring overhead use of the upper extremity.[3,6]

GHOA can impact quality of life and arm function; especially related to overhead activities and those requiring shoulder external rotation.[6] Sleep issues have been reported related to difficulty falling asleep and night pain waking individuals.[6] Psychological factors, such as anxiety and depression, have been shown to influence pain perception and impact outcomes of care.[7,8] Treatment for GHOA has included pain and anti-inflammatory medications (including injections), thermo therapy, strengthening and flexibility exercises, massage, and bracing. When these interventions are not effective, surgery of the joint may be indicated in the form of arthroscopy or TSA.[9] While joint replacement surgery is most common in hips and knees, shoulder joint replacements are the third most commonly performed surgery to mitigate pain and disability.[10] Annually, 53,000 adults undergo GH joint replacement surgery, which accounts for 4% of all joint replacements and tends to increase in prevalence with aging.[11]

Pre-operative health status related to physical strength and function has been associated with favorable post-operative outcomes of total joint replacements.[12] These studies related to THA and TKA, suggest pre-operative and post-operative care for patients with TSA will provide benefits in reducing pain and disability, however research in this area for TSA is not available. For patients being managed post operatively, a recent study[13] reported a high prevalence of outpatient falls following shoulder arthroplasty. In 198 patients who underwent shoulder arthroplasty, 10.6% had a fall after they went home that resulted in visits to the emergency room and hospital readmission due to injury to an anatomic site other than the shoulder and/or injury at the surgical site (eg, periprosthetic humeral fracture). This begs the question to be answered: What type(s) of postoperative management is needed to optimize the quality of life for people who have undergone a TSA?

Etiology

The etiology of GHOA is similar to that of OA in other large joints via classification into primary or degenerative for no known cause, or secondary OA related to prior injury or disease process. GHOA has been characterized by humeral head cartilage loss with subsequent adaptive changes to the subchondral bone and development of osteophytes that impact the biomechanical function of the shoulder.[14] In aging, the collagen content is unchanged but becomes less hydrated and more permeable. In contrast, with OA, there is an increase in activity of collagenase and matrix metal-loproteinases that is associated with increased water content, disorganization of the collagen framework, and breakdown of protein proteoglycan content.[15] Multiple factors have been identified that increase risk of developing GHOA, defined in the risk factor section.

As GHOA progresses in severity of symptoms and limiting arm function, a TSA may become an option. The goal of TSA is to relieve pain and improve function. This surgery can be indicated when arthritis has progressed to degeneration of the joint cartilage, impacting the articular surfaces between the humeral head and the glenoid fossa on the scapula. Rotator cuff tendon tears, severe fracture, and rheumatoid disease can also lead to TSA. The humeral head is held in the glenoid fossa of the scapula by the rotator cuff muscles and ligaments. During a TSA, prosthetic components replace the articular surfaces of the humerus and glenoid fossa. The humeral head and stem are fabricated primarily from metal, and the stem is fixed into the humeral shaft. Stemless humeral head implants are also used. The artificial glenoid socket can be made of polyethylene, metal, or a combination of both, and fixed into the glenoid socket. Both components can be press-fitted (pressed into the bone without cement) or cemented in place. The use of the prosthetic socket is dependent on the severity of the arthritis and whether the rotator cuff tendons are still intact.[16]

Risk Factors

There are multiple proposed risk factors for GHOA, including age, genetics, obesity, joint loading, occupation, exercise, GH joint stability and integrity, rotator cuff arthropathy, and scapular morphology.[17] Age is a known risk factor, similar to arthritis in other joints. Prevalence of GHOA has been reported in 17.4%-20.3% of those 65 years and older in South Korean and Japanese cohorts.[3,4] Women have a higher prevalence of GHOA, but being female is not an independent risk factor.[3,6] Other factors besides age may lead to secondary OA that include trauma, shoulder instability, joint infections, and fracture of the GH joint are associated with the development of GHOA. Other anatomical factors associated with GHOA include rotator cuff tears and, in particular, cuff arthropathy, and scapular morphological deficits that can increase the compressive forces at the GH joint. Environmental risk factors such as heavy construction jobs that involve loading to the shoulder and overhead sports may also play a role in the development of GHOA. Genetics have been identified as a factor in degenerative joint disease. Interplaying with genetics are associated risk factors of joint and systemic inflammation and obesity. Obesity has been associated more with lower extremity OA but not found to be an independent risk factor for GHOA.[3] Obesity can be associated with upper extremity OA, but is more intertwined with inflammation and dyslipidemia.

Potential Benefits, Risks, Harms, and Costs

The potential benefits, risks, harms, and costs are provided for each recommendation within this document. TSA is a relatively new orthopedic surgery; thus, follow-up studies are just now emerging from the last 15 years or so, and overall global harm is not available. Short- and long-term follow-up have shown that the radiographic findings of complications include periprosthetic lucency (thinning of the bone around the implant), subluxation (partial dislocation of the implant), and erosion (wearing away) of the bone underneath the implant.[18,19] Some of these complications required revisions due to loosening of the

implant, polyethylene wear, and bone fracture of the humerus (upper arm bone). Most patient complaints focused on loss of motion, persistent pain, and need for revision.

Emotional and Physical Impact

Psychological factors can impact pain and functional outcomes.[17] Patients undergoing hip or knee joint arthroplasty who had high SF-36 mental health scores had lower functional outcomes both preoperatively and postoperatively than did those with lower psychological distress.[20] In patients with GHOA undergoing TSA, those with higher depression and anxiety scores preoperatively had less improvements postoperatively in self-report function and pain.[7] Assessment of psychological factors may be indicated to determine if the management of the mental health factors is indicated.[21] A comprehensive screening tool may be helpful to identify the presence of psychosocial factors that can impact recovery, such as the Optimal Screening for Prediction of Referral and Outcome for Yellow Flags (OSPRO-YF).[22]

The presence of GHOA and undergoing TSA can impact functional limitations of the shoulder complex that can reduce the ability to perform social and work-related tasks involving the UE. Depending on the tasks (both at home and in the workplace) the demands on the muscular and joint structures of the shoulder complex may lead to awkward postures to perform a task resulting in fatigue and overuse syndromes. Additionally, psychosocial work issues may alter an individual's perception of pain and functional difficulties and thus impact recovery.[6] Patient-reported functional outcomes indicate that surgical (TSA) and nonsurgical management that includes physical therapist services can be beneficial.[23–25]

Outcome Measures

Assessment of ROM (passive and active), strength, pain, anthropometrics and mechanics of the shoulder complex along with patient-reported outcome measures should be used to develop a patient-specific treatment plan and determine patient response to care. Valid and reliable patient-reported outcome measures are an important part of the initial assessments and reassessments to quantify the patient perspective of symptoms, activity limitations and participation restrictions. A triangulation of patient-reported outcome measures may be useful when assessing the impact on activity limitations and participation restrictions. A condition-specific, upper extremity-specific, or shoulder-specific outcome measure may be included as one piece of outcome assessment. The Western Ontario Osteoarthritis Score (WOOS) Shoulder Index is a specifically designed outcome measure to assess symptoms, function/disability, and emotions in patients with shoulder osteoarthritis.[26] Examples of upper extremity measures include the Disability of the Arm, Shoulder and Hand (DASH) or shortened version, the QuickDASH.[27,28] Many shoulder specific outcome measures would be appropriate to assess patients with GHOA and/or pre- and postop TSA such as the Shoulder Pain and Disability Index (SPADI),[29,30] Penn Shoulder Score (PENN),[31] Simple Shoulder Test (SST),[32–34] and American Shoulder and Elbow Surgeons score (ASES).[34,35] The ASES and WOOS have been demonstrated to be the most responsive of extremity-specific and condition-specific measures in patients undergoing TSA.[36] Patient-specific measures should also be used to guide individual patient care, such as the Patient-Specific Functional Scale (PSFS).[37,38] Finally, an anchor may be helpful to interpret the patient-reported outcome scores, such as determining the Patient Acceptable Symptom State[39] or simply asking if the patient is satisfied with their current status. Patient-reported outcome measures can be found on the APTA webpage for Tests and Measures.[40]

Future Research

Consideration for future research is provided for each recommendation within this document.

Methods

The methods used to develop this CPG 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 for physical therapist management of GHOA and TSA. Methods from the *APTA Clinical Practice Guideline Manual*[41] and *AAOS Clinical Practice Guideline Methodology*[42] were used in development of this CPG.

This CPG evaluates the effectiveness of approaches in the physical therapist management of GHOA. APTA sought out the expertise of the AAOS Evidence-Based Medicine Unit as paid consultants to assist in the methodology of this CPG. The multi-disciplinary guideline development group (GDG) consisted of physical therapist members from APTA and its representative sections and academies, AAOS, American Occupational Therapy Association, and American Academy of Physical Medicine and Rehabilitation. All GDG members, APTA staff, and methodologists were free of potential conflicts of interest relevant to the topic under study, as recommended by the National Academies of Sciences and Medicine's *Clinical Guidelines We Can Trust*.[15]

This CPG was prepared by the APTA Glenohumeral Joint Osteoarthritis Clinical Practice Guideline Development Group (clinical experts) with the assistance of the AAOS Clinical Quality and Value (CQV) Department (methodologists). To develop this guideline, the GDG held an introductory meeting on June 16, 2020, to establish the scope of the CPG. The GDG defined the scope of the CPG by creating PICOT questions (i.e., population, intervention, comparison, outcome, and time) that directed the literature search. The AAOS medical librarian created and executed the search (see Appendix 3 for search strategy). AAOS chose the included studies and performed quality assessments based on the published guideline methodology. The GDG performed final reviews of the literature and recommendations, provided rationale in the context of physical therapist practice, and adjusted the strength of the recommendations depending on the magnitude of benefit, risk, harm, and cost.

Best Evidence Synthesis

This CPG includes only the best available evidence for any given outcome addressing a recommendation. Accordingly, the highest quality evidence for any given outcome is included first if it was available. In the absence of 2 or more occurrences of an outcome based on the highest-quality (Level I) evidence, outcomes based on the next level of quality were considered until at least 2 or more occurrences of an outcome had been acquired (see Table 2). For example, if there were 2 "moderate" quality (Level II) occurrences of an outcome that addressed a recommendation, the recommendation does not include "low" quality (Level III) occurrences of evidence for this outcome. For best practice statements for which high- or moderate-quality studies were not available, the other two elements of evidence-based practice (clinician experience/knowledge base, and patient values and preferences) were used to make the recommendation. A summary of excluded articles can be viewed in Appendix 2.

Literature Searches

The medical librarian conducted a comprehensive search of PubMed, Embase, and the Cochrane Central Register of Controlled Trials based on key terms and concepts from the PICOT questions. Bibliographies of relevant systematic reviews were hand searched for additional references. All databases were last searched on December 8, 2020, with limits for publication dates from 1990 through 2020 and English language. The PICOT questions used to define the literature search and inclusion criteria, and the literature search strategy used to develop this CPG, can be found in Appendix 3.

Defining the Strength of the Recommendations

Judging the quality of evidence is only a steppingstone toward arriving at the strength of a CPG recommendation. The operational definitions for the quality of evidence are listed in Table 2, and rating of magnitude of benefits versus risk, harms, and cost is provided in Table 3. The strength of recommendation (Table 4) also takes into account the quality, quantity, and trade-off between the benefits and harms of a treatment, the magnitude of a treatment's effect, and whether there is data on critical outcomes. Table 5 addresses how to link the assigned grade with the language of obligation of each recommendation.

Patient Involvement

Two individuals who had GHOA and a TSA participated in the development of this CPG through the peer-review process. These reviewers provided input on the final draft, which the GDG took into consideration in making any necessary edits to the CPG (see Supplementary Appendix X.).

Voting on the Recommendations

GDG members agreed on the strength of every recommendation, which were approved and adopted when a majority of 60% of the GDG voted to approve. All recommendations received 100% agreement among the quorum of the voting GDG. No disagreements were recorded during recommendation voting. When changes were made to the strength of a recommendation based on the magnitude of benefit or potential risk, harm, or cost, the GDG voted and provided an explanation in the rationale.

