OPTIMIZING THE MANAGEMENT OF ROTATOR CUFF PROBLEMS

GUIDELINE AND EVIDENCE REPORT

Adopted by the American Academy of Orthopaedic Surgeons
Board of Directors
December 4, 2010

This Clinical Practice Guideline was developed by an American Academy of Orthopaedic Surgeons (AAOS) physician volunteer work group based on a systematic review of the current scientific and clinical information and accepted approaches to treatment and/or diagnosis. This Clinical Practice Guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment should always be based on a clinician’s independent medical judgment, given the individual patient’s clinical circumstances.

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Disclaimer
An AAOS physician volunteer Work Group developed this clinical practice guideline based on a systematic review of the current scientific and clinical information as well as accepted approaches to treatment and/or diagnosis. This clinical practice guideline is not intended to be used as a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment should always be based on a clinician’s independent medical judgment, given the individual patient’s clinical circumstances.

Disclosure Requirement
In accordance with AAOS 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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Summary of Recommendations

The following is a summary of the recommendations in the AAOS’ clinical practice guideline, Optimizing the Management of Rotator Cuff Problems. This summary does not contain rationales that explain how and why these recommendations were developed nor does it contain the evidence supporting these recommendations. *All readers of this summary are strongly urged to consult the full guideline and evidence report for this information.* We are confident that those who read the full guideline and evidence report will see that the recommendations were developed using systematic evidence-based processes designed to combat bias, enhance transparency, and promote reproducibility. This summary of recommendations is not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient and physician.

**Full Thickness Tears and Asymptomatic Patients**
1. In the absence of reliable evidence, it is the opinion of the work group that surgery not be performed for asymptomatic, full thickness rotator cuff tears.

   Strength of Recommendation: Consensus

**Full Thickness Tears and Symptomatic Patients**
2. Rotator cuff repair is an option for patients with chronic, symptomatic full thickness tears.

   Strength of Recommendation: Weak

**Rotator Cuff Tears and Exercise**
3. a. We cannot recommend for or against exercise programs (supervised or unsupervised) for patients with rotator cuff tears.

   Strength of Recommendation: Inconclusive

**Rotator Cuff Tears and Corticosteroid Injections**
3. b. We cannot recommend for or against subacromial injections for patients with rotator cuff tears.

   Strength of Recommendation: Inconclusive

**Rotator Cuff Tears and NSAIDS, Activity Modification, Ice, Heat, Iontophoresis, Massage, T.E.N.S., PEMF, and Phonophoresis**
3. c. We cannot recommend for or against the use of NSAIDS, activity modification, ice, heat, iontophoresis, massage, Transcutaneous Electrical Nerve Stimulation (TENS), Pulsed Electromagnetic Field (PEMF), or phonophoresis (ultrasound) for nonoperative management of rotator cuff tears.
Rotator Cuff Related Symptoms and Exercise or Nonsteroidal Anti-Inflammatory Medication
4. a. We suggest that patients who have rotator cuff-related symptoms in the absence of a full thickness tear be initially treated non-operatively using exercise and/or non-steroidal anti-inflammatory drugs.

Strength of Recommendation: Moderate

Rotator Cuff Related Symptoms and Corticosteroid Injections or PEMF
4. b. We cannot recommend for or against subacromial corticosteroid injection or Pulsed Electromagnetic Field (PEMF) in the treatment of rotator cuff-related symptoms in the absence of a full thickness tear.

Strength of Recommendation: Inconclusive

Rotator Cuff Related Symptoms and Iontophoresis, Phonophoresis, Transcutaneous electrical nerve stimulation (TENS), ice, heat, massage or activity modification
4. c. We cannot recommend for or against the use of iontophoresis, phonophoresis, transcutaneous Electrical Nerve Stimulation (TENS), ice, heat, massage, or activity modification for patients who have rotator cuff related symptoms in the absence of a full thickness tear.

Strength of Recommendation: Inconclusive

Acute Traumatic Rotator Cuff Tears and Surgery
5. Early surgical repair after acute injury is an option for patients with a rotator cuff tear.

Strength of Recommendation: Weak

Perioperative Interventions – Corticosteroid Injections/NSAIDS
6. We cannot recommend for or against the use of perioperative subacromial corticosteroid injections or non-steroidal anti-inflammatory medications in patients undergoing rotator cuff surgery.

Strength of Recommendation: Inconclusive

Confounding factors – Age, Atrophy/Fatty Degeneration and Worker’s Compensation Status
7. a. It is an option for physicians to advise patients that the following factors correlate with less favorable outcomes after rotator cuff surgery:
   • Increasing Age
   • MRI Tear Characteristics
   • Worker’s Compensation Status

Strength of Recommendation: Increasing Age: Weak,
MRI Tear Characteristics: Weak, Worker’s Compensation Status: Moderate

Confounding Factors - Diabetes, Co-morbidities, Smoking, Infection, and Cervical Disease

7. b. We cannot recommend for or against advising patients in regard to the following factors related to rotator cuff surgery:

- Diabetes
- Co-morbidities
- Smoking
- Prior Shoulder Infection
- Cervical Disease

<table>
<thead>
<tr>
<th>Confounding Factor</th>
<th>Strength of Recommendation</th>
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<tbody>
<tr>
<td>Diabetes</td>
<td>Inconclusive</td>
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<tr>
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<td>Inconclusive</td>
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<td>Smoking</td>
<td>Inconclusive</td>
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<tr>
<td>Infection</td>
<td>Inconclusive</td>
</tr>
<tr>
<td>Cervical Disease</td>
<td>Inconclusive</td>
</tr>
</tbody>
</table>

Surgery - Acromioplasty

8. We suggest that routine acromioplasty is not required at the time of rotator cuff repair.

Strength of Recommendation: Moderate

Surgery – Partial Rotator Cuff Repair, Debridement, or muscle transfers for patients with irreparable rotator cuff tears when surgery is indicated.

9. It is an option to perform partial rotator cuff repair, debridement, or muscle transfers for patients with irreparable rotator cuff tears when surgery is indicated.

Strength of recommendation: Weak

Surgery – Tendon to Bone Healing

10. a. It is an option for surgeons to attempt to achieve tendon to bone healing of the cuff in all patients undergoing rotator cuff repair.

Strength of Recommendation: Weak

Surgery - Suture Anchors and Bone Tunnels

10. b. We cannot recommend for or against the preferential use of suture anchors versus bone tunnels for repair of full thickness rotator cuff tears.

Strength of Recommendation: Inconclusive

Surgery – Arthroscopic, Open, Mini-Open

10. c. We cannot recommend for or against a specific technique (arthroscopic, mini-open or open repair) when surgery is indicated for full thickness rotator cuff tears.
Strength of Recommendation: Inconclusive

**Surgery - Non-Crosslinked, Porcine Small Intestine Submucosal Xenografts**

11. a. We suggest surgeons not use a non-crosslinked, porcine small intestine submucosal xenograft patch to treat patients with rotator cuff tears.

   Strength of Recommendation: Moderate

**Surgery - Allografts and Xenografts**

11. b. We cannot recommend for or against the use of soft tissue allografts or other xenografts to treat patients with rotator cuff tears.

   Strength of Recommendation: Inconclusive

**Post-Operative Treatment - Cold Therapy**

12. In the absence of reliable evidence, it is the opinion of the work group that local cold therapy is beneficial to relieve pain after rotator cuff surgery.

   Strength of Recommendation: Consensus

**Post-Operative – sling, shoulder immobilizer, abduction pillow, or abduction brace**

13. a. We cannot recommend for or against the preferential use of an abduction pillow versus a standard sling after rotator cuff repair.

   Strength of Recommendation: Inconclusive

**Post-Operative Rehabilitation – Range of Motion Exercises**

13. b. We cannot recommend for or against a specific time frame of shoulder immobilization without range of motion exercises after rotator cuff repair.

   Strength of Recommendation: Inconclusive

**Post-Operative Rehabilitation – Active Resistance Exercises**

13. c. We cannot recommend for or against a specific time interval prior to initiation of active resistance exercises after rotator cuff repair.

   Strength of Recommendation: Inconclusive

**Post-Operative Rehabilitation – Home Based Exercise and Facility Based Rehabilitation**

13. d. We cannot recommend for or against home-based exercise programs versus facility-based rehabilitation after rotator cuff surgery.

   Strength of Recommendation: Inconclusive
Post-Operative - Infusion Catheters

14. We cannot recommend for or against the use of an indwelling subacromial infusion catheter for pain management after rotator cuff repair.

Strength of Recommendation: Inconclusive
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American Society for Surgery of the Hand (ASSH)
American Society of Shoulder and Elbow Therapists (ASSET)
American Physical Therapy Association (APTA)

Participation in the AAOS peer review process does not constitute an endorsement of this guideline by the participating organization.
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I. INTRODUCTION

OVERVIEW
This clinical practice guideline is based on a systematic review of published studies on the treatment of rotator cuff problems in adults (>19 years). In addition to providing practice recommendations, this guideline also highlights gaps in the literature and areas that require future research.

GOALS AND RATIONALE
The purpose of this clinical practice guideline is to use the best currently available evidence to improve treatment. This is in keeping with current evidence-based practice (EBP) standards. To assist in this decision making, this clinical practice guideline consists of a multiple systematic reviews of the available literature regarding the treatment of rotator cuff problems. The systematic reviews detailed herein include evidence published from 1966 through October 1, 2008 and demonstrates where there is good evidence, where evidence is lacking, and what topics future research must target in order to improve the treatment of patients with rotator cuff problems. AAOS staff and the physician work group responsible for developing this guideline systematically reviewed the available literature and subsequently wrote its recommendations based on a rigorous, standardized process.

Musculoskeletal care is provided in many different settings by many different providers. This guideline is an educational tool to assist qualified physicians in a series of treatment decisions, and is an effort to improve the quality and efficiency of patient care. This guideline should not be construed as including all proper methods of care or excluding methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment must be made in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution.

INTENDED USERS
This guideline is intended to be used by orthopaedic surgeons and physicians managing patients with rotator cuff problems. Typically, orthopaedic surgeons will have completed medical training, a qualified residency in orthopaedic surgery, and some may have completed additional sub-specialty training. Insurance payers, governmental bodies, and health-policy decision-makers may also find this guideline useful as an evolving standard of evidence regarding treatment rotator cuff problems. Physical therapists, occupational therapists trained in upper extremity rehabilitation, nurse practitioners, athletic trainers, primary care physicians, physician assistants and other healthcare professionals who routinely see this type of patient in various practice settings may also find this guideline useful.

Diagnosis of rotator cuff problems is made on the basis of patient history, clinical examination, and diagnostic imaging (i.e. ultrasound, MRI). However, treatment for rotator cuff problems is based on the assumption that decisions are predicated on patient and physician mutual communication with discussion of available treatments and procedures applicable to the individual patient. Once the patient has been informed of
available therapies and has discussed these options with his/her physician, an informed decision can be made. Clinician input based on experience with both conservative management and surgical skills increases the probability of identifying patients who will benefit from specific treatment options.

**PATIENT POPULATION**
This document addresses the treatment of rotator cuff problems in adults (defined as patients 19 years of age and older). The guideline provides information on patient management after diagnosis of a rotator cuff tear or rotator cuff related symptoms. Surgical technique recommendations in this guideline are only applicable to patients with full thickness rotator cuff tears. This guideline does not address patients diagnosed with adhesive capsulitis/frozen shoulder, inflammatory arthropathies, or co-existing fractures of the shoulder. Patients undergoing shoulder arthroplasty and patients with wheelchair/weight bearing shoulders (i.e. polio patients, paraplegics, crutches) are not addressed by this guideline.