Structure of the Recommendations

Each recommendation contains information on the quality of the body of evidence and the strength of each recommendation. Additional categories for potential benefits, risks, harms, and costs of implementing each recommendation; future research; value judgments; intentional vagueness; exclusions; quality improvement; and implementation and audit are also provided. The rationales for each recommendation are intended to provide the reader with an overview of the included studies, highlighting consistencies or discrepancies in results where applicable, and are not intended to provide specific details of each study. References of the included studies for each recommendation are provided in the action statement profiles, and readers are encouraged to search individual studies for details. Additionally, information on Quality Improvement (what aspect of practice will improve as a result of following the recommendation) and Implementation and Audit (specific strategies for implementing a particular recommendation and how its implementation might be measured for adherence) are provided for each recommendation.

Role of the Funding Source

The American Physical Therapy Association, which funded AAOS services, provided coordination and played no role in the design, conduct, and reporting of the recommendations.

Table 2. Rating Quality of Evidence

RATING OF OVERALL QUALITY OF EVIDENCE	DEFINITION
High	Preponderance of Level I or II evidence with at least 1 Level I study. Indicates a high level of certainty that further research is not likely to change outcomes of the combined evidence.

Moderate	Preponderance of Level II evidence. Indicates a moderate level of certainty that further research is not likely to change the outcomes direction of the combined evidence; however, further evidence may impact the magnitude of the outcome.
Low	A moderate level of certainty of slight benefit, harm, or cost, or a low level of certainty for moderate-to-substantial benefit, harm, or cost. Based on Level II thru V evidence. Indicates that there is some but not enough evidence to be confident of the true outcomes of the study and that future research may change the direction of the outcome and/or impact magnitude of the outcome.
Insufficient	Based on Level II thru V evidence. Indicates that there is minimal or conflicting evidence to support the true direction and/or magnitude of the outcome. Future research may inform the recommendation.

Table 3. Magnitude of Benefit, Risk, Harms, or Cost

RATING OF MAGNITUDE	DEFINITION
Substantial	The balance of the benefits versus risk, harms, or cost overwhelmingly supports a specified direction.
Moderate	The balance of the benefits versus risk, harms, or cost supports a specified direction.
Slight	The balance of the benefits versus risk, harms, or cost demonstrates a small support in a specified direction.

Table 4. Strength of Recommendations

Strength	Strength Visual	Definition
Strong		A high level of certainty of moderate-to-substantial benefit, harms, or cost, or a moderate level of certainty for substantial benefit, harms, or cost (based on a preponderance of Level I or II evidence with at least 1 Level I study).
Moderate		A high level of certainty of slight-to-moderate benefit, harms, or cost, or a moderate level of certainty for a moderate level of benefit, harms, or cost (based on a preponderance of Level II evidence, or a single high-quality RCT).
Weak		A moderate level of certainty of slight benefit, harms, or cost, or a low level of certainty for moderate-to-substantial benefit, harms, or cost (based on Level II thru V evidence).
Theoretical/ foundational		A preponderance of evidence from animal or cadaver studies, from conceptual/theoretical models/principles, or from basic science/bench research, or published expert opinion in peer-reviewed journals that supports the recommendation.
Best Practice		Recommended practice based on current clinical practice norms; exceptional situations in which validating studies have not or cannot be performed yet there is a clear benefit, harm, or cost; or expert opinion.

Table 5. Linking the Strength of Recommendation, Quality of Evidence, Rating of Magnitude, and Preponderance of Risk vs Harm to the Language of Obligation

RECOMMENDATION STRENGTH	QUALITY OF EVIDENCE AND RATING OF MAGNITUDE	PREPONDERANCE OF BENEFIT OR RISK, HARMS, OR COST	LEVEL OF OBLIGATION TO FOLLOW THE RECOMMEND-ATION
Strong	High-quality and moderate-to-substantial magnitude *or* Moderate-quality and substantial magnitude	Benefit	Must or Should
		Risk, harms, or cost	Must not or Should not
Moderate	High-quality and slight-to-moderate magnitude *or* Moderate-quality and moderate magnitude	Benefit	Should
		Risk, harms, or cost	Should not
Weak	Moderate-quality and slight magnitude *or* Low quality and moderate-to-substantial magnitude	Benefit	May
		Risk, harms, or cost	May not
Theoretical/ foundational	N/A	Benefit	May
		Risk, harms, or cost	May not
Best Practice	Insufficient quality and clear magnitude	Benefit	Should or May
		Risk, harms, or cost	Should not or May not

Peer Review and Public Commentary

Following the formation of a final draft, the CPG draft was subjected to a 3-week peer review for additional input from external content experts and stakeholders. More than 84 comments from 4 number of societies (Appendix X) were collected via an electronic structured review form. All peer reviewers were required to disclose any potential conflicts of interest, which were recorded and, as necessary, addressed.

After modifying the draft in response to peer review, the CPG was subjected to a 2-week public comment period. Commenters consisted of the APTA Board of Directors (Board), the APTA Scientific and Practice Affairs Advisory Committee (SPAC), all relevant APTA sections and academies, stakeholder organizations, and the physical therapy community at large. More than X public comments were received. Revisions to the draft were made in response to relevant comments.

Revision Plans

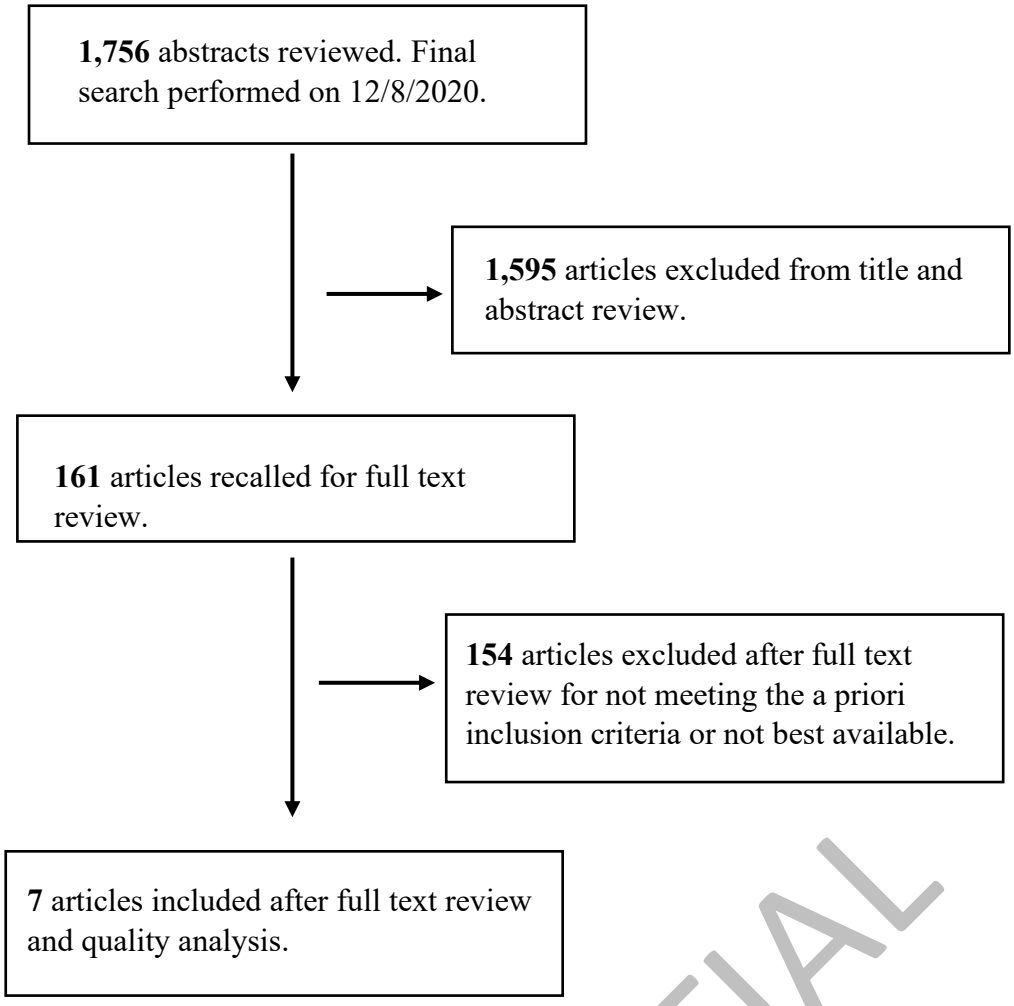
This CPG represents a cross-sectional view of current management strategies and may become outdated as new evidence becomes available. This CPG will be revised in accordance with new evidence, changing practice, rapidly emerging treatment options, and new technology; reaffirmed; or withdrawn in five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

Dissemination Plans and Implementation Tools

The primary purpose of this CPG is to provide interested readers with full documentation of the best available evidence for various intervention strategies associated with the physical therapist management of GHOA and TSA. Publication of this CPG will be announced by press release and published in *PTJ: Physical Therapy & Rehabilitation Journal*, the journal of the American Physical Therapy Association. This CPG is available in Spanish; see Supplementary Material.

Education and implementation tools for this CPG will be disseminated via online resources, such as webinars, podcasts, pocket guides INSERT GUIDELINE CENTRAL LINK, and continuing education courses, at professional annual meetings, and via social media. A CPG+, which includes an appraisal rating using the AGREE II tool, highlights, a check-your-practice section, and review comments, is available on apta.org for this CPG.INSERT LINK Additional implementation tools will be forthcoming.

Study Attrition Flowchart



RECOMMENDATIONS

DIAGNOSIS: HISTORY, PHYSICAL EXAM, RADIOGRAPH, MRI

Diagnosis Recommendation #1: History, Physical Exam, and Radiograph

History, physical exam, and radiographs can be useful to differentially diagnose GHOA; specifically, critical shoulder angle on radiograph and age can be predictive of the diagnosis.

Evidence quality: Moderate
Recommendation Strength: Moderate

Action Statement Profile
Aggregate Evidence Quality: 1 high quality study[43] and 1 moderate quality[44]

Rationale
One high-quality study found that age was useful to differentially diagnose GHOA from other similar conditions; older age noted in those with cuff arthropathy and younger age in those with rotator cuff tears.[44] One high-quality[43] and 1 moderate-quality study[44] found that a decrease in the critical shoulder angle* in true anterior-posterior radiographs was useful to diagnose GHOA. Evidence and consensus-based patient care pathways developed with the National Health Service Evidence-Based Interventions program in the United Kingdom indicate that GHOA diagnosis should include symptoms of shoulder pain occurring for more than 3 months, no findings of instability or localized pain to the AC joint upon manual examination, a global reduction in range of motion with the greatest loss in passive external rotation with the arm at the side, and radiographs to confirm the diagnosis.[45] Differential diagnosis should be performed for rotator cuff tendon pathology, adhesive capsulitis, and labral tears that may have a similar patient presentation.[45]

*Critical shoulder angle is defined as the angle between the line connecting the superior and inferior osseous margins of the glenoid cavity (parallel to glenoid surface) and a second line from the inferolateral border of the acromion to the inferior glenoid margin.[44]

Diagnosis Recommendation #2: MRI

Advanced imaging of MRI is beneficial in the differential diagnosis of GHOA. MRI is helpful to confirm the diagnosis; but is less useful to rule out the diagnosis.

Evidence Quality: High
Recommendation Strength: Strong

Action Statement Profile
Aggregate Evidence Quality: 2 high-quality studies[46,47]

Rationale
Two high-quality studies found that MRI is helpful to confirm the diagnosis of GHOA but less useful to rule it out.[46,47] An MRI-based grading system for shoulder osteoarthritis severity is reliable and useful to detect early OA, classify severity, and track progression of shoulder OA. Consensus-based patient care

pathway[45] indicates that the first step in diagnosis is the use of a clinical examination and radiographs to diagnose GHOA. Use of advanced imaging of MRI may be indicated if the diagnosis is unclear.

Potential benefits, Risks, Harms, and Costs of Implementing These Recommendations for History, Physical Exam, Radiographs, and MRI:

Benefits are as follows:

- Aids in clinical decision making and differential diagnosis

Risk, harms, and/or costs are as follows:

- There are no risks or harms with performing the history and physical examination.
- There are costs associated with performing unnecessary radiologic imaging; for example, use of advanced imaging such as MRI does increase the cost of care.

Benefit-harm Assessment

History/Physical Exam/Radiographs: The balance of the benefits versus risk, harms, or cost supports this recommendation.

MRI: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Future studies should continue to evaluate the ability of the history, physical examination, and imaging to diagnose GHOA. This would enable increased certainty in the diagnoses of GHOA and enable specific care pathways for the nonoperative management of GHOA.

Value Judgments

Physical therapists use clinical decision making and differential diagnosis skills during the physical examination to determine the plan of care, which may include the need for other health care provider involvement. Some states have granted physical therapists the legal ability to order radiographs,[48] which can be used for diagnosis of GHOA.

Intentional Vagueness

Differential diagnosis from other musculoskeletal conditions was not included in the search.

Exclusions

Diagnostic ultrasound was not included, as there was no available literature.

Quality Improvement

Organizations may use documentation of history, physical exam, and referral for and/or evidence of a radiograph or MRI as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of history, physical exam, and referral for and/or evidence of radiograph or MRI.

POST-OPERATIVE MANAGEMENT: SLING AND EXERCISE

Physical therapists should implement the use of a sling with the shoulder in a neutral position and progressive exercises for ROM and strengthening to improve patient-reported outcomes, and ROM in patients with GHOA who have undergone TSA.

Evidence Quality: Strong
Recommendation Strength: Strong
Action Statement Profile
Aggregate Evidence Quality: 2 high-quality studies[49,50]

Rationale
One high-quality study indicates improved patient-reported outcomes and range of motion at 1 year in patients with primary GHOA who have undergone TSA (with lesser tuberosity osteotomy).[49] Post-operative physical therapist services in the high-quality study consisted of sling use for 4 weeks, followed by 4 weeks of progressive assistive and active ROM, and then strengthening exercises.[49] This randomized clinical trial (n=60 patients), showed earlier improvements (4 and 8 weeks) in ROM and patient-reported functional outcomes (ASES scores) with immediate ROM exercises (flexion and external rotation to 30 degrees) compared with delayed motion (4 weeks) during the immobilization period, but no differences in ROM, pain, or patient-reported function (ASES, SST, SANE), at 1 year.[49]

One high-quality study of patients (n=36) who underwent standard physical therapy with immobilization in 2 different types of sling positions (neutral or internal rotation) for 6 weeks following TSA suggest both sling immobilization positions had significant improvements in pain, patient-reported function (DASH, WOOS, SANE), and ROM outcomes.[50] During 6 weeks of immobilization, patients who were randomized to use of a sling in a neutral shoulder position had less night pain at 2 weeks postoperative and greater ROM in external rotation at 1 year compared with patients immobilized in a traditional internal rotation sling.[50] Thus, the recommendation of the GDG is that immobilization in a neutral position should be a management option.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation
Benefits are as follows:

- Improved patient-reported arm function
- Decrease in postoperative daily and night pain
- Improved range of motion

Risks, harms, and/or costs are as follows:

- There is no harm in ROM and functional outcomes (ASES) with delayed ROM (4 weeks) compared with immediate active assistive ROM exercises with follow-up at 6 months and 1 year. While earlier gains in ROM can occur when ROM exercises are initiated immediately post-operative, there is a small risk for adverse healing of subscapularis with immediate ROM versus the delayed group following TSA.[49]
- Impaired subscapularis or osteotomy healing after TSA results in higher level of pain, instability, and reduced active internal rotation ROM.[49,51–53] Protection of subscapularis healing during the early postoperative healing stage of recovery with delayed ROM (4 weeks) and initiating ROM with limits in external rotation to 30 degrees should be considered.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Since ROM exercises are the standard of care for physical therapist intervention of patients following TSA, randomized trials with control groups comparing physical therapist interventions without progressive ROM exercise is unlikely. Future research should evaluate which physical therapist interventions (passive ROM versus active assistive; formal strengthening versus ADLs) and dosing of interventions are the most effective to improve patient-reported outcomes. Comparative studies on the timing of initiating passive and active ROM and strengthening are also recommended. The impact of implant designs (e.g., stemmed, stemless) and subscapularis fixation methods (e.g., tenotomy, less tuberosity osteotomy, and peel to bone tunnels) and healing of the subscapularis should be considered in relationship to ROM guidelines after TSA.

Value Judgments

Sling use and delayed exercises are intended for management of the GHJO and may affect other regions in the upper extremity. Therefore, the function of the entire upper extremity should be assessed to determine if physical therapist management is appropriate.

Intentional Vagueness

Specific slings were not described as the focus was on glenohumeral joint position (e.g., degree of rotation). Specific dose and type of exercises are not defined. Precautions about weight-bearing on the operated extremity during transfers or functional activities were not specifically described.

Exclusions

Studies of nonprimary OA (rotator cuff tear arthropathy or reverse TSA) were excluded.[54,55]

Quality Improvement

Organizations may use documentation of sling immobilization position and duration, exercise parameters to include ROM exercises as a performance indicator. Patient-rated outcomes of care should be assessed to determine effectiveness and areas for improvement.

Implementation and Audit

Organizations may audit occurrence of early exercise following TSA for management of GHJO.

POST-OPERATIVE PHYSICAL THERAPY PAIN MANAGEMENT

Physical therapists should implement the use of a sling with the shoulder in a neutral position for pain management in patients with GHOA who have undergone TSA.

Evidence Quality: Moderate
Recommendation Strength: Moderate

Action Statement Profile

Aggregate Evidence Quality: 1 high-quality study[50]

Rationale

One high-quality study assessed the effects of arm position (shoulder neutral rotation versus internal rotation) during 6-week sling immobilization on patient-reported outcomes. The neutral rotation sling group demonstrated less night pain at 2 weeks but no differences at longer-term follow-up at 6, 12, 32, and 54 weeks. Positioning the arm in a sling in neutral rotation appeared to result in slightly better patient-reported pain outcomes (DASH, WOOS, SANE) compared with internal rotation, but the difference was not statistically significant. Improved pain ratings (overall and night) were seen in both groups who were immobilized in a sling for the first 6 weeks postoperatively in conjunction with a standardized program supervised by physical therapists. Sling use in neutral arm position should begin postoperatively, with instructions from the surgeon if PROM exercises, such as pendulum, may be performed out of sling until the patient initiates physical therapy.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- Improved patient-reported arm function
- Decrease in postoperative daily and night pain
- Improved range of motion

Risks, harms, and/or costs are as follows:

- Loss of range of motion/shoulder joint contracture if protected range of motion is not initiated or properly performed.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost supports this recommendation.

Future Research

Studies are needed that characterize the effects of physical therapy pain modalities, optimal duration of sling use on pain and functional outcomes. Importantly, studies are needed to define optimal multimodal pain management strategies for patients with TSA and GHOA. Large sample sizes could help to determine the optimal position of shoulder rotation during sling immobilization.

Value Judgments

As pain is an important aspect of quality of life, the need for pain control was determined to be an important consideration despite having only one quality study.

Intentional Vagueness

Specific sling types were not identified.

Exclusions

None were identified. Other methods for pain management exist but were not included in the literature base for this recommendation. These include the use of cryotherapy or other physical modalities.

Quality Improvement

Organizations may use documentation of sling immobilization position, duration, and pain intensity as performance indicators. Patient-rated outcomes of care should be assessed to determine effectiveness and areas for improvement.

Implementation and Audit

Organizations may audit the occurrence of documentation of sling immobilization for management of pain control in patients with GHOA and management postoperative of TSA.

POST-OPERATIVE PHYSICAL THERAPY TIMING

The timing of the introduction of shoulder ROM exercises by physical therapists may be delayed up to 4 weeks without negatively impacting patient-reported outcomes in patients with GHOA who have undergone TSA.

Evidence Quality: Moderate
Recommendation Strength: Moderate

Action Statement Profile
Aggregate Evidence Quality: 1 high-quality study[49]

Rationale
One high-quality study[49] of 60 individuals who had undergone a TSA using a lesser tuberosity osteotomy approach compared immediate with delayed (4 weeks) ROM exercises and found no difference between groups in outcomes. Treatment consisted of sling use for 4 weeks, followed by 4 weeks of progressive assistive and active ROM, and then strengthening exercises. Outcome measures included ROM measurements, VAS, ASES, STT, and SANE scores. At 1 year post-operatively there were no significant differences between groups in any of the outcomes. During the early phase of the study the immediate group showed improved trends in external rotation and forward flexion ROM, VAS, SANE, and ASES scores. However, these differences narrowed over time with no differences seen by 3 months. Of concern, nonhealing of the lesser tuberosity osteotomy was higher in the immediate ROM group (5/27= 19%) than in the delayed group (1/28= 4%). Other studies[56,57] have shown trends toward greater functional improvement with healing of the osteotomy or subscapularis tenotomy repair when ROM exercises were delayed. While this study is related to shoulder exercises, this does not preclude the need for exercising the other upper quadrant muscles and joints, such as neck, elbow, and hand. The need for early PROM should be individualized to the patient's needs and type of surgery. Overall, the timing of initiation of physical therapist services related to ROM exercises does not affect patient-related outcomes.

- Initial limitation of external rotation to 30 degrees is recommended (to not stress healing site).
- Patient presentation/characteristics of overall health status can help determine timing.
- Protection of the subscapularis during the healing phase postoperatively must be a primary objective.

There was no evidence evaluating the intensity levels of ROM exercises with respect to timing of delivery. Physical therapists should be guided by the individual patient evaluation and their goals and consider the need for adequate healing of the osteotomy in patients when determining the intensity and timing of treatment.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation
Benefits are as follows:

- No difference between immediate and delayed ROM exercises on patient-reported functional outcomes
- Relief from pain and swelling with ROM exercises

Risks, harms, and/or costs are as follows:

- Early stress on the subscapularis tenotomy or lesser tuberosity osteotomy may impair healing rates, which has been shown to compromise long-term functional outcomes.
- Early initiation of ROM exercises has been associated with delayed lesser tuberosity osteotomy healing.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or costs supports this recommendation.

Future Research

Studies are needed to determine optimal timing for exercise for patient management after TSA, and factors of muscle integrity and surgical variables (including various implants and fixation methods) related to exercise implementation and healing. Determining the type and/or timing of exercise implementation can enable the optimization of postoperative healing, pain relief, and long-term functional outcomes. Comparative studies on the timing of initiating passive and active ROM and strengthening are also recommended. The impact of implant designs (e.g., stemmed, stemless) and subscapularis fixation methods (e.g., tenotomy, less tuberosity osteotomy, and peel to bone tunnels) and healing of the subscapularis should be considered in relationship to ROM guidelines after TSA.

Value Judgments

While outcomes at 1 year were similar for the shoulder, this recommendation does not speak to interventions for other joints of the upper extremity to maintain function.

Intentional Vagueness

Timing was left vague; intensity of ROM exercise was not defined.

Exclusions

None were identified.

Quality Improvement

Organizations may use information provided by the patient, care team documentation, and referral to help make decisions related to the timing of physical therapist services. Patient-rated outcomes of care should be assessed to determine effectiveness and areas for improvement.

Implementation and Audit

Organizations may audit occurrence of history, care team documentation, and referral for timing the physical therapist intervention(s).

BEST PRACTICE STATEMENTS

PRE-OPERATIVE PHYSICAL THERAPY FOR PATIENTS SCHEDULED FOR TSA

In the absence of reliable evidence, the opinion of the GDG is that physical therapist services delivered preoperatively may benefit postoperative outcomes in patients with GHOA undergoing TSA.

Evidence Quality: Insufficient
Recommendation Strength: Best Practice
Action Statement Profile
Aggregate Evidence Quality: 0 included studies

Rationale
There are no studies investigating the effects of preoperative physical therapist services on patient-reported outcomes for those undergoing TSA for GHOA. The AAOS guidelines[58] and the United Kingdom's NICE Guidelines[59] for management of GHOA indicate that preoperative physical therapist services may decrease pain, restore function, and in some cases may eliminate the need for surgery.

Systematic reviews report benefits of preoperative physical therapist services for lower extremity joint replacements. A systematic review[60] found preoperative patient education before total knee arthroplasty improved patient knowledge and expectations, knee motion, and postoperative exercise performance. A more recent systematic review and meta-analysis[61] reported that preoperative education and physical therapist services improved function and decreased length of stay for both total hip and knee arthroplasty. They also found decreased pain for those who had a total hip arthroplasty, and improved quadriceps strength in those undergoing total knee arthroplasty.[61] A recent randomized trial not included in the prior systematic reviews[62] found that those undergoing total knee arthroplasty who received preoperative physical therapy took less pain medication and had improved physical activity both preop and postop compared with a control group that maintained activity as tolerated.