**INCIDENCE & PREVALENCE**
Rotator cuff disease is one of the most common musculoskeletal disorders in the adult population. Approximately 18 million Americans self-reported shoulder pain in 2005, meaning that it follows only knee complaints in prevalence. Rotator cuff tears were noted in 39% of cadaver shoulders in the classic study of De Palma et al. and a high prevalence of asymptomatic cuff tears was noted in contemporary studies. A substantial proportion of asymptomatic cuff tears become symptomatic over time, begging the question of the impact and efficacy of earlier diagnosis and treatment upon the ultimate clinical outcome and cost of rotator cuff treatment. The incidence of full thickness rotator cuff tears increases as a function of age. With the “graying” of the baby boomer generation, we can therefore expect the prevalence of rotator cuff disorders to increase over the next two decades.

**BURDEN OF DISEASE**
Rotator cuff disorders comprise a large subset of shoulder disorders overall and are one of the most common causes of shoulder pain in the upper extremity, especially when pooled as a continuum from sub-acromial impingement/bursitis to rotator cuff degeneration/tear. In 2007, 76,000 work-related shoulder injuries and illnesses involving days away from work were reported in the United States. The potential cost burden of rotator cuff disease is worth acknowledging particularly when calculated as a summation of costs related to diagnostic imaging, therapy services, and surgical intervention.

**ETIOLOGY**
Rotator cuff degeneration (tendinosis) begins in the early decades of life, with partial thickness cuff tears and full thickness cuff tears increasing in frequency in the later decades. Cuff tears are occasionally truly traumatic in nature; however tendon tears usually occur in the presence of some degree of tendinosis. In some cases, extrinsic damage related to acromial spurring co-exists, however current opinion places greater emphasis upon the intrinsic nature of rotator cuff degeneration, including the inherent
vascularity of the rotator cuff. Unfortunately, the fundamental pathoetiology of intrinsic tendinosis is not well understood.

**RISK FACTORS**

Increasing age is a positive risk factor for development of a rotator cuff tear, and repetitive trauma may play a role as well (for example industrial exposure, some high demand sports activities).

**EMOTIONAL AND PHYSICAL IMPACT OF ROTATOR CUFF PROBLEMS**

Rotator cuff disorders substantially affect quality of life, including disordered activities of daily living, altered sleep patterns, and adverse impact on work and recreation. This impact ranges from a chronic low level nuisance to un-remitting and severe pain and disability. Although post-operative recovery is most dramatic in the first few months, patients report gradual improvement in function and decreased pain for a year or more after surgical intervention. Some patients become physically dependent during the early post-operative phase, since they are unable to utilize the operated extremity for activities of daily living. This is a particular burden in the elderly, especially for patients who were living alone and independently prior to surgery.

**POTENTIAL HARMS AND CONTRAINDICATIONS**

Most treatments are associated with some known risks, especially invasive and operative treatments. In addition, contraindications vary widely based on the treatment administered. Therefore, discussion of available treatments and procedures applicable to the individual patient rely on mutual communication between the patient and physician, weighing the potential risks and benefits for that patient.
II. METHODS

This clinical practice guideline and the systematic reviews upon which it is based evaluate the effectiveness of treatments for rotator cuff problems. This section describes the methods used to prepare this guideline and the systematic reviews, including search strategies used to identify literature, criteria for selecting eligible articles, grading the evidence, data extraction, methods of statistical analysis, and the review and approval of the guideline. We employed systematic review methods to minimize bias.8, 9

The physician members of the AAOS Rotator Cuff Problems work group prepared this guideline and systematic review with the assistance of the AAOS Clinical Practice Guidelines Unit (Appendix I). When information from the literature was sparse or lacking, it was supplemented by the consensus opinion of the work group.

To develop this guideline, the work group initially met in an introductory meeting on March 14 and 15, 2008 to establish the scope of the guideline and systematic review. Upon completion of the systematic reviews the work group participated in a two-day recommendation meeting on November 1 and 2, 2008. An initial draft was completed and submitted for peer review in January 2009. As a result of input received during peer review, the work group agreed to meet for an additional meeting on January 16 and 17, 2010 at which the final recommendations and rationales were edited, written and voted on.

The resulting draft guidelines are then peer-reviewed, edited in response to that review, and then sent for public commentary whereafter additional edits are made. Thereafter, the draft guideline is sequentially sent for approval by the AAOS Evidence Based Practice Committee, the AAOS Guidelines and Technology Oversight Committee, the AAOS Council on Research, Quality Assessment, and Technology, and the AAOS Board of Directors (Appendix II provides a description of the AAOS bodies involved in the approval process). All AAOS guidelines are reviewed and updated or retired every five years in accordance with the criteria of the National Guideline Clearinghouse.

SIMULATED RECOMMENDATIONS

The work group began work on this guideline by constructing a set of simulated recommendations. These recommendations specify [what] should be done in [whom], [when], [where], and [how often or how long]. They function as questions for the systematic review, not as final recommendations or conclusions. Simulated recommendations are almost always modified on the basis of the results of the systematic review. These recommendations also form the guideline’s scope and guide the searches for literature. These a priori simulated recommendations are inviolate in that, once specified, they cannot be modified, they must all be addressed by the systematic review, and the relevant review results must be presented in the final guideline. The a priori and inviolate nature of the simulated recommendations combats bias.
STUDY SELECTION CRITERIA
TYPES OF STUDIES
We developed *a priori* article selection criteria for our review. Specifically, to be included in our systematic reviews an article had to be a report of a study that:

- Evaluates a treatment for rotator cuff problems including:
  - rotator cuff tear or
  - rotator cuff related symptoms
    - Impingement syndrome (Subacromial impingement syndrome)
    - Rotator cuff disease
    - Rotator cuff tendonitis
    - Shoulder tendonitis
    - Subacromial bursitis
    - Subacromial tendonitis
    - Supraspinatus tendonopathy (tendonitis)
- Is a full article published in the peer reviewed literature.
- Is an English language article published after 1965.
- Is not a cadaveric, animal, or in vitro study.
- Is not a retrospective case series, medical records review, meeting abstract, unpublished study report, case report, historical article, editorial, letter, or commentary.
- Is the most recent report of a study or the report with the largest number of enrolled patients in a study with multiple publications.
- Enrolled $\geq$ 10 patients in each of its study groups.
- Enrolled a patient population of at least 80% of patients with rotator cuff problems 19 years of age and older.
- Enrolled $> 90\%$ patients without pre-existing shoulder surgery.
- Reports quantified results.
• Enrolled only patients with full thickness rotator cuff tears (for surgical techniques and post-operative treatment recommendations).

• Enrolled patients without the following conditions
  • arthroplasty (shoulder replacement)
  • concomitant capsular release for adhesive capsulitis /frozen shoulder
  • inflammatory arthropathy (i.e. rheumatoid arthritis, systemic lupus erythematosus)
  • coexisting fractures of the shoulder, proximal humerus, or greater tuberosity
  • wheelchair/weight bearing shoulder (i.e. polio patients, paraplegics, crutches)

BEST AVAILABLE EVIDENCE
When examining primary studies, we analyzed the best available evidence. We first considered the 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 case-series studies. Only studies of the highest level of available evidence are included, assuming that there are 2 or more studies of that higher level. For example, if there were two Level II studies that addressed a recommendation, Level III and IV studies were not included.

We did not include systematic reviews compiled by others or guidelines developed by other organizations. These documents are developed using different inclusion criteria than those specified by the AAOS work group. Therefore they may include studies that do not meet our inclusion criteria. We recalled these documents, if the abstract suggested they might provide an answer to one of our recommendations, and searched their bibliographies for additional studies to supplement our systematic review.

We included only patient-oriented outcomes and did not include surrogate/intermediate outcomes. Patient-oriented outcomes are outcomes that directly show whether a patient is living longer, healthier, and/or happier. Surrogate outcomes are substitutes for these outcomes. Surrogates include laboratory measurements and other physical signs.10

When study authors reported outcomes that were measured using “paper and pencil” instruments, we considered only results from instruments for which validation was attempted. That such attempts were made does not imply that all of these instruments are valid. Table 1 identifies the “paper and pencil” instruments used in the studies that met all inclusion criteria listed above and the key psychometric properties on which attempts at validation were made. In order to include an instrument in this guideline, the instrument must have had at least two of the four key psychometric properties tested.
Table 1 Validation of Outcome Instruments

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ASES(^{11}) (American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form)</td>
<td>(X^{12})</td>
<td>(X^{12})</td>
<td>(X^{13, 12})</td>
<td>(X^{12})</td>
</tr>
<tr>
<td>Constant-Murley Score(^{14}) (CMS or Constant Score)</td>
<td>(X^{15\dagger})</td>
<td>(X^{16, 17, 18})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DASH(^{15}) (Disabilities of the Arm, Shoulder and Hand)</td>
<td>(X^{20})</td>
<td>(X^{21})</td>
<td>(X^{21})</td>
<td>(X^{21})</td>
</tr>
<tr>
<td>FSET(^{22}) (Functional Shoulder Elevation Test)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional Assessment Questionnaire(^{23})</td>
<td>(X^{24})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JOA(^{24}) (Japanese Orthopaedic Association)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neer Guidelines(^{25})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSS(^{26}) (Oxford Shoulder Scores)</td>
<td>(X^{26})</td>
<td>(X^{26})</td>
<td>(X^{26})</td>
<td>(X^{26})</td>
</tr>
<tr>
<td>PENN Shoulder Score(^{27}) (PSS)</td>
<td>(X^{27})</td>
<td>(X^{27})</td>
<td>(X^{27})</td>
<td>(X^{27})</td>
</tr>
<tr>
<td>RC-QOL(^{22}) (Rotator Cuff Quality-of-Life Measure)</td>
<td>(X^{22})</td>
<td>(X^{22})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDQ(^{28, 29}) (Shoulder Disability Questionnaire)</td>
<td>(X^{10})</td>
<td>(X^{10})</td>
<td>(X^{10})</td>
<td></td>
</tr>
<tr>
<td>SF-36(^{28}) (Short Form 36 Health Questionnaire Survey)</td>
<td>(X^{11})</td>
<td>(X^{11})</td>
<td>(X^{17, 31})</td>
<td>(X^{17, 31})</td>
</tr>
<tr>
<td>SRQ(^{11}) (Shoulder Rating Questionnaire or L’ Insalata)</td>
<td>(X^{28})</td>
<td>(X^{28})</td>
<td>(X^{28})</td>
<td>(X^{28})</td>
</tr>
<tr>
<td>SPADI(^{32}) (Shoulder Pain and Disability Index)</td>
<td>(X^{32, 33})</td>
<td>(X^{32})</td>
<td>(X^{32})</td>
<td>(X^{32})</td>
</tr>
<tr>
<td>SST(^{33}) (Simple Shoulder Test)</td>
<td>(X^{15})</td>
<td>(X^{15})</td>
<td>(X^{15})</td>
<td>(X^{15})</td>
</tr>
<tr>
<td>UCLA Shoulder Score(^{34})</td>
<td>(X^{37})</td>
<td>(X^{37})</td>
<td>(X^{37})</td>
<td>(X^{37})</td>
</tr>
<tr>
<td>VAS (Visual Analogue Scale)</td>
<td>(X^{35})</td>
<td>(X^{35})</td>
<td>(X^{35})</td>
<td>(X^{35})</td>
</tr>
<tr>
<td>WORC(^{36}) (Western Ontario Rotator Cuff Index)</td>
<td>(X^{37})</td>
<td>(X^{37})</td>
<td>(X^{37})</td>
<td>(X^{37})</td>
</tr>
</tbody>
</table>

I.C. = Internal Consistency (Reliability); Rep. = Reproducibility (Reliability); Val. = Validity; Resp. = Responsiveness; X = psychometric property addressed by study; *Construct or convergent validity; † Authors note, “Reliability of the score was low, with a 95% confidence limit of between 15 and 20 points out of 100 for a single observation on a single patient.”

We only considered an outcome if ≥ 80% of the patients were followed for that outcome (for example, some studies reported short-term outcomes data on nearly all enrolled patients, and reported longer-term data on only a few patients. In such cases, we did not include the longer-term data). We also excluded outcomes for study groups that did not have at least 10 patients.

**MINIMAL CLINICALLY IMPORTANT IMPROVEMENT**

Wherever possible, we considered not only whether a study result was statistically significant, but also whether the effect of a treatment achieved a minimal clinically important improvement (MCII). The MCII is the smallest clinical change that is important to patients, and recognizes the fact that there are some treatment-induced statistically significant improvements that are too small to matter to patients. We derived the values we used for MCII from the published studies that enrolled only patients with rotator cuff tears (Table 2). For all calculated MCII, we standardized the effect size for an instrument by dividing the reported minimal clinically important difference between baseline and follow-up scores by the standard deviation of the mean baseline score.
Table 2 MCII of Validated Outcomes

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Study</th>
<th>Points</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES)</td>
<td>Michener, et al.\textsuperscript{12}</td>
<td>6.4</td>
<td>0.379</td>
</tr>
<tr>
<td>Disabilities of the Arm, Shoulder and Hand (DASH)</td>
<td>Gummesson, et al.\textsuperscript{20}</td>
<td>10</td>
<td>0.455</td>
</tr>
<tr>
<td>PENN Shoulder Score (PSS)</td>
<td>Leggin, et al.\textsuperscript{27}</td>
<td>11.4</td>
<td>0.585</td>
</tr>
<tr>
<td>Shoulder Rating Questionnaire or L’Insalata (SRQ)</td>
<td>L’Insalata, et al.\textsuperscript{28}</td>
<td>12</td>
<td>0.896</td>
</tr>
</tbody>
</table>

When possible we describe the results of studies using terminology based on that of Armitage et al.\textsuperscript{38} The associated descriptive terms we use in this guideline and the conditions for using each of these terms, are outlined in the following table:

Table 3 Description of Results with MCII

<table>
<thead>
<tr>
<th>Descriptive Term</th>
<th>Condition for Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinically Important</td>
<td>Statistically significant and lower confidence limit &gt; MCII</td>
</tr>
<tr>
<td>Possibly Clinically Important</td>
<td>Statistically significant and confidence intervals contain the MCII</td>
</tr>
<tr>
<td>Not Clinically Important</td>
<td>Statistically significant and upper confidence limit &lt; MCII</td>
</tr>
<tr>
<td>Negative</td>
<td>Not statistically significant and upper confidence limit &lt; MCII</td>
</tr>
<tr>
<td>Inconclusive</td>
<td>Not statistically significant but confidence intervals contain the MCII</td>
</tr>
</tbody>
</table>

LITERATURE SEARCHES
We searched for articles published up to October 1, 2008. The work group reviewed search strategies prior to conducting the searches. All literature searches were supplemented with manual screening of bibliographies of all publications retrieved. We
also searched the bibliographies of recent systematic reviews and other review articles for potentially relevant citations. Three potentially relevant studies not identified by the literature search were also provided by the work group members for evaluation for inclusion. These three studies were published in September 2008 and had not been entered to the Pub Med database. One article, provided by a work group member, met all inclusion criteria and was subsequently included.

SEARCH FOR RCTS AND OTHER STUDY DESIGNS
To identify primary studies for this guideline, we searched four electronic databases; PubMed, EMBASE, CINAHL, and The Cochrane Central Register of Controlled Trials. The search strategies we used are provided in Appendix III.

We used a previously published search strategy39 to identify relevant randomized controlled trials. In the absence of relevant RCTs, we modified the search strategy to identify studies of other designs.

The study attrition diagram in Appendix IV provides details about the inclusion and exclusion of these studies. A total of seventy-five studies met the inclusion criteria for this guideline; fifteen of these studies answered at least two of the recommendations.

JUDGING THE QUALITY OF EVIDENCE
We rated the quality of evidence using an evidence hierarchy in which the Level of Evidence was determined from a checklist. The hierarchy and checklist are provided in Appendix V.

For “Therapeutic Studies” investigating the results of a treatment, randomized controlled trials were initially categorized as Level I studies, but the level of evidence was reduced by one level if there was a “No” or “Not Reported by Authors” to any of the following checklist questions:

- Was randomization stochastic? (i.e. at the time of assignment to groups, did all patients have an equal probability of being assigned to any given group)
- Was there concealment of the allocation to groups?
- Were the patients, caregivers, or evaluators blinded?

According to the AAOS Levels of Evidence for “Therapeutic Studies”, non-randomized controlled trials and other prospective comparative studies were categorized as Level II studies. Retrospective comparative studies and case-control studies were initially categorized as Level III studies and case-series studies/reports were categorized as Level IV studies.

Some randomized controlled trials were included that enrolled patients relevant to the recommendation but the comparisons between the treatments were not relevant to the specific recommendation. When this occurred, we considered the relevant data from such
studies as coming from a prospective case series (because we were evaluating only one of the study’s groups). Accordingly, we appraised this evidence as Level IV.

For “Prognostic Studies” investigating risk or prognostic factors, high quality prospective studies were categorized as Level I studies. A high quality study is defined as a study with a “yes” to all of the following checklist questions:40,41

- Were participants at a common point in the course of their disease?
- Were participants, health workers, researchers blind to prognostic factors?
- Were all groups/participants treated with the same intervention?
- Was follow up time sufficiently long to detect important prognostic factors?

According to the AAOS Levels of Evidence for “Prognostic Studies”, lower quality prospective studies and retrospective comparative studies were categorized as Level II studies. Retrospective case control studies were initially categorized as Level III studies and case-series studies/reports were categorized as Level IV studies.

Downgrading of Level I studies, regardless of whether a study was of a treatment or a prognostic, was not cumulative. If a Level I study had more than one of the methodological flaws listed above, it would only decrease by a single level. The downgrading of the formal level of evidence of a study indicates the discrepancy between claims of the study authors and the results of the critical appraisal process.

DATA EXTRACTION
Data elements extracted from studies were defined in consultation with the physician work group. Five reviewers completed data extraction independently for all studies. Disagreements were resolved by consensus and by consulting the work group. We report the elements extracted in Appendix VI

Evidence tables were constructed to summarize the best evidence for each simulated recommendation. These tables appear in a supplemental document on the AAOS website [insert link here]. The evidence tables include complete lists of included and excluded articles, quality and design parameters of the included studies, and raw data extracted from the included studies.

GRADING THE RECOMMENDATIONS
Following data extraction and analyses, each guideline recommendation was assigned a preliminary grade that was based on the total body of evidence available using the following system:
Table 4 Grade of Recommendation Description

<table>
<thead>
<tr>
<th>Grade</th>
<th>Overall Quality of Evidence</th>
<th>Description of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Good Quality Evidence</td>
<td>More than one Level I study with consistent findings for or against recommending intervention.</td>
</tr>
<tr>
<td>B</td>
<td>Fair Quality Evidence</td>
<td>More than 1 Level II or III study with consistent findings or a single Level I study for or against recommending intervention.</td>
</tr>
<tr>
<td>C</td>
<td>Poor Quality Evidence</td>
<td>More than 1 Level IV or V study or a single Level II or III study for or against recommending intervention.</td>
</tr>
<tr>
<td>I</td>
<td>No Evidence or Conflicting Evidence</td>
<td>There is insufficient or conflicting evidence not allowing a recommendation for or against intervention.</td>
</tr>
</tbody>
</table>

Final grades were based upon preliminary grades assigned by AAOS staff. Preliminary grades took into account only the quality and quantity of the available evidence as listed in the table above. Work group members then modified the grade using the ‘Form for Assigning Grade of Recommendation (Interventions)’ shown in Appendix VII. This form, which is based on recommendations of the GRADE work group, requires consideration of the harms, benefits, and critical outcomes associated with a treatment. It also requires the work group to evaluate the applicability of the evidence. The final grade is assigned by the physician work group, which modifies the preliminary grade on the basis of these considerations.

CONSENSUS DEVELOPMENT
The recommendations and their grades of recommendation were voted on using a structured voting technique known as the nominal group technique. We present details of this technique in Appendix VIII. Each recommendation was constructed using the following language which takes into account the final grade of recommendation.

Table 5 AAOS Guideline Language

<table>
<thead>
<tr>
<th>Guideline Language</th>
<th>Grade of Recommendation</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>We recommend</td>
<td>A</td>
<td>Level I</td>
</tr>
<tr>
<td>We suggest</td>
<td>B</td>
<td>Level II or III</td>
</tr>
<tr>
<td>option</td>
<td>C</td>
<td>Level IV or V</td>
</tr>
<tr>
<td>We are unable to recommend for or against</td>
<td>I</td>
<td>None or Conflicting</td>
</tr>
<tr>
<td><em>In the absence of reliable evidence, it is the opinion of the work group that</em></td>
<td>Consensus*</td>
<td>None</td>
</tr>
</tbody>
</table>
*Consensus based recommendations are made according to specific criteria. These criteria can be found in Appendix VIII.

STATISTICAL METHODS
When possible we report the results of the statistical analyses conducted by the authors of the included studies. In some circumstances, the authors did not perform statistical tests, but sufficient quantitative data, including measures of dispersion or patient level data were reported by the authors. In these circumstances we performed our own statistical analyses. To do so we used the statistical program STATA (StatCorp LP, College Station, Texas). P-values that were < 0.05 were considered statistically significant. In the evidence tables, we note if the analysis was that of the study authors or our own.

STATA was also used to determine 95% confidence intervals. When authors of the included studies reported counts or proportions we used the method of Wilson, to compute these intervals. We also used STATA to determine the magnitude of the treatment effect. For data reported as means (and associated measures of dispersion) we calculated a standardized mean difference by the method of Hedges and Olkin. For proportions, we calculated the odds ratio as a measure of treatment effect.

We used G*Power 3 (Franz Faul, Universitat Kiel, Germany) to determine if a study was sufficiently powered to detect the MCII. Our power calculations were based on 80% power and an alpha of 0.05 stratifications.

When published studies only reported the median, range, and size of the trial, we estimated their means and variances according to a published method. We used the program TechDig 2.0 (Ronald B. Jones, Mundelein, Illinois) to estimate means and variances from studies presenting data only in graphical form.