Based on these studies for other joint replacements, preoperative physical therapist services may be beneficial for those undergoing a TSA for GHOA. The preoperative treatment should include exercise, pain management, and education for expectations of function and lifestyle after surgery. This may improve physical activity and decrease pain and reduce overall health care costs. Patients with GHOA should be offered preoperative physical therapy at least 6 weeks prior to surgery.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation
Benefits are as follows:

- Improved physical activity
- Decreased pain
- Improved postoperative patient-reported outcomes
- Improved expectations of outcomes following surgery
- Reduced length of stay

Risks, harms, and/or costs are as follows:

- A finite number of physical therapy visits may be available based on patient healthcare resources, and thus preoperative visits may reduce the available for postoperative care.

- There are no known harms related to physical therapist services with interventions that are appropriately designed to match the patient's irritability level.[63] Increased pain may result if intervention intensity and selection are not matched to the patient's level of irritability.

Future Research

Future research should focus on comparing the effects of preoperative physical therapist services with no preoperative management on postoperative outcomes of pain, function, and length of stay in patients undergoing TSA for GHOA. Additionally, research should determine the optimal dose and components of preoperative management that may lead to the best postoperative outcomes.

Value Judgments

With no studies directly assessing the effects of preoperative physical therapy, the APTA CPG for TKA[64] indicates the benefit of preoperative physical therapy and education and could be applied to TSA as well.

Intentional Vagueness

No specifics for pre-operative TSA were found.

Exclusions

None were identified

Quality Improvement

Organizations may use information provided by the patient, care team documentation, imaging, and physical examination to help develop preoperative goals for physical therapist services. Patient-rated outcomes of care should be assessed to determine effectiveness and areas for improvement.

Implementation and Audit

Organizations may audit occurrence of history, care team documentation, and prior imaging to help develop goals related to preoperative physical therapist intervention(s).

NONOPERATIVE PHYSICAL THERAPY COMPARISON TO OTHER MANAGEMENT STRATEGIES

In the absence of reliable evidence, the opinion of the GDG is that physical therapist services may benefit patients with GHOA who have not undergone TSA.

Evidence Quality: Insufficient
Recommendation Strength: Best Practice

Action Statement Profile
Aggregate Evidence Quality: 0 included studies

Rationale
No high- or moderate-quality studies exist examining physical therapist services of multimodal treatment compared with placebo, wait and see/no treatment, or surgical management for patients with GHOA who are not seeking TSA. Surgical interventions for patients diagnosed with GHOA should be reserved for patients who fail nonoperative management to address pain, limitation in motion, and loss of function.[45,59] Nonoperative management for GHOA can include NSAIDs, acupuncture, local injections, and rehabilitation management to include physical therapy. In a prospective cohort (n=129) of older adults (65 years or older) with GHOA,[25] patients were treated nonoperatively with a combination of NSAIDs, corticosteroid and sodium hyaluronate injections, education, and physical therapist management including range of motion and muscular strengthening exercises. Although this represents low-level evidence, the study participants demonstrated improvements in perceived function, pain, mental health, and health-related quality of life at 3 years' follow-up.[25]

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation
Benefits are as follows:
Some patients with primary GHOA undergoing physical therapy management have:

- Improved ROM
- Improved pain management
- Improved function

There is potential benefit of physical therapist intervention for some patients who are unable to undergo TSA or for patients who respond favorably to a trial of conservative treatment that includes physical therapy.

Risks, harms, and/or costs are as follows:

- There are no known harms related to physical therapist services with interventions that are appropriately designed to match the patient's irritability level.[63] Increased pain may result if intervention intensity and selection are not matched to the patient's level of irritability.
- There are expenses associated with the provision of physical therapist services.

Future Research: There is a need for high-quality research studies that examine the outcomes of physical therapist services for the management of patients with symptoms and functional deficits related to GHOA. Comparisons should be made to placebo treatment, wait-and-see or no-treatment groups, and to surgical interventions. Studies should be designed to determine the optimal frequency and duration of physical therapist interventions. There is a need for prognostic cohort studies to identify characteristics of patients who would most benefit from nonoperative multimodal physical therapist-led interventions for

management of pain and functional deficits associated with GHOA, including type and extent of glenoid OA deformity, duration of symptoms, patient expectations, and comorbidities.

Value Judgments

With the improvements noted in function, pain control, and quality of life in an observational study, the GDG agreed that the use of physical therapist services with interventions that are appropriately designed to match the patient's irritability level is advisable.

Intentional Vagueness

Specific exercises are identified based on the examination findings of the individual patient, including the associated impairments and tissue irritability levels.

Exclusions

This question did not address efficacy of preoperative physical therapist services; please refer to the preoperative physical therapy best practice statement.

Quality Improvement

Organizations may use information provided by the patient, care team documentation, imaging, and physical examination to help develop nonoperative goals for physical therapist services. Patient-rated outcomes of care should be assessed to determine effectiveness and areas for improvement.

Implementation and Audit

Organizations may audit occurrence of history, care team documentation, and prior imaging to help develop goals related to nonoperative physical therapist intervention(s).

NONOPERATIVE PHYSICAL THERAPY INTERVENTION OPTIONS

In the absence of reliable evidence, the opinion of the GDG is that no one specific intervention performed by a physical therapist is superior to another for patients with GHOA.

Evidence quality: Insufficient
Recommendation Strength: Best Practice

Action Statement Profile
Aggregate Evidence Quality: 0 included studies

Rationale
No literature exists comparing physical therapist interventions for patients with GHOA. In the absence of evidence, intervention selection should be guided by best available evidence, clinical expertise, and patient values. Also, intervention selection should be guided by the individual patient evaluation and their goals. Patient-reported outcomes should be used to assess function and disability and aid in determining the effectiveness of treatment.

Nonoperative management for GHOA can include, but not limited to NSAIDs, local injections and physical therapy management. A case series of 129 patients with GHOA investigated the effects of a multimodal management of physical therapy, NSAIDs, injections (cortisone and/or sodium hyaluronate), and education approach.[25] Physical therapist services consisted of range-of-motion and strength-training exercises delivered by a physical therapist. Outcomes of pain, function, and overall quality of life improved at 6 and 12 months and remained at 3-year long-term follow-up. This study suggests that 12 months of conservative care before determining if shoulder arthroplasty is appropriate for a patient with GHOA. Expert opinion indicates that physical therapy for patients with GHOA is often effective in decreasing pain, restoring function, and obviating the need for surgical intervention.[59]

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation
Benefits are as follows:

- Improved symptoms/pain, muscle performance, ROM, and functional patient-reported outcomes

Risk, harms, and/or costs are as follows:

- There are potential harms of ongoing use of NSAIDs and repeated injections.

Future Research
Future studies should determine the dose, parameters, effectiveness, and outcomes of physical therapist interventions for patients with GHOA. Studies should characterize parameters and dose of interventions delivered to determine the optimal physical therapist services to include interventions, length of treatment, and delivery of care. Additionally, comorbidities, psychosocial status and functional demands should be assessed to determine the impact on outcomes.

Value Judgments
Reducing pain through nonpharmaceutical means may be more beneficial to the quality of life of individuals with GHOA and reduce the need for costly surgery and or pharmaceuticals.

Intentional Vagueness
Physical therapist interventions should be based on individual patient needs and impairments.

Exclusions

Patients already scheduled for a TSA were excluded.

Quality Improvement

Organizations may use information provided by the patient, care team documentation, imaging, and physical examination to help develop a nonoperative plan of care for physical therapist services. Patient-rated outcomes of care should be assessed to determine effectiveness and areas for improvement.

Implementation and Audit

Organizations may track types of plans of care that achieve the most effective and efficient outcomes for the patients with GHOA.

POST-OPERATIVE PHYSICAL THERAPY OUTCOMES

In the absence of reliable evidence, the opinion of the GDG is that physical therapist services delivered postoperatively may benefit patient-rated functional outcomes in the management of patients who have undergone TSA for GHOA.

Evidence quality: Insufficient
Recommendation Strength: Best Practice

Action Statement Profile

Aggregate Evidence Quality: 1 low-quality study[54]

Rationale

One low-quality study examined outcomes of physical therapy services after TSA. Physical therapy services were compared with a physician-guided home exercise program, with no differences found in functional outcomes or patient satisfaction between groups.[54] This study was a low-quality retrospective study examining two cohorts treated during different time periods; it did not control for exercise volume nor did it measure compliance to treatment. A recent systematic review of outcomes of TSA[65] provided no additional evidence. AAOS recommends that formal physical therapist management be considered for patients following TSA.[58]

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- Earlier improvements and optimized outcomes of pain, range of motion, and function.
- Earlier detection of postsurgical complications including infection.

Risks, harms, and/or costs are as follows:

- There was no difference in outcomes compared with self- or physician-directed management.
- There are expenses associated with the provision of physical therapist services.

Future Research

High-quality studies are needed to characterize the outcomes of postoperative physical therapist management following TSA for GHOA. Comparisons should be made for self-directed or physician-directed home exercise programs, controlling for the volume of exercise. Given the variety of protocols that guide postoperative management of TSA, studies should determine optimal timing to initiate range of motion to preserve the integrity of healing structures such as the subscapularis, frequency and duration of physical therapist treatments, and which interventions best improve shoulder motion and function after TSA. Prognostic cohort studies are needed to identify characteristics of patients who would benefit from formal physical therapist intervention over a home exercise program following TSA for GHOA. Given the advances in telehealth technology, studies that examine differences in delivery methods of physical therapist services are also needed.

Value Judgments

Physical therapist supervision of patients may be appropriate after TSA for GHOA; however, additional research may help identify which individuals may succeed with a less-structured rehabilitation program.

Intentional Vagueness

Given the lack of published research, the GDG cannot recommend the amount or extent of physical therapist supervision for optimal outcomes following TSA for GHOA. Patient preferences, comorbidities, and specific functional needs likely impact individual patient needs for supervision.

Exclusions

This question did not address efficacy of physical therapist services for the nonoperative or conservative management of GHOA; please refer to the nonoperative and conservative physical therapist management best practice statements.

Quality Improvement

Organizations may use documentation of relevant outcomes to include range of motion, functional status and patient-reported outcomes of pain and disability with physical therapist supervised care and non-supervised care provided in the postoperative management of patients with TSA for GHOA.

Implementation and Audit

Organizations may audit outcomes of care with physical therapist supervised care versus non-supervised care provided in the postoperative management of patients with TSA for GHOA.

POST-OPERATIVE PHYSICAL THERAPY EDEMA MANAGEMENT

In the absence of reliable evidence, the opinion of the GDG is that physical therapist interventions for edema in patients who have undergone TSA for GHOA should be based on best available evidence, clinical expertise, and patient values.

Evidence quality: Insufficient
Recommendation Strength: Best Practice

Action Statement Profile

Aggregate Evidence Quality: 0 included studies

Rationale

Edema after injury or surgery is important to manage to optimize patient outcomes. Commonly used interventions such as ice, compression, and elevation may be effective to manage swelling. Prolonged edema can interfere with the healing process. A systematic review concluded various lymphatic therapies can be effective in those with prolonged or extensive edema, pain, and/or ROM limitations.[66] The addition of manual lymphatic drainage may assist lymphatic system function by promoting variations in interstitial pressures and should be considered in reduction of prolonged edema.[67,68]

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- A program for management of swelling and edema may assist in pain management and reduce secondary complications that can result from prolonged edema that delays the healing process.

Risks, harms, and/or costs are as follows:

- Using interventions that manage swelling and edema has shown no risk or harm to patients, and the overall cost to health care may be lowered by reducing the secondary complications that could occur with prolonged healing.

Future Research

Prior evidence[66–68] indicates swelling can impact healing. Studies are needed to determine the effectiveness of treatment for edema management in patients post TSA. Also, a focus on which interventions are most effective for patient outcomes is needed. Questions could consider if the conventional use of ice, compression, and elevation impact edema and patient outcomes, or if the use of manual lymphatic drainage techniques would be beneficial.

Value Judgments

With no studies available, the impact of swelling on healing[66–68] should be considered as a management tool for those with TSA.

Intentional Vagueness

Type of edema control is not identified.

Exclusions

None noted.

Quality Improvement

Organizations may use information provided by the patient, care team documentation, imaging, and physical examination to help determine the impact of edema management on patient-report outcomes.