STRATIFICATIONS
When reported in included articles, outcomes stratified by the following factors were analyzed:

- Time: from injury to surgery
- Time: duration of symptoms
- Gender
- Age
- Size of rotator cuff tear
- Degree of muscle degeneration/fatty infiltration
- Etiology of tear
- Duration of non-operative treatment
- Location of tear (tendons involved)
- Hand dominance
- Time from surgery to rehab
- Duration of sling treatment
- Number of pre-operative cortisone injections
- Acromial morphology
• Acromial humeral interval

PEER REVIEW
The draft of the guideline and evidence report were peer reviewed for content. The work group nominated outside specialty societies *a priori* to the development of the guideline who then chose content experts to review the document on their behalf. The physician members of the AAOS Guidelines and Technology Oversight Committee and the Evidence Based Practice Committees also peer reviewed this document. Peer review was accomplished using a structured peer review form (Appendix IX). The draft guideline was sent to ten review organizations and fifteen reviewers returned comments. Based on the initial period of review, the work group convened for a third meeting to address peer reviewers’ concerns. The guideline was edited and resubmitted for a second round of peer review. Original peer reviewers were solicited to reevaluate the guideline, as well as additional peer reviewers, at this time. The disposition of all non-editorial peer review comments was documented and accompanied this guideline through Public Commentary and the subsequent approval process.

PUBLIC COMMENTARY
After modifying the draft in response to peer review, the guideline was subjected to a thirty day period of “Public Commentary.” Commentators consist of members of the AAOS Board of Directors (BOD), members of the AAOS Council on Research, Quality Assessment, and Technology (CORQAT), members of the Board of Councilors (BOC), and members of the Board of Specialty Societies (BOS). Based on these bodies, up to 185 commentators had the opportunity to provide input into the development of this guideline. Of these, one member returned public comments.

THE AAOS GUIDELINE APPROVAL PROCESS
Following peer review, the final guideline draft was approved by the AAOS Guidelines and Technology Oversight Committee, the AAOS Evidence Based Practice Committee, the AAOS Council on Research, Quality Assessment, and Technology, and the AAOS Board of Directors. Descriptions of these bodies are provided in Appendix II.

REVISION PLANS
This guideline represents a cross-sectional view of current treatment and will become outdated when more sophisticated tests, more objective assessments, and more rigorous differential diagnoses are possible. All AAOS guidelines are updated or retired after five years, in accordance with the criteria of the National Guideline Clearinghouse.
III. RECOMMENDATIONS AND SUPPORTING DATA
RECOMMENDATION 1: FULL THICKNESS TEARS AND ASYMPTOMATIC PATIENTS

In the absence of reliable evidence, it is the opinion of the work group that surgery not be performed for asymptomatic, full thickness rotator cuff tears.

Level of Evidence: V

Strength of Recommendation: Consensus

Rationale:

Although there is a growing awareness that a large proportion of our population can have full thickness rotator cuff tears that are asymptomatic, we were unable to find quality literature that addressed the issue of operative vs. non-operative treatment for such patients. The issue of appropriate treatment of asymptomatic full thickness tears is potentially important given the high prevalence rate, concerns regarding progression in the form of an enlarging tear, or deterioration into a symptomatic process. Given the potential importance of this patient population, the work group felt that a consensus opinion would be appropriate in light of a paucity of published evidence. The opinion that surgery not be performed for asymptomatic, full thickness rotator cuff tear was based on the following considerations:

- Asymptomatic rotator cuff disease is highly prevalent in the older population. A large percentage of our population will have full thickness rotator cuff tears without any apparent difficulties. Thus, the presence of a tear in and of itself is not clinically significant for many people as they have no pain or apparent lack of function.

- For patients with bilateral asymptomatic shoulders, there is no reliable evidence that surgery prevents long-term clinical deterioration of a rotator cuff tear.

- Post-surgical healing rates are inconsistent in elderly patients - the patients most likely to have asymptomatic rotator cuff tear.

- Surgical repair of the rotator cuff has peri-operative morbidity and risks, including pain and loss of use of the arm for a significant time period, infection, deltoid injury, implant failure, and arthrofibrosis. The morbidity and risk are probably not warranted in absence of symptoms.

- Currently, the primary indication for rotator cuff repair is significant pain or dysfunction affecting quality of life; neither indication is present in patients with asymptomatic rotator cuff tears.

Given the above considerations, it is the opinion of this work group that patients with asymptomatic full thickness tears not be treated with operative repair.
RECOMMENDATION 2: FULL THICKNESS TEARS AND SYMPTOMATIC PATIENTS

Rotator cuff repair is an option for patients with chronic, symptomatic full thickness tears.

Level of Evidence: IV

Strength of Recommendation: Weak

Rationale:

Our systematic review identified one Level III study\textsuperscript{46} that compared conservative to surgical treatment of rotator cuff tears. In this study, sixty patients treated without surgery were compared to seventy-seven with rotator cuff repair. Per this study, in group A, tears were non-traumatic in 73\% of cases and traumatic in 27\% of cases. In group B, tears were non-traumatic in 32\% of cases and traumatic in 68\% of cases. Statistically significant less pain on shoulder range of motion and at night was seen in those patients who had surgery as compared to those with conservative treatment. Eighty-one percent of the surgical patients reported excellent results as compared to thirty-seven percent with conservative treatment although the authors did not report statistical significance in this comparison. Because there was only one Level III study to support this recommendation, we also examined Level IV articles.

We identified multiple Level IV articles\textsuperscript{47-52} on the influence of advanced muscle disease on rotator cuff repair. Six studies\textsuperscript{47-52} assessed MRI tear characteristics of fatty infiltration and/or muscle atrophy on outcome. One study\textsuperscript{47} reported that patients undergoing open, mini-open or arthroscopic repairs of full thickness tears had fatty atrophy or infiltration of the infraspinatus that led to lower ASES scores. Atrophy and infiltration of the supraspinatus did not correlate with ASES scores. Another study\textsuperscript{51} reported that the degree of preoperative supraspinatus atrophy correlated with postoperative Constant-Murley scores. Constant-Murley scores in patients with greater atrophy were associated with poorer outcome. Another study\textsuperscript{48} did not show a statistically significant correlation between preoperative fatty infiltration and postoperative Constant-Murley score. A final study\textsuperscript{50} showed positive correlation between decreasing postoperative UCLA scores and greater preoperative muscle degeneration as assessed by MRI. While these studies in total suggest that greater post operative functional deficits may occur in the presence of more significant muscle disease, the overall positive outcome of the surgery still suggests that operative treatment of chronic rotator cuff tears is an option.

Because this recommendation is supported by a single Level III article and several Level IV articles, the strength of the evidence that supports it is weak.
SUPPORTING EVIDENCE- SURGICAL VERSUS CONSERVATIVE TREATMENT:
Tables relevant to this recommendation are: Table 6
Figures relevant to this recommendation are: Figure 1 through Figure 3

SURGICAL VERSUS CONSERVATIVE TREATMENT
One Level III study comprised of 150 patients with complete tears of the rotator cuff compared conservative to surgical treatment. Patients in the surgically treated group averaged fifty-nine years while patients treated conservatively averaged sixty-three years.

Table 6 Results of conservatively and surgically treated patients

<table>
<thead>
<tr>
<th>Author</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Final Visit*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tabata et al.</td>
<td>III</td>
<td>150</td>
<td>Surgical vs. Conservative Treatment</td>
<td>Pain: At night</td>
<td>s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain: On motion</td>
<td>s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Response to</td>
<td>nr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treatment</td>
<td></td>
</tr>
</tbody>
</table>

= statistically significant results
s = favoring surgical treatment
nr = statistical significance not reported by authors
LoE = level of evidence
* = final visit not defined by author
**PAIN: AT NIGHT**

One Level III study by Tabata, et al.\(^4^6\) assessed patients with complete tears of the rotator cuff treated surgically or conservatively. The authors did not define conservative treatment. Patients reporting pain at night were assessed. AAOS calculations found statistically significantly fewer patients reporting pain at night when treated by surgery than when treated conservatively (OR = 88.19, 95% CI 5.23 – 1486.48; see Figure 1).

**Figure 1 Patients reporting pain at night**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Events,</th>
<th>Events,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>23/67</td>
<td>0/83</td>
</tr>
<tr>
<td>Surgery</td>
<td>88.19 (5.23, 1486.48)</td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size; OR = Odds Ratio
**PAIN: ON MOTION**

One Level III study by Tabata, et al. assessed patients with complete tears of the rotator cuff treated surgically or conservatively. The authors did not define “conservative treatment”. Patients reporting pain on motion were assessed. AAOS calculations found statistically significantly fewer patients reporting pain on motion when treated by surgery than when treated conservatively ($OR = 27.95$, 95% CI 9.95 – 78.52; see Figure 2).

**Figure 2. Patients reporting pain on motion**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>OR (95% CI)</th>
<th>Events, Conservative</th>
<th>Events, Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain on motion</td>
<td>27.95 (9.95, 78.52)</td>
<td>43/67</td>
<td>5/83</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
RESPONSE TO TREATMENT

One Level III study by Tabata, et al. assessed response to treatment in patients treated surgically or conservatively. The authors did not define “conservative treatment”. Patients were rated according to the cumulative score of pain, range of motion, muscle strength and activities of daily living outcomes (see Figure 3). The authors did not report statistical analyses and time of final evaluation.

Figure 3 Response to treatment of conservatively and surgically treated patients

Authors report no statistical analyses
SUPPORTING EVIDENCE- MRI TEAR CHARACTERISTICS:
Tables relevant to this recommendation are: Table 7 through Table 10
Figures relevant to this recommendation are: Figure 4 through Figure 6

MRI TEAR CHARACTERISTICS
Six Level IV studies\textsuperscript{47-52} assessed the MRI tear characteristics of fatty infiltration and/or muscle atrophy.

**ASES SCORE**
One Level IV study by Gladstone et al. assessed patients undergoing open, mini-open or arthroscopic repair of a full thickness rotator cuff tear and patient pre-operative muscle quality (muscle atrophy and fatty infiltration). Muscle atrophy was graded using a system by Warner and fatty infiltration was graded using a system by Goutallier. The authors first examined the correlation between preoperative muscle quality and post-operative Constant-Murley score (see Table 7). The authors then performed a stepwise regression analysis and found muscle atrophy and fatty infiltration of the infraspinatus to be a statistically significant predictor of the ASES score ($p = 0.001$ and $p = 0.01$ respectively). Muscle atrophy and fatty infiltration of the supraspinatus was not a statistically significant predictor of the ASES score. The authors did not provide the regression coefficients used in the analysis.

<table>
<thead>
<tr>
<th>ASES Score</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infraspinatus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>-0.364</td>
<td>0.027</td>
</tr>
<tr>
<td>MA</td>
<td>-0.401</td>
<td>0.014</td>
</tr>
<tr>
<td><strong>Supraspinatus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>-0.231</td>
<td>0.17</td>
</tr>
<tr>
<td>MA</td>
<td>-0.354</td>
<td>0.034</td>
</tr>
</tbody>
</table>

MA = muscle atrophy; FI = fatty infiltration

**CONSTANT-MURLEY SCORE**
Three Level IV studies assessed pre-operative muscle atrophy and fatty infiltration in relation to the post-operative Constant-Murley score.