Implementation and Audit

Organizations may use the data of patient outcomes to determine future interventions for patients with GHOA after TSA.

Appendix 1

References for Included Literature

1. Banks KP, Beall DP, McCollum MJ, et al. The accuracy of magnetic resonance imaging in the assessment of glenohumeral articular degenerative disease. *J Okla State Med Assoc.* 2007;2:52-6.
2. Baumgarten KM, Osborn R., Schweinle WE III, Zens MJ. The position of sling immobilization influences the outcomes of anatomic total shoulder arthroplasty: a randomized, single-blind, prospective study. *J Should Elbow Surg.* 2018;12:2120-2128.
3. Denard PJ, Lädermann A. Immediate versus delayed passive range of motion following total shoulder arthroplasty. *J Should Elbow Surg.* 2016;12:1918-1924.
4. Heuberer PR, Plachel F, Willinger L, et al. Critical shoulder angle combined with age predict five shoulder pathologies: a retrospective analysis of 1000 cases. *BMC Musculo Dis.* 2017;1:259.
5. Jungmann PM, Gersing, AS, Woertler K., et al. Reliable semiquantitative whole-joint MRI score for the shoulder joint: The shoulder osteoarthritis severity (SOAS) score. *J Magnetic Resonance Imaging.* 2019;7:e152-e163.
6. Miswan MF, Saman MS, Hui TS, et al. Correlation between anatomy of the scapula and the incidence of rotator cuff tear and glenohumeral osteoarthritis via radiological study. *J Ortho Surg.* 2017;1:2309499017690317.
7. Mulieri PJ, Holcomb JO, Dunning P, et al. Is a formal physical therapy program necessary after total shoulder arthroplasty for osteoarthritis? *J Should Elbow Surg.* 2010;4:570-9.

Appendix 2

Excluded Literature

Authors	Article Title	Year	Reason for Exclusion
Abdelshafi ME,; Yosry M, Elmulla AF, et al.	Relief of chronic shoulder pain: a comparative study of three approaches	2011	Irrelevant topic: frozen shoulder and RA
Abdelzaher, M. G.; Tharwat, S.; AbdElkhalek, A.; Abdelsalam, A.	Ultrasound versus magnetic resonance imaging in the evaluation of shoulder joint pathologies in a cohort of rheumatoid arthritis patients	2019	Irrelevant Topic: Rheumatoid Arthritis
Alasaarela, E.; Leppilahti, J.; Hakala, M.	Ultrasound and operative evaluation of arthritic shoulder joints	1998	excluded by the workgroup for "inappropriate patient population"
Berkoff, D. J.; Miller, L. E.; Block, J. E.	Clinical utility of ultrasound guidance for intra-articular knee injections: a review	2012	systematic review, bib review complete
Bervoets, D. C.; Luijsterburg, P. A.; Alessie, J. J.; Buijs, M. J.; Verhagen, A. P.	Massage therapy has short-term benefits for people with common musculoskeletal disorders compared to no treatment: a systematic review	2015	systematic review, bib review complete
Blaine, T.; Moskowitz, R.; Udell, J.; Skyhar, M.; Levin, R.; Friedlander, J.; Daley, M.; Altman, R.	Treatment of persistent shoulder pain with sodium hyaluronate: a randomized, controlled trial (a multicenter study)	2008	Irrelevant Topic: Injections
Boardman Iii, N. D.; Cofield, R. H.; Bengtson, K. A.; Little, R.; Jones, M. C.; Rowland, C. M.	Rehabilitation after total shoulder arthroplasty	2001	Retrospective Non-Comparative Case Series
Boorman, R. S.; Kopjar, B.; Fehringer, E.; Churchill, R. S.; Smith, K.; Matsen Iii, F. A.	The effect of total shoulder arthroplasty on self-assessed health status is comparable to that of total hip arthroplasty and coronary artery bypass grafting	2003	Irrelevant Topic: Total Shoulder Arthroplasty
Brander, V. A.; Gomberawalla, A.; Chambers, M.; Bowen, M.; Nuber, G.	Efficacy and safety of hylan G-F 20 for symptomatic glenohumeral osteoarthritis: a prospective, pilot study	2010	only one comparison group
Brantingham, J. W.; Cassa, T. K.; Bonnefin, D.; Jensen, M.; Globe, G.; Hicks, M.; Korporaal, C.	Manipulative therapy for shoulder pain and disorders: expansion of a systematic review	2011	systematic review, bib review complete
Bryant, D.; Litchfield, R.; Sandow, M.; Gartsman, G. M.; Guyatt, G.; Kirkley, A.	A comparison of pain, strength, range of motion, and functional outcomes after hemiarthroplasty and total shoulder arthroplasty in patients with osteoarthritis of the shoulder (a systematic review and meta-analysis)	2005	systematic review, bib review complete
Burke, C. J.; Walter, W. R.; Adler, R. S.; Babb, J. S.; Sanger, J.; Ponzo, F.	Ultrasound and PET-CT correlation in shoulder pathology: a 5-year retrospective analysis	2017	Sample Size too Small (n < 10 per group)

Cameron, M.; Gagnier, J. J.; Little, C. V.; Parsons, T. J.; Blümle, A.; Chrubasik, S.	Evidence of effectiveness of herbal medicinal products in the treatment of arthritis. Part I: Osteoarthritis	2009	systematic review, bib review complete
Caniggia, M.; Fornara, P.; Franci, M.; Picinotti, A.; Popolizio, A.	Rehabilitation after shoulder arthroplasty	1998	No GJO
Carnevale, A.; Longo, U. G.; Schena, E.; Massaroni, C.; Lo Presti, D.; Berton, A.; Candela, V.; Denaro, V.	Wearable systems for shoulder kinematics assessment: a systematic review	2019	systematic review, bib review complete
Cay, N.; Tosun, O.; Dogan, M.; Karaoglanoglu, M.; Bozkurt, M.	The effect of morphometric relationship between the glenoid fossa and the humeral head on rotator cuff pathology	2012	Irrelevant Topic: Rotator Cuff Pathology
Centeno, C. J.; Al-Sayegh, H.; Bashir, J.; Goodyear, S.; Freeman, M. D.	A prospective multi-site registry study of a specific protocol of autologous bone marrow concentrate for the treatment of shoulder rotator cuff tears and osteoarthritis	2015	GJO and RCT patients combined in same group
Centeno, C. J.; Al-Sayegh, H.; Freeman, M. D.; Smith, J.; Murrell, W. D.; Bubnov, R.	A multi-center analysis of adverse events among two thousand, three hundred and seventy two adult patients undergoing adult autologous stem cell therapy for orthopaedic conditions	2016	Irrelevant Topic: Stem Cell Therapy
Chalmers, P. N.; Beck, L.; Miller, M.; Kawakami, J.; Dukas, A. G.; Burks, R. T.; Greis, P. E.; Tashjian, R. Z.	Acromial morphology is not associated with rotator cuff tearing or repair healing	2020	No GJO
Chalmers, P. N.; Beck, L.; Stertz, I.; Aleem, A.; Keener, J. D.; Henninger, H. B.; Tashjian, R. Z.	Do magnetic resonance imaging and computed tomography provide equivalent measures of rotator cuff muscle size in glenohumeral osteoarthritis?	2018	No Outcomes of Interest
Cheah, J. W.; Sing, D. C.; McLaughlin, D.; Feeley, B. T.; Ma, C. B.; Zhang, A. L.	The perioperative effects of chronic preoperative opioid use on shoulder arthroplasty outcomes	2017	No GJO
Chen, K.; Deng, S.; Ma, Y.; Yao, Y.; Chen, J.; Zhang, Y.	A preliminary exploration of plain-film radiography in scapular dyskinesis evaluation	2018	Sample Size too Small (n < 10 per group)
Cinone, N.; Letizia, S.; Santoro, L.; Gravina, M.; Amoruso, L.; Molteni, F.; Ranieri, M.; Santamato, A.	Intra-articular injection of botulinum toxin type A for shoulder pain in glenohumeral osteoarthritis: a case series summary and review of the literature	2018	systematic review, bib review complete
Codsi, M.; Howe, C. R.	Shoulder conditions. Diagnosis and treatment guideline	2015	non-systematic review

Colen, S.; Haverkamp, D.; Mulier, M.; van den Bekerom, M. P.	Hyaluronic acid for the treatment of osteoarthritis in all joints except the knee: what is the current evidence?	2012	systematic review, bib review complete
Collins, N. J.; Hart, H. F.; Mills, K. A. G.	Osteoarthritis year in review 2018: rehabilitation and outcomes	2019	systematic review, bib review complete
Conway, R.; O'Shea, F. D.; Cunnane, G.; Doran, M. F.	Safety of joint and soft tissue injections in patients on warfarin anticoagulation	2013	systematic review, bib review complete
Craig, R. S.; Goodier, H.; Singh, J. A.; Hopewell, S.; Rees, J. L.	Shoulder replacement surgery for osteoarthritis and rotator cuff tear arthropathy	2020	systematic review, bib review complete
Cunnington, J.; Marshall, N.; Hide, G.; Bracewell, C.; Isaacs, J.; Platt, P.; Kane, D.	A randomized, double-blind, controlled study of ultrasound-guided corticosteroid injection into the joint of patients with inflammatory arthritis	2010	No GJO
Cushman, D. M.; Bruno, B.; Christiansen, J.; Schultz, A.; McCormick, Z. L.	Efficacy of injected corticosteroid type, dose, and volume for pain in large joints: a narrative review	2018	review
Darrow, M.; Shaw, B.; Schmidt, N.; Boeger, G.; Budgett, S.	Treatment of shoulder osteoarthritis and rotator cuff tears with bone marrow concentrate and whole bone marrow injections	2019	patients had both OA and RCT
Deasey, M. J.; Bell, J. E.; Chen, M.; Werner, B. C.	A comparison of perioperative pain control in total shoulder arthroplasty: preoperative tramadol is associated with decreased long-term opiate use when compared with traditional opioids	2020	Pharmacological Treatment
Di Giacomo, G.; de Gasperis, N.	Hyaluronic acid intra-articular injections in patients affected by moderate to severe glenohumeral osteoarthritis: a prospective randomized study	2017	Irrelevant Topic: Injections
Di Giacomo, G.; De Gasperis, N.	The role of hyaluronic acid in patients affected by glenohumeral osteoarthritis	2015	Irrelevant Topic: Injections
Dorsher, P. T.	Clinical equivalence of laser needle to metal acupuncture needle in treating musculoskeletal pain: a pilot study	2010	Sample Size too Small (n < 10 per group)
Ernst, E.; Lee, M. S.	Acupuncture for rheumatic conditions: an overview of systematic reviews	2010	systematic review, bib review complete
Fitzgerald, M.; Lawler, S. M.; Lowe, J. T.; Nelson, R.; Mantell, M. T.; Jawa, A.	Computed tomography underestimates rotator cuff pathology in patients with glenohumeral osteoarthritis	2018	Irrelevant Topic: Rotator Cuff Tear