Gladstone et al. assessed patients undergoing open, mini-open or arthroscopic repair of a full thickness rotator cuff tear and patient pre-operative muscle quality (muscle atrophy and fatty infiltration). Muscle atrophy was graded using a system by Warner and fatty infiltration was graded using the Goutallier staging system. The authors first examined the correlation between preoperative muscle quality and post-operative Constant-Murley score (see Table 8). The authors then performed a stepwise regression analysis and found muscle atrophy (but not fatty infiltration) of the infraspinatus is a statistically significant predictor of the Constant-Murley score ($p = 0.033$). Muscle atrophy and fatty infiltration of the supraspinatus was not a statistically significant predictor of the Constant-Murley score. The authors did not provide regression coefficients.
### Table 8 Correlation of muscle quality and Constant-Murley score

<table>
<thead>
<tr>
<th></th>
<th>Constant-Murley score</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>Infraspinatus</td>
<td>FI -0.359</td>
<td>0.029</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MA -0.440</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>FI -0.236</td>
<td>0.160</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MA -0.402</td>
<td>0.015</td>
<td></td>
</tr>
</tbody>
</table>

MA = muscle atrophy; FI = fatty infiltration

Shen et al. assessed patients undergoing mini-open repair of a rotator cuff tear. Authors assessed atrophy by calculating a ratio between the atrophic and total area (A/T ratio). AAOS calculations found postoperative Constant-Murley score was statistically significantly correlated to pre-operative A/T ratios with greater atrophy of the supraspinatus and subscapularis being associated with a poorer outcome (see Table 9).

### Table 9 Correlation of muscle quality and Constant-Murley score

<table>
<thead>
<tr>
<th></th>
<th>Constant-Murley score</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>Infraspinatus &amp; teres minor</td>
<td>0.1934</td>
<td>0.3339</td>
<td></td>
</tr>
<tr>
<td>Subscapularis</td>
<td>0.5612</td>
<td>0.0023</td>
<td></td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>0.6146</td>
<td>0.0006</td>
<td></td>
</tr>
</tbody>
</table>

Gerber et al. (2007) assessed patients undergoing surgical repair of a full-thickness supraspinatus tear. Authors assessed fatty infiltration according to the Goutallier staging system. AAOS calculations found no statistically significant correlation between pre-operative fatty infiltration and postoperative Constant-Murley (see Table 10).

### Table 10 Correlation of fatty infiltration and Constant-Murley score

<table>
<thead>
<tr>
<th></th>
<th>Constant-Murley score</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>Infraspinatus</td>
<td>-0.264</td>
<td>0.384</td>
<td></td>
</tr>
<tr>
<td>Subscapularis</td>
<td>0.263</td>
<td>0.385</td>
<td></td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>-0.120</td>
<td>0.696</td>
<td></td>
</tr>
</tbody>
</table>
**UCLA SCORE**

One Level IV study by Mellado et al. correlated preoperative fatty degeneration and postoperative UCLA Score. Twenty-eight patients diagnosed as having massive rotator cuff tears were surgically repaired. Diagnosis was confirmed intraoperatively and complete repair was performed whenever possible. Prior to surgery, muscle degeneration and atrophy were assessed using MRI. Authors report preoperative fatty degeneration of the infraspinatus muscle was negatively correlated with the postoperative UCLA Score ($r = -0.4, p = 0.03$). Authors report no additional preoperative muscle disease characteristics in relation to postoperative outcomes.

**RE-TEAR**

Three Level IV studies assessed pre-operative muscle atrophy and fatty infiltration in relation to post-operative re-tear rates.

Gladstone et al. assessed patients undergoing open or arthroscopic repair of a full thickness rotator cuff tear and patient pre-operative muscle quality (muscle atrophy and fatty infiltration). Muscle atrophy was graded using a system by Warner and fatty infiltration was graded using a system by Goutallier whereby higher scores indicate greater atrophy or infiltration. The authors examined pre-operative muscle quality scores and patients who develop re-tears post-operatively (see Figure 4).

**Figure 4 Pre-operative muscle quality in patients with and without retears**

*Authors report, $p < .01$; **Authors report, $p < .05$; MA = muscle atrophy; FI = fatty infiltration; AAOS calculated confidence intervals uses standard deviation estimated from range.
Liem et al. assessed patients undergoing arthroscopic repair of an isolated supraspinatus tear and pre-operative muscle quality. Supraspinatus atrophy was graded using a system by Thomazeau and fatty infiltration was graded using a system by Goutallier. Authors compared post-operative re-tear rates in patients with grade one supraspinatus atrophy to those with grade two and report a statistically significant effect favoring Grade 1 (p = 0.018; see Figure 5). Additionally, authors compared post-operative re-tear rates in patients with either stage zero or one to patients with stage two fatty infiltration and report a statistically significant effect favoring Stage 0 and 1 (p = 0.021); however, AAOS calculations failed to find a statistically significant effect (see Figure 6).

Thomazeau et al. report, “…preoperative atrophy of the supraspinatus muscle was the main anatomic predictive factor for a postoperative re-tear (p = 0.0028).” The value of the correlation coefficient could not be determined.

**Figure 5 Re-tear occurrence by supraspinatus atrophy grade**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>OR (95% CI)</th>
<th>Events, Grade 1</th>
<th>Events, Grade 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retear</td>
<td>0.17 (0.04, 0.79)</td>
<td>5/35</td>
<td>5/10</td>
</tr>
<tr>
<td>Favors Grade 1</td>
<td>1</td>
<td>Favors Grade 2</td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**Figure 6 Re-tear occurrence by fatty infiltration stage**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>OR (95% CI)</th>
<th>Grade</th>
<th>Events,</th>
<th>OR (95% CI)</th>
<th>Grade</th>
<th>Events,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retear</td>
<td>0.31 (0.07, 1.45)</td>
<td>0 &amp; 1</td>
<td>6/35</td>
<td>4/10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Favors Grade 0 & 1  
Favors Grade 2

AAOS calculated effect size.
RECOMMENDATION 3A: ROTATOR CUFF TEARS AND EXERCISE

We cannot recommend for or against exercise programs (supervised or unsupervised) for patients with rotator cuff tears.

Level of Evidence: IV

Strength of Recommendation: Inconclusive

Rationale:

When the patient and physician select non-operative management of a rotator cuff tear, the primary objectives are to decrease pain, increase function, and enhance activities of daily living (while mitigating potential long term adverse outcomes). We found no quality evidence that demonstrated a specific impact of an exercise program, compared to the natural history of disease without other interventions. Similarly, we found no reliable evidence demonstrating that the efficacy of an exercise program is predicated upon a specific form of education, supervision, or exercise environment.

Although reliable evidence was not found to definitively support a positive impact, we also found no such evidence to suggest that there are adverse impacts of exercise programs upon rotator cuff disease.

One Level IV study\(^53\) addressed a physical therapy program. This study observed statistically significant improvement on the Oxford shoulder disability questionnaire and the SF-36 for General Health at three months in a cohort of ten patients treated with a physical therapy-supervised program for massive irreparable cuff tears. It is not possible to generalize this study across patients with different severities and durations of rotator cuff tears.

A second Level IV study\(^54\) reported inconsistent results on the Simple Shoulder Test (SST) but did observe improvement at an average of 2.5 years in three scales with a home exercise program in a larger group of patients with chronic rotator cuff tears.
SUPPORTING EVIDENCE- PHYSICAL THERAPY

Tables relevant to this recommendation are: Table 11 through Table 12
Figures relevant to this recommendation are: Figure 7 through Figure 10

PHYSICAL THERAPY

One Level IV study assessed a physical therapy program in ten patients diagnosed with massive, irreparable rotator cuff tears (see Table 11).

Table 11 Results of physical therapy intervention

<table>
<thead>
<tr>
<th>Author</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ainsworth et al.</td>
<td>IV</td>
<td>10</td>
<td>Change from baseline</td>
<td>OSDQ</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Physical Health</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Emotional Health</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: General Health</td>
<td>↑</td>
</tr>
</tbody>
</table>

= not statistically significant result
= statistically significant result
↑ = improved
LoE = level of evidence
PT = physical therapy
OSDQ = Oxford shoulder disability questionnaire
**OXFORD SHOULDER DISABILITY QUESTIONNAIRE (OSDQ)**

One Level IV study by Ainsworth et al. assessed ten patients with massive, irreparable rotator cuff tears using the OSDQ (see Figure 7). The OSDQ consists of twelve questions with five point responses. The scale ranges from twelve (best score) to sixty (worst score).

**Figure 7 Patient shoulder disability measured by OSDQ**

AAOS calculated paired t-test, $p < 0.01$. 
**SHORT FORM-36 (SF-36)**

Ainsworth et al. also assessed patients with massive, irreparable rotator cuff tears using the SF-36. The physical health (see Figure 8), emotional health (see Figure 9), and general health (see Figure 10) subscales were reported.

**Figure 8 Patient physical health measured by SF-36**

![Figure 8: SF-36 Physical Health](image)

AAOS calculated paired t-test, not statistically significant (ns).

**Figure 9 Patient emotional health measured by SF-36**

![Figure 9: SF-36 Emotional Health](image)

AAOS calculated paired t-test, *ns.*
Figure 10 Patient general health measured by SF-36

AAOS calculated paired t-test, $p < 0.05$.

**STRATIFICATIONS**

Ainsworth et al. provided patient characteristics for age, gender and duration of symptoms. AAOS calculated correlations with the final outcome (SF-36 subscales) and patient characteristics (see Table 12).

**Table 12 Rotator cuff tear stratifications pertaining to physical therapy treatment**

<table>
<thead>
<tr>
<th>Stratification</th>
<th>SF-36 Subscales*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Physical Health</td>
</tr>
<tr>
<td>Age</td>
<td>-0.57 (p = 0.08)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.45 (p = 0.19)</td>
</tr>
<tr>
<td>Duration of Symptoms</td>
<td>0.15 (p = 0.67)</td>
</tr>
</tbody>
</table>

*AAOS calculated Pearson correlation (p-value)
SUPPORTING EVIDENCE - EXERCISE

Tables relevant to this recommendation are: Table 13 through Table 16
Figures relevant to this recommendation are: None

EXERCISE

One Level IV study assessed an exercise program in forty-six patients diagnosed with chronic, full-thickness rotator cuff tears (see Table 13).

Table 13 Results of exercise intervention

<table>
<thead>
<tr>
<th>Author</th>
<th>LoE</th>
<th>n</th>
<th>Change from baseline</th>
<th>Outcome</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldberg et al.</td>
<td>IV</td>
<td>46</td>
<td></td>
<td>SST: Comfortable at side</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Sleep on side</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Tuck in shirt behind</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Hand behind head</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Place coin on shelf</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Place pound on shelf</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Place 8 lbs on shelf</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Carry 20 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Toss underhand</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Throw overhand</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Wash opposite shoulder</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SST: Do usual work</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Physical role</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Comfort</td>
<td>⬆</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Vitality</td>
<td>⬇</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Physical function</td>
<td>⬆</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Emotional role</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Social function</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Mental health</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: General health</td>
<td>⬇</td>
</tr>
</tbody>
</table>

○ = no statistically significant difference
● = statistically significant detriment
↑ = improved
↓ = worsened
LoE = level of evidence
* = final visit 2.5 ± 0.46 years after baseline
SIMPLE SHOULDER TEST (SST)

One Level IV study by Goldberg et al. utilized the SST to assess a home exercise program in forty-six patients diagnosed with chronic, full-thickness rotator cuff tears (see Table 14). The program focused on stretching and strengthening the remaining rotator cuff, deltoid, pectoralis major and trapezius muscles. The SST is a function-based outcome assessment tool consisting of twelve "yes" or "no" questions. The authors reported the results as the percent of patients able to perform each task. Patients averaged sixty-five years of age (95% CI 62.33 – 67.67 years).

Table 14 SST results at baseline and final visit

<table>
<thead>
<tr>
<th>Function</th>
<th>Baseline %</th>
<th>Outcome* %</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable at side</td>
<td>67%</td>
<td>75%</td>
<td>ns</td>
</tr>
<tr>
<td>Sleep on side</td>
<td>37%</td>
<td>67%</td>
<td>p &lt; .01</td>
</tr>
<tr>
<td>Tuck in shirt behind</td>
<td>61%</td>
<td>72%</td>
<td>ns</td>
</tr>
<tr>
<td>Hand behind head</td>
<td>54%</td>
<td>80%</td>
<td>p &lt; .01</td>
</tr>
<tr>
<td>Place coin on shelf</td>
<td>70%</td>
<td>74%</td>
<td>ns</td>
</tr>
<tr>
<td>Place pound on shelf</td>
<td>46%</td>
<td>61%</td>
<td>ns</td>
</tr>
<tr>
<td>Place 8 lbs on shelf</td>
<td>20%</td>
<td>26%</td>
<td>ns</td>
</tr>
<tr>
<td>Carry 20 lbs</td>
<td>48%</td>
<td>57%</td>
<td>ns</td>
</tr>
<tr>
<td>Toss underhand</td>
<td>54%</td>
<td>52%</td>
<td>ns</td>
</tr>
<tr>
<td>Throw overhand</td>
<td>24%</td>
<td>24%</td>
<td>ns</td>
</tr>
<tr>
<td>Wash opposite shoulder</td>
<td>41%</td>
<td>61%</td>
<td>ns</td>
</tr>
<tr>
<td>Do usual work</td>
<td>39%</td>
<td>54%</td>
<td>ns</td>
</tr>
</tbody>
</table>

Statistical significance as reported by authors; *Final visit averaged 2.5 ± 0.46 years after baseline.
SHORT FORM-36 (SF-36)

One Level IV study by Goldberg et al. utilized the SF-36 to assess a home exercise program in forty-six patients diagnosed with chronic, full-thickness rotator cuff tears averaging sixty-five years of age (95% CI 62.33 – 67.67 years). The program focused on stretching and strengthening the remaining rotator cuff, deltoid, pectoralis major and trapezius muscles. A statistically significant improvement was found on the subscale comfort; however, a statistically significant decline was found on the vitality, physical function, and general health subscales (see Table 15).

Table 15 SF-36 scores at baseline and final visit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline Score</th>
<th>Outcome* Score</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical role</td>
<td>35.3</td>
<td>33.2</td>
<td>ns</td>
</tr>
<tr>
<td>Comfort</td>
<td>48.3</td>
<td>58.5</td>
<td>0.0010</td>
</tr>
<tr>
<td>Vitality</td>
<td>60</td>
<td>49.6</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical function</td>
<td>60.4</td>
<td>48.3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Emotional role</td>
<td>73.2</td>
<td>73.9</td>
<td>ns</td>
</tr>
<tr>
<td>Social function</td>
<td>79.7</td>
<td>73.4</td>
<td>ns</td>
</tr>
<tr>
<td>Mental health</td>
<td>76.9</td>
<td>73</td>
<td>ns</td>
</tr>
<tr>
<td>General health</td>
<td>76.4</td>
<td>60.8</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Statistical significance as reported by authors; *Final visit averaged 2.5 ± 0.46 years after baseline.
**STRATIFICATIONS**

Goldberg et al. reported, "Although the outcome of nonoperative treatment could not be predicted from the patient age, gender, or tear size, some factors were statistically associated with improvement. Patients who improved were more likely to have a rotator cuff tear of the dominant extremity (p= 0.02)..." (see Table 16).

**Table 16 Rotator cuff tear stratifications pertaining to exercise treatment**

<table>
<thead>
<tr>
<th>Stratification</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>ns</td>
</tr>
<tr>
<td>Age</td>
<td>ns</td>
</tr>
<tr>
<td>Size of tear</td>
<td>ns</td>
</tr>
<tr>
<td>Hand dominance</td>
<td>0.02*</td>
</tr>
</tbody>
</table>

ns = not statistically significant  
* = favoring tear of dominant extremity
RECOMMENDATION 3B: ROTATOR CUFF TEARS AND CORTICOSTEROID INJECTIONS
We cannot recommend for or against subacromial injections for patients with rotator cuff tears.

Level of Evidence: IV

Strength of Recommendation: Inconclusive

One level II study\textsuperscript{55} found no statistically significant difference in pain or tenderness up to six weeks after injection of steroid with lidocaine compared to lidocaine injection alone.

In contrast, three Level IV\textsuperscript{56, 57, 58} studies noted short term improvement with corticosteroid injection compared to baseline status, without comparison to a placebo control. We found no specific, compelling evidence to provide evidence-based recommendations concerning an ideal / absolute / safe number or frequency of subacromial corticosteroid injections in the setting of a rotator cuff tear. While it is logical for clinicians to consider potential adverse effects of corticosteroid injection upon rotator cuff tendon biology and healing capacity with rotator cuff repair (based upon general concerns across other areas of orthopaedic practice), there was no quality evidence to guide recommendations in this regard. Because the evidence that addresses this recommendation is weak and conflicting, the strength of this recommendation is Inconclusive.

SUPPORTING EVIDENCE- CORTICOSTEROID
Tables relevant to this recommendation are: Table 17 through Table 19
Figures relevant to this recommendation are: Figure 11 through Figure 16

CORTICOSTEROID INJECTIONS
One level II\textsuperscript{55} and three Level IV\textsuperscript{56, 57, 58} studies examined the use of cortisone injections. See Table 17 (next page) for a summary of results.
Table 17 Results of cortisone injection interventions

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Final Visit*</th>
<th>1 week</th>
<th>2 weeks</th>
<th>3 weeks</th>
<th>4 weeks</th>
<th>5 weeks</th>
<th>6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darlington et al.</td>
<td>II</td>
<td>37</td>
<td>Steroid vs. Control</td>
<td>Pain: Likert-like</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Shibata et al.</td>
<td>IV</td>
<td>40</td>
<td>Change from baseline</td>
<td>Pain: UCLA</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Shibata et al.</td>
<td>IV</td>
<td>40</td>
<td>Change from baseline</td>
<td>Function: UCLA</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Fearnley et al.</td>
<td>IV</td>
<td>38</td>
<td>Change from baseline</td>
<td>Response to Treatment</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Weiss</td>
<td>IV</td>
<td>15</td>
<td>Change from baseline</td>
<td>Response to Treatment</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

O = no statistically significant difference
● = statistically significant result
↑ = improved
LoE = Level of Evidence
*= final visit not defined by author

Duration
Darlington et al.
Shibata et al.
Shibata et al.
Fearnley et al.
Weiss

z = statistically significant result
**PAIN: LIKERT-LIKE SCALE**

One Level II study by Darlington et al. assessed the use of cortisone injections in forty patients with supraspinatus tendon lesions. Patients received either a lidocaine injection plus steroid or lidocaine only (control). Pain was measured on a four point, Likert-like scale (none, mild, moderate or severe, scored 0-3). Authors report no statistically significant difference between groups at any time point (see Figure 11).

**Figure 11 Pain measured by four-point Likert-like scale**

Authors do not provide dispersions for point estimates; authors report no statistically significant difference between groups at any time point.
**ANALGESIC CONSUMPTION**

One Level II study by Darlington et al. assessed the use of cortisone injections in forty patients with supraspinatus tendon lesions. Patients received either a lidocaine injection plus steroid or lidocaine only (control). Analgesic consumption (soluble aspirin) was compiled on a weekly basis (see Figure 12). Authors report no statistically significant difference between groups at week one. No other between group comparisons were reported by the authors.

**Figure 12 Analgesic consumption per week**

Authors do not provide dispersion for point estimates; authors report no statistically significant difference between groups at week one. No other between group comparisons were reported by the authors.
TENDERNESS

One Level II study by Darlington et al. assessed the use of cortisone injections in forty patients with supraspinatus tendon lesions. Patients received either a lidocaine injection plus steroid or lidocaine only (control). Patients were examined for tenderness at each assessment. Authors reported no statistically significant difference between groups at any time point (see Figure 13).

Figure 13 Percent of patients with tenderness

Authors do not provide dispersion for point estimates; authors reported no statistically significant difference between groups at any time point.
**PAIN: UCLA SCORE**

In a randomized, controlled trial by Shibata et al. patients with full-thickness rotator cuff tears received either cortisone injections (plus lidocaine) or sodium hyaluronate. We classified this study as Level IV because we included only the cortisone injection data (this recommendation pertains to non-operative treatments) from this group, and did not include data from the study’s other groups. Accordingly, we are analyzing these data as if they were derived from a case series. Pain was assessed using the UCLA Score pain subscale at four weeks (see Figure 14).

**Figure 14 Pain as measured by UCLA Score**

![Graph showing pain measured by UCLA Score]

AAOS calculated independent t-test, $p < .05$; post-treatment confidence interval derived from pooled standard deviation.
FUNCTION: UCLA SCORE

In a randomized, controlled trial by Shibata et al. patients with full-thickness rotator cuff tears received either cortisone injections (plus lidocaine) or sodium hyaluronate. We classified this study as Level IV because we included only the cortisone injection data (this recommendation pertains to non-operative treatments) and did not include data from the study’s other groups. Accordingly, we are analyzing these data as if they were derived from a case series. The authors assessed function using the UCLA Score function subscale at four weeks (see Figure 15).

Figure 15 Function as measured by UCLA Score

AAOS calculated independent t-test, \( p < .05 \); post-treatment confidence interval derived from pooled standard deviation.
**RESPONSE TO TREATMENT**

Two Level IV studies assessed response to treatment. Fearnley and Vadasz assessed thirty-eight patients diagnosed with a rotator-cuff lesion two weeks after a cortisone injection with lidocaine. Patient response to treatment was categorized on a four-point Likert-like scale: symptom free, definite improvement, slight or dubious improvement, no change or worse. AAOS calculations found significantly more patients classified as “symptom free” or “definite improvement” than “slight or dubious improvement” or “no change or worse” ($p = 0.049$; Figure 16).

**Figure 16 Patient response to treatment**

AAOS calculated odds ratio, OR = 2.441 (95% CI 1.01 - 5.93), $p = 0.049$. 
Weiss reported the results of fifteen patients with a diagnosis of rotator-cuff tear at a maximum of 3-4 weeks after cortisone injection (see Table 18). Results were classified on a three-point Likert-like scale: good (pain free motion, able to resume previous activities without restrictions), satisfactory (some pain on motion, partial limitation of motion but able to return to work and recreational activities) or poor (painful motion and unable to undertake usual activities). The authors did not report duration at which the final assessment took place.

Table 18 Patient results after cortisone injection

<table>
<thead>
<tr>
<th>No. of injections</th>
<th>Poor</th>
<th>Satisfactory</th>
<th>Good</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>4</td>
<td>9</td>
<td>N = 15</td>
</tr>
</tbody>
</table>
STRATIFICATIONS
Darlington et al. and Shibata et al. examined stratifications pertaining to: duration of symptoms, gender, age, or hand dominance.

Darlington et al.\textsuperscript{55} reported, "There was no significant correlation between the duration of symptoms and any response to treatment evaluated in this study….The sex of the patient had no significant effect upon the response to treatment."

Shibata et al. reported, "…no difference was found between satisfied and unsatisfied patients in age, dominant side…disease duration…" (see Table 19).