Fogerty, S.; King, D. G.; Groves, C.; Scally, A.; Chandramohan, M.	Interobserver variation in reporting CT arthrograms of the shoulder	2011	Measuring IOV between two observers
Foster, N. E.; Vertosick, E. A.; Lewith, G.; Linde, K.; MacPherson, H.; Sherman, K. J.; Witt, C. M.; Vickers, A. J.; Acupuncture Trialists, Collaboration	Identifying patients with chronic pain who respond to acupuncture: results from an individual patient data meta-analysis	2020	systematic review, bib review complete
Franca, F. O.; Freitas, J. M. A.; Mariosa, C. A. M.; Bastiani, C. E.; Godinho, G. G.	Shoulder arthroplasty: tenotomy of the subscapularis tendon versus the lesser tuberosity osteotomy	2020	Abstract is in English but the article is not
Fulga, C.; Fulga, I. G.; Predescu, M.	Clinical study of the effect of laser therapy in rheumatic degenerative diseases	1994	patients were not assigned to groups
Goud, A.; Segal, D.; Hedayati, P.; Pan, J. J.; Weissman, B. N.	Radiographic evaluation of the shoulder	2008	non-systematic review
Gratz, S.; Koster, G.; Behr, T.; Vosshenrich, R.; Grabbe, E.; Becker, W.	Arthroscintigraphy in suspected rotator cuff rupture	1998	Sample Size too Small (n < 10 per group)
Gray, M.; Wallace, A.; Aldridge, S.	Assessment of shoulder pain for non-specialists	2016	non-systematic review
Green, S.; Buchbinder, R.; Hetrick, S.	Acupuncture for shoulder pain	2005	systematic review, bib review complete
Gregory, T.; Hansen, U.; Khanna, M.; Mutchler, C.; Urien, S.; Amis, A. A.; Augereau, B.; Emery, R.	A CT scan protocol for the detection of radiographic loosening of the glenoid component after total shoulder arthroplasty	2014	Irrelevant Topic: Detecting Loosening of Glenoid Component
Grumet, R. C.; Bach Jr, B. R.; Provencher, M. T.	Arthroscopic stabilization for first-time versus recurrent shoulder instability	2010	systematic review, bib review complete
Guedes, V.; Castro, J. P.; Brito, I.	Topical capsaicin for pain in osteoarthritis: a literature review	2018	systematic review, bib review complete
Gumina, S.; Castagna, A.; Candela, V.; Venditto, T.; Giannicola, G.; Borroni, M.; Villani, C.	Aetiopathogenesis of cuff-tear arthropathy: Could juvenile joint laxity be considered a predisposing factor?	2018	Irrelevant Topic: Joint Laxity as a Predisposing Factor
Guo, J. J.; Wu, K.; Guan, H.; Zhang, L.; Ji, C.; Yang, H.; Tang, T.	Three-year follow-up of conservative treatments of shoulder osteoarthritis in older patients	2016	no comparison group
Hagen, K. B.; Dagfinrud, H.; Moe, R. H.; Osteras, N.; Kjeken, I.; Grotle, M.; Smedslund, G.	Exercise therapy for bone and muscle health: an overview of systematic reviews	2012	systematic review, bib review complete

Hamada, K.; Yamanaka, K.; Uchiyama, Y.; Mikasa, T.; Mikasa, M.	A radiographic classification of massive rotator cuff tear arthritis	2011	not target population; RC tear
Harris, G. R.; Susman, J. L.	Managing musculoskeletal complaints with rehabilitation therapy: summary of the Philadelphia Panel evidence-based clinical practice guidelines on musculoskeletal rehabilitation interventions	2002	systematic review, bib review complete
Hashemi, S. M.; Khamene, S. M. H.; Naderi-Nabi, B.; Ghasemi, M.	Effects of ultrasound-guided intraarticular botox vs corticosteroids for shoulder osteoarthritis	2018	Irrelevant Topic: Injections
Hawi, N.; Tauber, M.; Messina, M. J.; Habermeyer, P.; Martetschläger, F.	Anatomic stemless shoulder arthroplasty and related outcomes: a systematic review	2016	systematic review, bib review complete
Hegedus, E. J.; Goode, A. P.; Cook, C. E.; Michener, L.; Myer, C. A.; Myer, D. M.; Wright, A. A.	Which physical examination tests provide clinicians with the most value when examining the shoulder? Update of a systematic review with meta-analysis of individual tests	2012	systematic review, bib review complete
Iannotti, J. P.; Weiner, S.; Rodriguez, E.; Subhas, N.; Patterson, T. E.; Jun, B. J.; Ricchetti, E. T.	Three-dimensional imaging and templating improve glenoid implant positioning	2015	Irrelevant Topic: Improving Surgeon's Ability to Place Implant
Kappe, T.; Elsharkawi, M.; Floren, M.; Reichel, H.; Cakir, B.	Plain radiographs have limited sensitivity for glenohumeral cartilage lesions	2010	Detecting Glenohumeral Cartilage Lesions
Karagulle, M.; Kardes, S.; Karagulle, M. Z.	Real-life effectiveness of spa therapy in rheumatic and musculoskeletal diseases: a retrospective study of 819 patients	2017	No GJO
Kennedy, D. J.; Mattie, R.; Nguyen, Q.; Hamilton, S.; Conrad, B.	Glenohumeral joint pain referral patterns: a descriptive Study	2015	Irrelevant Topic: Non-Specific Shoulder Pain Pathology
Khazzam, M.; Gee, A. O.; Pearl, M.	Management of glenohumeral joint osteoarthritis	2020	non-systematic review
Khenioui, H.; Houvenagel, E.; Catanzariti, J. F.; Guyot, M. A.; Agnani, O.; Donze, C.	Usefulness of intra-articular botulinum toxin injections: a systematic review	2016	systematic review, bib review complete
Khitrov, N. A.	The use of artrofoon in the therapy of disorders of the pararticular apparatus	2009	Irrelevant Topic: Periarthritis
Kligler, B.; Nielsen, A.; Kohrherr, C.; Schmid, T.; Waltermaurer, E.; Perez, E.; Merrell, W.	Acupuncture therapy in a group setting for chronic pain	2018	Not Specific to GJO

Kloth, J. K.; Winterstein, M.; Akbar, M.; Meyer, E.; Paul, D.; Kauczor, H. U.; Weber, M. A.	Comparison of 3D turbo spin-echo SPACE sequences with conventional 2D MRI sequences to assess the shoulder joint	2014	No GJO
Kocic, M.; Dimitrijevic, L.; Stankovic, I.; Spalevic, M.; Colovic, H.; Stankovic, A.	Physical therapy in treatment of patients with glenohumeral osteoarthritis	2014	poster abstracts
Kuper, G.; Shanmugaraj, A.; Horner, N. S.; Ekhtiari, S.; Simunovic, N.; Cadet, E. R.; Ayeni, O. R.	Critical shoulder angle is an effective radiographic parameter that is associated with rotator cuff tears and osteoarthritis: A systematic review	2019	systematic review, bib review complete
Kwon, C. Y.; Yoon, S. H.; Lee, B.	Clinical effectiveness and safety of acupotomy: an overview of systematic reviews	2019	systematic review, bib review complete
Kwon, Y. W.; Eisenberg, G.; Zuckerman, J. D.	Sodium hyaluronate for the treatment of chronic shoulder pain associated with glenohumeral osteoarthritis: a multicenter, randomized, double-blind, placebo-controlled trial	2013	Irrelevant Topic: Injections
Lanzetti, R. M.; Spoliti, M.	A new geometric model to quantify the area of glenoid bone defect and medialisation of the native joint line in glenohumeral arthritis	2019	No GJO
Laslett, L. L.; Jones, G.	Capsaicin for osteoarthritis pain	2014	systematic review, bib review complete
Lathia, A. T.; Jung, S. M.; Chen, L. X.	Efficacy of acupuncture as a treatment for chronic shoulder pain	2009	Sample Size too Small (n < 10 per group), patients not specific to GJO
Lau, B. C.; Motamedi, D.; Luke, A.	Use of pocket-sized ultrasound device in the diagnosis of shoulder pathology	2020	No GJO
Lecouvet, F. E.; Dorzee, B.; Dubuc, J. E.; Vande Berg, B. C.; Jamart, J.; Malghem, J.	Cartilage lesions of the glenohumeral joint: diagnostic effectiveness of multidetector spiral CT arthrography and comparison with arthroscopy	2007	not diagnosing GJO; excluded degenerative shoulder disease pts
Lee, M. S.; Ernst, E.	Acupuncture for pain: an overview of Cochrane reviews	2011	systematic review, bib review complete
Lin, I.; Wiles, L. K.; Waller, R.; Goucke, R.; Nagree, Y.; Gibberd, M.; Straker, L.; Maher, C. G.; O'Sullivan, P. P. B.	Poor overall quality of clinical practice guidelines for musculoskeletal pain: a systematic review	2018	systematic review, bib review complete

Lin, I.; Wiles, L.; Waller, R.; Goucke, R.; Nagree, Y.; Gibberd, M.; Straker, L.; Maher, C. G.; O'Sullivan, P. P. B.	What does best practice care for musculoskeletal pain look like? Eleven consistent recommendations from high-quality clinical practice guidelines: systematic review	2020	systematic review, bib review complete
Lockard, M. A.	Exercise for the patient with upper quadrant osteoarthritis	2000	narrative review
Lotero, M. A. A.; Aguilar, M. A. M.; Díaz, R. C. R.; Montoya, L. P.	Comparison of two interventional techniques for the treatment of chronic shoulder pain	2018	Irrelevant Topic: Nerve Blocks
Lowry, V.; Bass, A.; Lavigne, P.; Léger-St-Jean, B.; Blanchette, D.; Perreault, K.; Roy, J. S.; Aiken, A.; Décary, S.; Desmeules, F.	Physiotherapists' ability to diagnose and manage shoulder disorders in an outpatient orthopedic clinic: results from a concordance study	2020	Irrelevant Topic: Diagnostic Agreement between Advanced Practice Physiotherapists and Orthopedic Surgeons
MacPherson, H.; Vertosick, E. A.; Foster, N. E.; Lewith, G.; Linde, K.; Sherman, K. J.; Witt, C. M.; Vickers, A. J.	The persistence of the effects of acupuncture after a course of treatment: a meta-analysis of patients with chronic pain	2017	systematic review, bib review complete
Mahowald, M. L.; Krug, H. E.; Singh, J. A.; Dykstra, D.	Intra-articular Botulinum Toxin Type A: a new approach to treat arthritis joint pain	2009	non-systematic review
Malik, A. T.; Bishop, J. Y.; Neviaser, A.; Jain, N.; Khan, S. N.	What are the costs of glenohumeral osteoarthritis in the year prior to a total shoulder arthroplasty (TSA)?	2020	cost analysis
Mansfield, C. J.; Vanetten, L.; Willy, R.; di Stasi, S.; Magnussen, R.; Briggs, M.	The effects of needling therapies on muscle force production: a systematic review and meta-analysis	2019	systematic review, bib review complete
Mantell, M. T.; Nelson, R.; Lowe, J. T.; Endrizzi, D. P.; Jawa, A.	Critical shoulder angle is associated with full-thickness rotator cuff tears in patients with glenohumeral osteoarthritis	2017	Patients have GJO w/ Rotator Cuff Tear
Marinko, L. N.; Chacko, J. M.; Dalton, D.; Chacko, C. C.	The effectiveness of therapeutic exercise for painful shoulder conditions: a meta-analysis	2011	systematic review, bib review complete
Matsen, F. A., 3rd; Gupta, A.	Axillary view: arthritic glenohumeral anatomy and changes after ream and run	2014	No Outcomes of Interest
Matsen, F. A., 3rd; Smith, K. L.; DeBartolo, S. E.; Von Oesen, G.	A comparison of patients with late-stage rheumatoid arthritis and osteoarthritis of the shoulder using self-assessed shoulder function and health status	1997	Irrelevant Topic: Shoulder Function in RA vs. OA
Matsen, F. A.; Tang, A.; Russ, S. M.; Hsu, J. E.	Relationship between patient-reported assessment of shoulder function and objective range-of-motion measurements	2017	No Outcomes of Interest