Table 19 Rotator cuff tear stratifications pertaining to cortisone injection(s)

<table>
<thead>
<tr>
<th>Stratification</th>
<th>Author Reported p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shibata et al.</td>
</tr>
<tr>
<td>Duration of symptoms</td>
<td>ns</td>
</tr>
<tr>
<td>Gender</td>
<td>-</td>
</tr>
<tr>
<td>Age</td>
<td>ns</td>
</tr>
<tr>
<td>Hand dominance</td>
<td>ns</td>
</tr>
</tbody>
</table>

\textit{ns} = not statistically significant
\textit{-} = not addressed by authors
RECOMMENDATION 3C: ROTATOR CUFF TEARS AND NSAIDS, ACTIVITY MODIFICATION, ICE, HEAT, IONTOPHORESIS, MASSAGE, T.E.N.S., PEMF AND PHONOPHORESIS

We cannot recommend for or against the use of NSAIDS, activity modification, ice, heat, iontophoresis, massage, Transcutaneous Electrical Nerve Stimulation (TENS), Pulsed Electromagnetic Field (PEMF), or phonophoresis (ultrasound) for nonoperative management of rotator cuff tears.

Level of Evidence: None

Strength of Recommendation: Inconclusive

Rationale:

In symptomatic patients with full thickness rotator cuff tears, treatment objectives are decreased pain, increased function, and enhancement of activities of daily living. Although we found no specific evidence demonstrating treatment efficacy, neither did we find evidence that the following modalities were ineffective non operative treatment alternatives for rotator cuff tears: NSAIDS, activity modification, ice, heat, iontophoresis, massage, TENS, PEMF, phonophoresis (ultrasound).
RECOMMENDATION 4A: ROTATOR CUFF RELATED SYMPTOMS AND EXERCISE OR NONSTEROIDAL ANTI-INFLAMMATORY MEDICATION

We suggest that patients who have rotator cuff-related symptoms in the absence of a full thickness tear be initially treated non-operatively using exercise and/or non-steroidal anti-inflammatory drugs.

Level of Evidence: II

Strength of Recommendation: Moderate

Rationale:

Several Level II studies report the beneficial effects of exercise in decreasing pain and improving function in patients with rotator cuff related symptoms without a full-thickness tear. One study reported on 24 patients undergoing an exercise program and noted significantly improved pain scores on the VAS [visual analog scale] after 8 weeks of treatment; post hoc pairwise comparisons of the two groups in this study showed significantly more improvement in the exercise plus manual therapy group using a composite pain measure. Another study reported patients had significant improvements in pain at rest, pain at night and Constant-Murley scores after 3 months of a home exercise program. A third study randomized patients between a group undergoing exercise and a control group. The group undergoing exercise had statistically significant improvements in pain levels at rest, pain with movement and upper extremity function (DASH-Laborers subscale). No statistically significant difference was reported in patients who participated in supervised and unsupervised exercises.

Our systematic review also identified two Level II studies that found better results with non-steroidal anti-inflammatory medications than with placebo in the treatment of rotator cuff-related symptoms in the absence of a full-thickness rotator cuff tear. The first study was a prospective, double-blinded placebo-controlled study in which 20 patients treated with oral diclofenac had significant improvements in pain (VAS) and shoulder function at four weeks compared to patients taking a placebo. The second study reported significant improvements in shoulder function VAS scores in 10 patients treated with naproxen compared to 10 patients receiving a placebo.
**SUPPORTING EVIDENCE - EXERCISE**

Tables relevant to this recommendation are: Table 20
Figures relevant to this recommendation are: Figure 17 through Figure 32

**EXERCISE**

Table 20 Results of patients treated with an exercise program

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Final Visit*</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bang et al.</td>
<td>I</td>
<td>49</td>
<td>Exercise with manual PT vs. Exercise</td>
<td>Pain: Composite VAS</td>
<td><strong>ept</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain: At Rest (VAS)</td>
<td><strong>e</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain: On Movement (VAS)</td>
<td><strong>e</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DASH-Laborers</td>
<td><strong>e</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DASH-Activities of Daily Living</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Physical Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lombardi et al.</td>
<td>II</td>
<td>60</td>
<td>Exercise vs. Control</td>
<td>SF-36: Role-physical</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Bodily Pain</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>SF-36: General Health</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Vitality</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Social Function</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Role-emotional</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Mental Health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walther et al.</td>
<td>I</td>
<td>60</td>
<td>Self-training vs. PT vs. Shoulder brace</td>
<td>Pain: At Rest</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain: On Activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain: At Night</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Constant-Murley Score</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **ept** = favoring exercise with manual PT
- **e** = favoring exercise treatment
- * = 3-4 weeks from baseline
- LoE = level of evidence
- DASH = disability of the arm, shoulder and hand

○ = no statistically significant difference
● = statistically significant result favoring treatment
**PAIN: COMPOSITE VAS SCORE**

One Level II study by Bang & Deyle assessed patients diagnosed as having subacromial impingement syndrome treated by either a supervised exercise program (group Exercise) or a supervised exercise program with manual physical therapy (group Exercise + PT). Patients’ pain was assessed by VAS and calculated as the sum of pain measures for a) function, b) active abduction and resisted break tests for internal/external rotation, c) abduction (see Figure 17).

**Figure 17 Composite pain score measured by VAS**

AAOS calculated effect size
PAIN: AT REST

Two level two studies examined pain at rest measured by VAS. Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found a statistically significant improvement in pain at rest in the exercise group compared to the control group ($ES = 0.69, 95\% CI 0.17 – 1.21$; see Figure 18). Walther et al. assessed patients diagnosed as having subacromial impingement syndrome treated with either: physiotherapy (ten sessions), self-training (centering and stretching exercises), or shoulder brace (to be worn as long as possible). There were twenty patients per treatment arm and all treatments lasted twelve weeks. Pain at rest was assessed using VAS. Authors report a statistically significant reduction in pain at rest for all three groups ($p < 0.05$); however, there were no differences noted between groups (see Figure 19).

Figure 18 Pain at rest as measured by VAS

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Control</th>
<th>N, mean (SD); Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: At Rest (VAS)</td>
<td>0.69 (0.17, 1.21)</td>
<td>30, 4.3 (3.2)</td>
<td>30, 2.4 (2.1)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
Authors do not provide dispersion for point estimates; authors report a statistically significant reduction for all three groups ($p < 0.05$); however, there were no between group differences.
**PAIN: ON ACTIVITY**

One Level II study by Walther et al. assessed patients diagnosed as having subacromial impingement syndrome treated with either: physiotherapy (ten sessions), self-training (centering and stretching exercises) or shoulder brace (to be worn as long as possible). There were twenty patients per treatment arm and all treatments lasted twelve weeks. Pain on activity was assessed using VAS. Authors report a statistically significant reduction in pain on activity for all three groups ($p < 0.05$); however, there were no statistically significant differences noted between groups (see Figure 20).

**Figure 20 Pain on activity measured by VAS**

Authors do not provide dispersion for point estimates; authors report a statistically significant reduction for all three groups ($p < 0.05$); however, there were no statistically significant between group differences.
**PAIN: AT NIGHT**

One Level II study by Walther et al. assessed patients diagnosed as having subacromial impingement syndrome treated with either: physiotherapy (ten sessions), self-training (centering and stretching exercises) or shoulder brace (to be worn as long as possible). There were twenty patients per treatment arm and all treatments lasted twelve weeks. Pain at night was assessed using VAS. Authors report a statistically significant reduction in pain at night for all three groups ($p < 0.05$); however, there were no statistically significant differences noted between groups (see Figure 21).

**Figure 21 Pain at night measured by VAS**

![Figure 21 Pain at night measured by VAS](image)

Authors do not provide dispersion for point estimates; authors report a statistically significant reduction for all three groups ($p < 0.05$); however, there were no statistically significant between group differences.
**PAIN: ON MOVEMENT**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found a statistically significant improvement in pain on movement (measured by VAS) in the exercise group compared to the control group ($ES = 0.83$, 95% CI $0.30 – 1.36$; see Figure 22).

**Figure 22 Pain on movement as measured by VAS**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: On Movement (VAS)</td>
<td>$0.83 (0.30, 1.36)$</td>
<td>30, 7.1 (2.5)</td>
<td>30, 5.2 (2)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**DASH: LABORERS**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found a statistically significant improvement in the DASH subscale pertaining to laborers in the exercise group compared to the control group ($ES = 0.58, 95\% CI 0.06 – 1.09$; see Figure 23).

**Figure 23 DASH subscale pertaining to laborers**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASH-Laborers</td>
<td>0.58 (0.06, 1.09)</td>
<td>30, 44.2 (28.2)</td>
<td>30, 28.7 (24.8)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**DASH: ACTIVITIES OF DAILY LIVING**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the DASH subscale pertaining to activities of daily living ($ES = 0.48$, 95% CI -0.03 – 1.00; see Figure 24).

**Figure 24 DASH subscale pertaining to activities of daily living**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI</th>
<th>(SD); Control</th>
<th>(SD); Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dash-Activities of Daily Living</td>
<td>0.48 (-0.03, 1.00)</td>
<td>30, 43.4 (22.8)</td>
<td>30, 33.2 (18.7)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**SHORT FORM 36-ITEM (SF-36): PHYSICAL FUNCTION**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to physical function ($ES = 0.07, 95\% CI -0.43 – 0.58$; see Figure 25).

**Figure 25 Physical function as measured by SF-36**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: Physical Function</td>
<td>0.07 (-0.43, 0.58)</td>
<td>30, 64.3 (19)</td>
<td>30, 62.8 (22.3)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**SF-36: ROLE-PHYSICAL**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to physical role \( ES = 0.14, 95\% CI \,-0.36 – 0.65; \) see Figure 26). The physical role assesses problems with work or other daily activities as a result of physical health.

**Figure 26 Physical role as measured by SF-36**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Exercise</th>
<th>N, mean (SD); Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: Role-physical</td>
<td>0.14 (-0.36, 0.65)</td>
<td>30, 36.7 (41.4)</td>
<td>30, 30.8 (39.4)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**SF-36: BODILY PAIN**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to bodily pain ($ES = 0.37$, 95% CI -0.14 – 0.88; see Figure 27).

**Figure 27 Bodily pain as measured by SF-36**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Exercise</th>
<th>N, mean (SD); Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: Bodily Pain</td>
<td>0.37 (-0.14, 0.88)</td>
<td>30, 54.3 (16)</td>
<td>30, 46.7 (24.1)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**SF-36: GENERAL HEALTH**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to general health (ES = 0.25, 95% CI -0.26 – 0.75; see Figure 28).

**Figure 28 General health as measured by SF-36**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%)</th>
<th>N, mean (SD)</th>
<th>N, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: General Health</td>
<td>0.25 (-0.26, 0.75)</td>
<td>30, 73.9 (20.3)</td>
<td>30, 68.2 (25.3)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**SF-36: VITALITY**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to vitality ($ES = 0.21$, 95% CI $-0.30 – 0.71$; see Figure 29). The vitality subscale assesses the degree to which patients feel tired or worn-out.

**Figure 29 Vitality as measured by SF-36**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD)</th>
<th>N, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: Vitality</td>
<td>0.21 (-0.30, 0.71)</td>
<td>30, 54.8 (24.7)</td>
<td>30, 49.4 (26.9)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**SF-36: SOCIAL FUNCTION**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to social function ($ES = 0.41$, 95% CI -0.10 – 0.92; see Figure 30).

**Figure 30 Social function as measured by SF-36**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Exercise</th>
<th>N, mean (SD); Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: Social Function</td>
<td>0.41 (-0.10, 0.92)</td>
<td>30, 76.7 (27.4)</td>
<td>30, 65.4 (27.2)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
SF-36: ROLE-EMOTIONAL

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to emotional role ($ES = 0.16$, 95% CI $-0.35$ – $0.67$; see Figure 31). The emotional role assesses problems with work or other daily activities as a result of emotional problems.