Maurer, A.; Fucentese, S. F.; Pfirrmann, C. W. A.; Wirth, S. H.; Djahangiri, A.; Jost, B.; Gerber, C.	Assessment of glenoid inclination on routine clinical radiographs and computed tomography examinations of the shoulder	2012	No Outcomes of Interest
Mazzola, A.; Spinner, D.	Ultrasound-guided peripheral nerve stimulation for shoulder pain: anatomic review and assessment of the current clinical evidence	2020	systematic review, bib review complete
McKee, M. D.; Litchfield, R.; Hall, J. A.; Wester, T.; Jones, J.; Harrison, A. J.	NASHA hyaluronic acid for the treatment of shoulder osteoarthritis: a prospective, single-arm clinical trial	2019	only one comparison group
Migliore, A.; Bizzi, E.; De Lucia, O.; Delle Sedie, A.; Tropea, S.; Bentivegna, M.; Mahmoud, A.; Foti, C.	Differences regarding branded HA in Italy, part 2: Data from clinical studies on knee, hip, shoulder, ankle, temporomandibular joint, vertebral facets, and carpometacarpal joint	2016	systematic review, bib review complete
Mikula, J. D.; Best, M. J.; Aziz, K. T.; Amin, R. M.; Raad, M.; Bansal, A.; Huish, E.; Srikumaran, U.	Preoperative functional status predicts outcomes after total shoulder arthroplasty	2020	Irrelevant Topic: Functional Status
Mitchell, C.; Adebajo, A.; Hay, E.; Carr, A.	Shoulder pain: diagnosis and management in primary care	2005	systematic review, bib review complete
Moor, B. K.; Bouaicha, S.; Rothenfluh, D. A.; Sukthankar, A.; Gerber, C.	Is there an association between the individual anatomy of the scapula and the development of rotator cuff tears or osteoarthritis of the glenohumeral joint? A radiological study of the critical shoulder angle	2013	OA group was compared to Non=OA group
Namdari, S.; Alosh, H.; Baldwin, K.; Glaser, D.; Kelly, J. D.	Biological glenoid resurfacing for glenohumeral osteoarthritis: a systematic review	2011	systematic review, bib review complete
Naredo, A. E.; Aguado, P.; Padron, M.; Bernad, M.; Uson, J.; Mayordomo, L.; Martin-Mola, E.	A comparative study of ultrasonography with magnetic resonance imaging in patients with painful shoulder	1999	Irrelevant Topic: Inflammatory Arthritis
Nelson, M. C.; Leather, G. P.; Nirschl, R. P.; Pettrone, F. A.; Freedman, M. T.	Evaluation of the painful shoulder. A prospective comparison of magnetic resonance imaging, computerized tomographic arthrography, ultrasonography, and operative findings	1991	Irrelevant Topic: Osteoarthrosis
Nguyen, B. J.; Burt, A.; Baldassarre, R. L.; Smitaman, E.; Morshedi, M.; Kao, S.; Chang, E. Y.; Obrzut, S.	The prognostic and diagnostic value of 18F-FDG PET/CT for assessment of symptomatic osteoarthritis	2018	No Outcomes of Interest

Noel, E.; Hardy, P.; Hagena, F. W.; Laprelle, E.; Goebel, F.; Faure, C.; Favard, L.; Gaudin, P.; Christ, R.; Baudot, C.; Dietl, J.; Goupille, P.	Efficacy and safety of Hylan G-F 20 in shoulder osteoarthritis with an intact rotator cuff. Open-label prospective multicenter study	2009	Irrelevant Topic: Injections
Obuli Ganesh Kishore, S.; Mohanraj, K. G.; Jothi Priya, A.	Association between shoulder osteoarthritis with age, exercise and work related damage among middle aged and old aged population-a survey based analysis	2020	No Outcomes of Interest
Orfaly, R. M.; Rockwood, C. A., Jr.; Esenyel, C. Z.; Wirth, M. A.	A prospective functional outcome study of shoulder arthroplasty for osteoarthritis with an intact rotator cuff	2003	Irrelevant Topic: TSA vs. Hemiarthroplasty
Ottenheijm, R. P.; van't Klooster, I. G.; Starmans, L. M.; Vanderdood, K.; de Bie, R. A.; Dinant, G. J.; Cals, J. W.	Ultrasound-diagnosed disorders in shoulder patients in daily general practice: a retrospective observational study	2014	No GJO
Page, M. J.; Huang, H.; Verhagen, A. P.; Gagnier, J. J.; Buchbinder, R.	Outcome reporting in randomized trials for shoulder disorders: literature review to inform the development of a core outcome set	2018	systematic review, bib review complete
Pal, B.; Quennell, P.; Hawes, S.	A review of accident and emergency attendances for non-traumatic musculo-skeletal complaints	2000	non-systematic review
Paolucci, T.; Pezzi, L.; Centra, M. A.; Porreca, A.; Barbato, C.; Bellomo, R. G.; Saggini, R.	Effects of capacitive and resistive electric transfer therapy in patients with painful shoulder impingement syndrome: a comparative study	2019	No GJO
Papalia, R.; Ciuffreda, M.; Albo, E.; De Andreis, C.; Balzani, L. A. D.; Alifano, A. M.; Fossati, C.; Macaluso, A.; Borzuola, R.; De Vincentis, A.; Denaro, V.	Return to sport after anatomic and reverse total shoulder arthroplasty in elderly patients: A systematic review and meta-analysis	2020	systematic review, bib review complete
Park, M. S.; Kim, S. J.; Chung, C. Y.; Choi, I. H.; Lee, S. H.; Lee, K. M.	Statistical consideration for bilateral cases in orthopaedic research	2010	systematic review, bib review complete
Paul, R. A.; Maldonado-Rodriguez, N.; Docter, S.; Khan, M.; Veillette, C.; Verma, N.; Nicholson, G.; Leroux, T.	Glenoid bone grafting in primary reverse total shoulder arthroplasty: a systematic review	2019	systematic review, bib review complete
Poon, P. C.; Ting, F. S.	A 2-dimensional glenoid vault method for measuring glenoid version on computed tomography	2012	No Outcomes of Interest
Ramsey, M. L.; Getz, C. L.; Parsons, B. O.	What's new in shoulder and elbow surgery	2009	non-systematic review

Ratcliffe, A.; Flatow, E. L.; Roth, N.; Saed-Nejad, F.; Bigliani, L. U.	Biochemical markers in synovial fluid identify early osteoarthritis of the glenohumeral joint	1996	Dx intervention doesn't fit our PICO; Doesn't address question of interest;
Raynor, M. B.; Kuhn, J. E.	Utility of features of the patient's history in the diagnosis of atraumatic shoulder pain: a systematic review	2016	systematic review, bib review complete
Razmjou, H.; Palinkas, V.; Christakis, M.; Robarts, S.; Kennedy, D.	Reduced acromiohumeral distance and increased critical shoulder angle: implications for primary care clinicians	2020	no GJO
Reid, M. C.	Viscosupplementation for osteoarthritis: a primer for primary care physicians	2013	non-systematic review
Ringshawl, Z. Y.; Bhat, A. A.; Bashir, Z.; Farooq, M.; Wani, M. M.	Correlation between the findings of magnetic resonance imaging shoulder and shoulder arthroscopy	2020	Irrelevant Topic: Functional Status
Rojas, J.; Choi, K.; Joseph, J.; Srikumaran, U.; McFarland, E. G.	Aseptic glenoid baseplate loosening after reverse total shoulder arthroplasty: a systematic review and meta-analysis	2019	systematic review, bib review complete
Samuel, A. M.; Jain, H.	Scintigraphic changes of osteoarthritis: An analysis of findings during routine bone scans to evaluate the incidence in an Indian population	2012	Irrelevant Topic: Non-Specific Bone Scans
Sanja, M. R.; Mirjana, Z. S.	Ultrasonographic study of the painful shoulder in patients with rheumatoid arthritis and patients with degenerative shoulder disease	2010	No GJO
Schnetzke, M.; Preis, A.; Coda, S.; Raiss, P.; Loew, M.	Anatomical and reverse shoulder replacement with a convertible, uncemented short-stem shoulder prosthesis: first clinical and radiological results	2017	Irrelevant Topic: Non-Conservative Treatment
Scott, N. A.; Guo, B.; Barton, P. M.; Gerwin, R. D.	Trigger point injections for chronic non-malignant musculoskeletal pain: a systematic review	2009	systematic review, bib review complete
Sershon, R. A.; Mather, R. C.; Sherman, S. L.; McGill, K. C.; Romeo, A. A.; Verma, N. N.	Low accuracy of interpretation of rotator cuff MRI in patients with osteoarthritis	2013	Detecting Rotator Cuff Tears in Patients w/ OA
Shanahan, E. M.; Ahern, M.; Smith, M.; Symmons, D.	Suprascapular nerve block reduced chronic shoulder pain and disability in degenerative disease or rheumatoid arthritis	2004	data not specific to GJO
Sher, J. S.; Iannotti, J. P.; Williams, G. R.; Herzog, R. J.; Kneeland, J. B.; Lisser, S.; Patel, N.	The effect of shoulder magnetic resonance imaging on clinical decision making	1998	No GJO

Silverstein, E.; Leger, R.; Shea, K. P.	The use of intra-articular hylan G-F 20 in the treatment of symptomatic osteoarthritis of the shoulder: a preliminary study	2007	only one comparison group
Singh, J. A.; Fitzgerald, P. M.	Botulinum toxin for shoulder pain: A cochrane systematic review	2011	systematic review, bib review complete
Singh, J. A.; Mahowald, M. L.; Kushnaryov, A.; Goelz, E.; Dykstra, D.	Repeat injections of intra-articular botulinum toxin A for the treatment of chronic arthritis joint pain	2009	Sample Size too Small (n < 10 per group)
Singh, J. A.; Mahowald, M. L.; Noorbaloochi, S.	Intra-articular botulinum toxin A for refractory shoulder pain: a randomized, double-blinded, placebo-controlled trial	2009	Irrelevant Topic: Injections
Singh, J. A.; Sperling, J.; Buchbinder, R.; McMaken, K.	Surgery for shoulder osteoarthritis: a Cochrane systematic review	2011	systematic review, bib review complete
Sloan, F. A.; Hanrahan, B. W.	Cost offsets to Medicare attributable to receipt of hip, knee, and shoulder arthroplasty	2014	cost analysis
Smidt, N.; de Vet, H. C.; Bouter, L. M.; Dekker, J.; Arendzen, J. H.; de Bie, R. A.; Bierma-Zeinstra, S. M.; Helders, P. J.; Keus, S. H.; Kwakkel, G.; Lenssen, T.; Oostendorp, R. A.; Ostelo, R. W.; Reijman, M.; Terwee, C. B.; Theunissen, C.; Thomas, S.; van Baar, M. E.; van 't Hul, A.; van Peppen, R. P.; Verhagen, A.; van der Windt, D. A.; Exercise Therapy, Group	Effectiveness of exercise therapy: a best-evidence summary of systematic reviews	2005	systematic review, bib review complete
Spiegl, U. J.; Horan, M. P.; Smith, S. W.; Ho, C. P.; Millett, P. J.	The critical shoulder angle is associated with rotator cuff tears and shoulder osteoarthritis and is better assessed with radiographs over MRI	2016	Sample Size too Small (n < 10 per group)
Stathopoulos, N.; Dimitriadis, Z.; Koumantakis, G. A.	Effectiveness of Mulligan's mobilization with movement techniques on range of motion in peripheral joint pathologies: a systematic review with meta-analysis between 2008 and 2018	2019	systematic review, bib review complete
Stieler, M. A.	The use of sonography in the detection of bony and calcific disorders of the shoulder	2001	Irrelevant Topic: ACJ OA
Strobel, K.; Zanetti, M.; Nagy, L.; Hodler, J.	Suspected rotator cuff lesions: tissue harmonic imaging versus conventional US of the shoulder	2004	NO GJO
Swedish Council on Health Technology, Assessment	(untitled)	2006	systematic review, bib review complete

van de Sande, M. A.; de Groot, J. H.; Rozing, P. M.	Clinical implications of rotator cuff degeneration in the rheumatic shoulder	2008	Irrelevant Topic: Rheumatoid Arthritis
Vellingiri, K.; Ethiraj, P.; Shanthappa, A. H.	Critical shoulder angle and its clinical correlation in shoulder pain	2020	only one comparison group
Verma, N. N.; Harris, J. D.	Surgery: Preserving shoulder movement in advanced OA-yes we CAN!	2013	non-systematic review
Verweij, L. P. E.; Pruijssen, E. C.; Kerkhoffs, G. M. M. J.; Blankevoort, L.; Sierevelt, I. N.; van Deurzen, D. F. P.; van den Bekerom, M. P. J.	Treatment type may influence degree of post-dislocation shoulder osteoarthritis: a systematic review and meta-analysis	2020	systematic review, bib review complete
Vickers, A. J.; Cronin, A. M.; Maschino, A. C.; Lewith, G.; MacPherson, H.; Foster, N. E.; Sherman, K. J.; Witt, C. M.; Linde, K.; Acupuncture Trialists, Collaboration	Acupuncture for chronic pain: individual patient data meta-analysis	2012	systematic review, bib review complete
Vickers, A. J.; Vertosick, E. A.; Lewith, G.; MacPherson, H.; Foster, N. E.; Sherman, K. J.; Irnich, D.; Witt, C. M.; Linde, K.; Acupuncture Trialists, Collaboration	Acupuncture for chronic pain: update of an individual patient data meta-analysis	2018	systematic review, bib review complete
Walch, G.; Mesiha, M.; Boileau, P.; Edwards, T. B.; Levigne, C.; Moineau, G.; Young, A.	Three-dimensional assessment of the dimensions of the osteoarthritic glenoid	2013	No Outcomes of Interest
Westad, K.; Tjoestolvsen, F.; Hebron, C.	The effectiveness of Mulligan's mobilisation with movement (MWM) on peripheral joints in musculoskeletal (MSK) conditions: A systematic review	2019	systematic review, bib review complete
Witt, C. M.; Vertosick, E. A.; Foster, N. E.; Lewith, G.; Linde, K.; MacPherson, H.; Sherman, K. J.; Vickers, A. J.; Acupuncture Trialists, Collaboration	The effect of patient characteristics on acupuncture treatment outcomes: an individual patient data meta-analysis of 20,827 chronic pain patients in randomized controlled trials	2019	systematic review, bib review complete
Yataba, I.; Otsuka, N.; Matsushita, I.; Matsumoto, H.; Hoshino, Y.	The long-term safety of S-flurbiprofen plaster for osteoarthritis patients: an open-label, 52-week study	2016	mixed population; 9 shoulder pts
Yuan, Q. L.; Wang, P.; Liu, L.; Sun, F.; Cai, Y. S.; Wu, W. T.; Ye, M. L.; Ma, J. T.; Xu, B. B.; Zhang, Y. G.	Acupuncture for musculoskeletal pain: A meta-analysis and meta-regression of sham-controlled randomized clinical trials	2016	systematic review, bib review complete

Zale, C. L.; Pace, G. I.; Lewis, G. S.; Chan, J.; Kim, H. M.	Interdepartmental imaging protocol for clinically based three-dimensional computed tomography can provide accurate measurement of glenoid version	2018	Irrelevant Topic: Measurement of Glenoid Version
Zappia, M.; Negri, G.; Grassi, S.; Pecoraro, C.; Rotondo, A.	The CT-arthrography in the antero-inferior glenoid labral lesion: Pictorial presentation and diagnostic value	2008	Irrelevant Topic: Glenohumeral Instability
Zhang, B.; Thayaparan, A.; Horner, N.; Bedi, A.; Alolabi, B.; Khan, M.	Outcomes of hyaluronic acid injections for glenohumeral osteoarthritis: a systematic review and meta-analysis	2019	systematic review, bib review complete
Zhang, K.; Crum, R. J.; Samuelsson, K.; Cadet, E.; Ayeni, O. R.; de Sa, D.	In-office needle arthroscopy: a systematic review of indications and clinical utility	2019	systematic review, bib review complete
Zhang, Y. P.; Hu, R. X.; Han, M.; Lai, B. Y.; Liang, S. B.; Chen, B. J.; Robinson, N.; Chen, K.; Liu, J. P.	Evidence base of clinical studies on qi gong: a bibliometric analysis	2020	systematic review, bib review complete
Zumstein, M. A.; Pinedo, M.; Old, J.; Boileau, P.	Problems, complications, reoperations, and revisions in reverse total shoulder arthroplasty: A systematic review	2011	systematic review, bib review complete

Guideline Development Group Disclosures

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

Appendix 3

PICO Questions Used to Define Literature Search

1. What history, physical examination or imaging test(s) diagnose GJOA?
2. In patients with GJOA undergoing TSA does preoperative physical therapy result in improved patient outcomes postsurgery?
3. In patients with GJOA does multimodal physical therapist directed nonoperative Tx result in improved patient outcomes compared with placebo, wait and see or no treatment, operative Tx?
4. In patients with GJOA, which PT intervention(s) result(s) in improved patient outcomes?
5. In patients with GJOA who have had TSA, which PT intervention(s) result(s) in improved patient outcomes?
6. In patients with GJOA who have had surgical intervention does physical therapist management result in improved patient outcomes?
7. In adult patients with GJOA who have had TSA, what pain management modalities improve patient outcomes?
8. In adult patients with GJOA who have had TSA, what swelling and edema management modalities improve patient outcomes?
9. In patients with GJOA who have had TSA, does the timing and/or intensity of physical therapist intervention affect patient outcomes?

Literature Search Strategy

Literature Search Methods

The medical librarian conducted a comprehensive search of MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials based on key terms and concepts from the workgroup-defined PICO questions. Bibliographies of relevant systematic reviews were hand searched for additional references. All databases were last searched on December 8, 2020 with limits for English language publications published between the years 1990-2020.

For PRISMA Diagram

Records identified through database searching: 2,450
Records after duplicates removed: 1,775
Additional records identified through other sources: 19
Records screened: 1,756

Appendix: Literature Search Strategies by Database

Database: MEDLINE [include database segments]
Interface: Ovid (http://ovidsp.ovid.com/autologin)
Date of Initial Search: September 8, 2020
Date of Updated Search: December 8, 2020

LINE	SEARCH SYNTAX
1	(exp "Animals"/ NOT Humans/) OR exp "Cadaver"/ OR (animal? OR dog OR dogs OR canine OR horse? OR equine OR mouse OR mice OR rat OR rats OR rabbit? OR sheep OR porcine OR pig OR pigs OR rodent? OR monkey?).ti. OR (cadaver* OR in vitro).ti,ab. 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.
2	(exp Infant/ OR exp Child/ OR (pediatric* OR paediatric* OR child OR children).ti.) NOT (exp Adult/ OR exp Adolescent/ OR adult*.ti.)
3	1 OR 2
4	exp Shoulder Joint/ or exp Shoulder/ or (glenohumeral or glenoid or ((humerus or humeral) and head) or shoulder or shoulders).ti,ab.
5	Osteoarthritis/ or Arthritis/ or (osteoarthriti* or osteo-arthriti* or osteo-arthros* or osteoarthros*).ti,ab. or ((non-inflamm* or noninflamm* or degenerat* or hypertrophic) and (arthriti* or joint? or disease?)).ti,ab.
6	4 AND 5
7	exp Sensitivity and Specificity/ OR (sensitiv* OR (predictive AND value?) OR accuracy).ti,ab.
8	exp Therapeutics/ OR exp Orthotic Devices/ OR (physical therap* OR physiotherap* OR manipulation? OR manual therap* OR mobilization OR mobilisation OR rehabilitation OR cryotherap* OR cold therapy OR ice OR cooling OR warming OR heating OR TENS OR NMES OR ((electric OR electrical) AND stimulat*) OR electrostimulation OR electrotherapy OR ((nerve OR muscle) adj stimulation) OR massag* OR exercise? OR ultrasound OR laser OR acupuncture).ti,ab.
9	((6 AND (7 OR 8)) NOT 3) AND English.lg.
10	limit 9 to yr="1990-Current"

Database: Embase
Interface: Elsevier (https://embase.com)
Date Searched: September 8, 2020
Date of Updated Search: December 8, 2020

LINE	SEARCH QUERY
1	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* OR 'in vitro'):ti,ab OR 'animal experiment'/exp OR (animal$ OR dog OR dogs OR canine OR horse$ OR equine OR mouse OR mice OR rat OR rats OR rabbit$ OR sheep OR porcine OR pig OR pigs OR rodent$ OR monkey$):ti
2	(Juvenile/exp OR p$ediatric*:ti OR child:ti OR children:ti) NOT (adult/exp OR adult*:ti)
3	#1 OR #2
4	shoulder'/exp OR (glenohumeral OR glenoid OR ((humerus OR humeral) AND head) OR shoulder OR shoulders):ti,ab
5	osteoarthritis'/de OR (osteoarthriti* OR osteo-arthriti* OR osteo-arthros* OR osteoarthros*):ti,ab OR ((non-inflamm* OR noninflamm* OR degenerat* OR hypertrophic) AND (arthriti* OR joint$ OR disease*)):ti,ab
6	(#4 AND #5) OR 'glenohumeral osteoarthritis'/exp
7	Sensitivity and Specificity'/de OR 'Diagnostic Accuracy'/de OR (sensitiv* OR (predictive AND value$) OR accuracy):ti,ab
8	therapy/exp OR orthosis/exp OR 'alternative medicine'/exp OR ('physical therap*' OR physiotherap* OR manipulation$ OR 'manual therap*' OR mobilization OR mobilisation OR rehabilitation OR cryotherap* OR 'cold therapy' OR ice OR cooling OR warming OR heating OR TENS OR NMES OR ((electric OR electrical) AND stimulat*) OR electrostimulation OR electrotherapy OR ((nerve OR muscle) NEXT/1 stimulation) OR massag* OR exercise$ OR ultrasound OR laser OR acupuncture):ti,ab
9	((#6 AND (#7 OR #8)) NOT #3) AND [english]/lim AND [1990-3000]/py

Database: Cochrane Central Register of Controlled Trials (CENTRAL)
Interface: Wiley (https://www.cochranelibrary.com/central)
Date Searched: September 8, 2020
Date of Updated Search: December 8, 2020

LINE	SEARCH QUERY
1	"conference abstract":pt OR (abstracts OR editorial OR reply OR comment OR commentary OR letter):ti OR (cadaver* OR "in vitro"):ti,ab OR (animal? OR dog OR dogs OR canine OR horse? OR equine OR mouse OR mice OR rat OR rats OR rabbit? OR sheep OR porcine OR pig OR pigs OR rodent? OR monkey?):ti
2	([mh Infant] OR [mh Child] OR (pediatric* OR paediatric* OR child OR children):ti) NOT ([mh Adult] OR [mh Adolescent] OR adult*:ti)
3	[mh "Shoulder Joint"] OR [mh "Shoulder"] OR (glenohumeral OR glenoid OR ((humerus OR humeral) AND head) OR shoulder OR shoulders):ti,ab
4	[mh ^"Osteoarthritis"] OR [mh ^"Arthritis"] OR (osteoarthriti* OR osteo-arthriti* OR osteo-arthros* OR osteoarthros*):ti,ab OR ((non-inflamm* OR noninflamm* OR degenerat* OR hypertrophic) AND (arthriti* OR joint? OR disease*)):ti,ab
5	[mh "Sensitivity and Specificity"] OR (sensitiv* OR (predictive AND value?) OR accuracy):ti,ab
6	[mh Therapeutics] OR [mh "Orthotic Devices"] OR ("physical therap*" OR physiotherap* OR manipulation? OR "manual therap*" OR mobilization OR mobilisation OR rehabilitation OR cryotherap* OR "cold therapy" OR ice OR cooling OR warming OR heating OR TENS OR NMES OR ((electric OR electrical) and stimulat*) OR electrostimulation OR electrotherapy OR ((nerve OR muscle) NEXT/1 stimulation) OR massag* OR exercise? OR ultrasound OR laser OR acupuncture):ti,ab
7	(((#3 AND #4) AND (#5 OR #6)) NOT (#1 OR #2)) *with Publication Year from 1990 to 2020, in Trials*

Inclusion Criteria

Scope of Guideline: Patients diagnosed with GHOA glenohumeral joint osteoarthritis (GHOA)

Standard Criteria for All CPGs

- Article must be a full article report of a clinical study (studies using registry data can be included in a guideline if it is published in a peer-reviewed journal and meets all other inclusion criteria/quality standards).
- Retrospective noncomparative 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 without appropriate sub-analysis or statistical adjustment) are ***excluded***.
- Case series studies that have nonconsecutive 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 for which the authors did not statistically adjust for these differences when analyzing the results are ***excluded***.
- All studies of "Very Weak" strength of evidence are ***excluded***.
- All studies evaluated as Level V are ***excluded***.
- Composite measures or outcomes are ***excluded*** even if they are patient-oriented.
- Studies that did not in a peer-reviewed publication are ***excluded***.
- For any included study that uses "paper-and-pencil" outcome measures (e.g., SF-36), only those outcome measures that have been validated are 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 is downgraded by one level).
- Studies not of humans are ***excluded***.
- Study not published in English are ***excluded***.
- Study with results not quantitatively presented are ***excluded***.
- In vitro studies are ***excluded***.
- Biomechanical studies are ***excluded***.
- Studies performed on cadavers are ***excluded***.

Customized Inclusion Criteria

- Study must be related to **Primary Glenohumeral Joint Osteoarthritis** (GHOA).
- Study must be published in or after **<1990>.**
- Study should have **10 or more patients per group.**
- Follow-up Times: **Consider all follow up times.**

We only evaluated surrogate outcomes when no patient-oriented outcomes (physical assessment or patient-reported outcomes) are available.

Best Available Evidence

When examining primary studies, we analyzed the best available evidence regardless of study design. We first considered randomized controlled trials identified by the search strategy. In the absence of two or more RCTs, we sequentially searched 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 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.

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