Figure 31 Emotional role as measured by SF-36

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: Role-emotional</td>
<td>0.16 (-0.35, 0.67)</td>
<td>30, 62.2 (40.8)</td>
<td>30, 55.5 (42.3)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**SF-36: MENTAL HEALTH**

One Level II study by Lombardi et al. examined the use of exercise in patients diagnosed with impingement syndrome after two months of treatment. Patients participated in twice-weekly strength training and results were compared to a wait-list control group. AAOS calculations found no statistically significant difference between exercise and control groups on the SF-36 subscale pertaining to mental health ($ES = 0.27, 95\% CI -0.24 – 0.78$; see Figure 32).

**Figure 32 Mental health as measured by SF-36**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD)</th>
<th>N, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36: Mental Health</td>
<td>0.27 (-0.24, 0.78)</td>
<td>30, 62.9 (22)</td>
<td>30, 56.5 (25.1)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
SUPPORTING EVIDENCE- NSAIDS

Tables relevant to this recommendation are: Table 21
Figures relevant to this recommendation are: Figure 33 through Figure 35

NSAIDS

Table 21 Results of patients treated with NSAIDs

<table>
<thead>
<tr>
<th>Author</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>2 weeks</th>
<th>4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adebajo et al.</td>
<td>II</td>
<td>40</td>
<td>NSAIDs vs. Placebo</td>
<td>Pain: VAS</td>
<td>●N</td>
<td></td>
</tr>
<tr>
<td>England et al.</td>
<td>II</td>
<td>20</td>
<td>NSAIDs vs. Dummy Laser</td>
<td>Function: VAS</td>
<td>●N</td>
<td></td>
</tr>
<tr>
<td>Adebajo et al.</td>
<td></td>
<td>40</td>
<td>NSAIDs vs. Placebo</td>
<td>Function: Limitations</td>
<td>●N</td>
<td></td>
</tr>
<tr>
<td>Adebajo et al.</td>
<td></td>
<td>40</td>
<td>NSAIDs vs. Placebo</td>
<td>Response to Treatment</td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>

= no statistically significant difference
● = significant result
N = favoring NSAIDs
LoE = level of evidence

PAIN: VAS

One Level II study by Adebajo et al. assessed patients diagnosed as having rotator cuff tendonitis. Patients were treated with either NSAID (oral NSAID plus injection of lidocaine) or placebo (placebo pill plus injection of lidocaine) and pain was measured using a VAS. AAOS calculations found a statistically significant effect in favor of NSAID treatment at four weeks (ES = 0.70, 95% CI 0.06 – 1.34; see Figure 33).

Figure 33 Improvement in pain score in patients treated with NSAID or placebo

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: VAS</td>
<td>0.70 (0.06, 1.34)</td>
<td>20, 3.6 (3)</td>
<td>20, 1.35 (3.31)</td>
</tr>
</tbody>
</table>
FUNCTION: VAS

One Level II study by England et al. examined the effect of laser treatment, drug treatment (naproxen sodium) or dummy laser treatment on function measured by VAS. Laser treatment data was not examined as this treatment was not considered for this recommendation. Authors report that patients in the drug treatment group had a significant improvement in function compared to the dummy laser treatment (-1cm difference between medians, 95% CI -2, 0; \( p = 0.05 \)).

FUNCTION: LIMITATIONS

One Level II study by Adebajo et al. assessed patients diagnosed as having rotator cuff tendonitis. Patients were treated with either NSAID (oral NSAID plus injection of lidocaine without steroid) or placebo (placebo pill plus injection of lidocaine). Authors reported patient function on a four point scale as: 0 = no limitation of function, 1 = mild limitation of function, 2 = moderate limitation of function, 3 = severe limitation of function. AAOS calculations found a statistically significant effect in favor of NSAIDs treatment at four weeks (\( ES = 1.15, 95\% CI 0.47 - 1.82 \); see Figure 34).

Figure 34 Improvement in function score in patients treated with NSAID or placebo

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Favors Placebo</td>
<td>1.15 (0.47, 1.82)</td>
<td>20, .85 (.492)</td>
<td>20, .3 (.447)</td>
</tr>
<tr>
<td>Favors NSAID</td>
<td>0.2 (.2)</td>
<td>.5 (.5)</td>
<td>.8 (.8)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
RESPONSE TO TREATMENT

One Level II study by Adebajo et al. assessed patients diagnosed as having rotator cuff tendonitis. Patients were treated with either NSAID (oral NSAID plus injection of lidocaine without steroid) or placebo (placebo pill plus injection of lidocaine). Patients were considered to have responded to treatment if they improved in all three outcomes examined: pain, range of active abduction and limitation of function. AAOS calculations failed to find a statistically significant effect for NSAIDs treatment at four weeks ($ES = 18.38$, 95% CI 0.96 – 352.57; see Figure 34).

### Figure 35 Patients responding to treatment after receiving NSAID or placebo

<table>
<thead>
<tr>
<th>Outcome</th>
<th>OR (95% CI)</th>
<th>Events, NSAID</th>
<th>Events, Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responder</td>
<td>18.38 (0.96, 352.57)</td>
<td>6/20</td>
<td>0/20</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
RECOMMENDATION 4B: ROTATOR CUFF RELATED SYMPTOMS AND CORTICOSTEROID INJECTIONS OR PEMF

We cannot recommend for or against subacromial corticosteroid injection or Pulsed Electromagnetic Field (PEMF) in the treatment of rotator cuff-related symptoms in the absence of a full thickness tear.

Level of Evidence: II

Strength of Recommendation: Inconclusive

Rationale:

We found one Level I study\textsuperscript{63} that evaluated the effect of subacromial corticosteroid injections on patients who had previously had 6 weeks of unsuccessful physical therapy and 2 weeks of NSAIDS for rotator cuff-related symptoms in the absence of a full-thickness tear. The authors reported no differences at 3 and 6 months in ASES scores, DASH scores or pain with impingement testing between groups. However, five Level II studies\textsuperscript{61, 64, 65, 66, 67} report conflicting results for the effect of subacromial steroid injections for durations between 2 and 6 weeks. These studies report various results for outcomes of pain and function and also vary in that some studies report results for one steroid injection while others report results for multiple steroid injections. The work group’s overall assessment of this evidence was conflicting. Because of these conflicting results, this recommendation is supported by inconclusive evidence.

Two Level II studies\textsuperscript{68, 69} also examined the use of pulsed electromagnetic field (PEMF) in patients diagnosed with rotator cuff related symptoms. One study\textsuperscript{69} reported no statistically significant differences in pain or Constant-Murley scores in patients treated with PEMF as compared to those treated with sham-controls. In the second study\textsuperscript{68} the authors measured pain on the VAS scale and found a statistically significant difference in favor of PEMF. Based on these conflicting results, the work group does not have sufficient evidence to provide specific treatment recommendations in regard to PEMF.

SUPPORTING EVIDENCE- CORTICOSTERIOD

Tables relevant to this recommendation are: Table 22
Figures relevant to this recommendation are: Figure 36 through Figure 52
### Table 22 Corticosteroid Injections

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Final Visit*</th>
<th>2 weeks</th>
<th>4 weeks</th>
<th>6 weeks</th>
<th>8 weeks</th>
<th>3 months</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alvarez et al.</td>
<td>I</td>
<td>58</td>
<td>Steroid vs. Control</td>
<td>Pain: VAS</td>
<td></td>
<td>O</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASES</td>
<td></td>
<td>?</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DASH</td>
<td></td>
<td>?</td>
<td>?</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WORC</td>
<td></td>
<td>O</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WORC: Sports Subscale</td>
<td></td>
<td>O</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adebajo et al.</td>
<td></td>
<td>40</td>
<td>Steroid vs. Control</td>
<td>Pain: VAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withrington et al.</td>
<td></td>
<td>25</td>
<td>Steroid vs. Placebo</td>
<td>Pain: VAS</td>
<td></td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blair et al.</td>
<td>II</td>
<td>37</td>
<td>Steroid vs. Control</td>
<td>Pain: Likert-like</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vecchio et al.</td>
<td></td>
<td>55</td>
<td>Steroid vs. Control</td>
<td>Composite Pain: VAS</td>
<td></td>
<td>O</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akgun et al.</td>
<td></td>
<td>48</td>
<td>Steroid vs. Control</td>
<td>Pain: At Rest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Akgun et al.</td>
<td></td>
<td>48</td>
<td>Steroid vs. Control</td>
<td>Pain: On Activity</td>
<td></td>
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</tr>
<tr>
<td>Akgun et al.</td>
<td></td>
<td>48</td>
<td>Steroid vs. Control</td>
<td>Pain: Disturbing Sleep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Akgun et al.</td>
<td></td>
<td>48</td>
<td>Steroid vs. Control</td>
<td>Function: Constant-Murley Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adebajo et al.</td>
<td></td>
<td>40</td>
<td>Steroid vs. Control</td>
<td>Function: Limitations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akgun et al.</td>
<td></td>
<td>48</td>
<td>Steroid vs. Control</td>
<td>Constant-Murley Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adebajo et al.</td>
<td></td>
<td>40</td>
<td>Steroid vs. Control</td>
<td>Response to Treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withrington et al.</td>
<td></td>
<td>25</td>
<td>Steroid vs. Placebo</td>
<td>Acetaminophen Consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **O** = no statistically significant difference
- **●** = statistically significant result favoring steroid
- ? = not sufficiently powered to detect the MCII; neither statistically or clinically significant
- **s** = favoring one steroid injection
- **ss** = favoring two steroid injections over one or no steroid injection
- **nr** = authors examined this outcome but did not report if the results were statistically significant
- * = 8.29 ± 0.26 months from baseline
- LoE = level of evidence
- ASES = American Shoulder and Elbow Surgeons
- DASH = Disabilities of the Arm, Shoulder and Hand
- WORC = Western Ontario Rotator Cuff Index
**PAIN: VAS**

One Level I study by Alvarez et al. assessed patients diagnosed as having rotator cuff disease treated with injections of either xylocaine or xylocaine plus a steroid. Pain with the Neer impingement sign was measured using a 100-mm VAS (see Figure 36).

**Figure 36 Pain with the Neer impingement sign measured by VAS**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Duration</th>
<th>SMD (95% CI)</th>
<th>(SD); Xylocaine</th>
<th>(SD); Xylocaine Plus Steroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: Neer/VAS</td>
<td>2 weeks</td>
<td>0.47 (-0.05, 0.99)</td>
<td>28, 52.3 (27.2)</td>
<td>30, 39 (28.4)</td>
</tr>
<tr>
<td></td>
<td>6 weeks</td>
<td>0.01 (-0.50, 0.53)</td>
<td>28, 46.8 (31.1)</td>
<td>30, 46.4 (30.1)</td>
</tr>
<tr>
<td></td>
<td>13 weeks</td>
<td>0.30 (-0.22, 0.82)</td>
<td>28, 48.1 (30.6)</td>
<td>30, 39.3 (27.1)</td>
</tr>
<tr>
<td></td>
<td>26 weeks</td>
<td>-0.08 (-0.60, 0.43)</td>
<td>28, 42.6 (35.9)</td>
<td>30, 45.2 (27.2)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**ASES SCORE**

One Level I study by Alvarez et al. assessed patients diagnosed as having rotator cuff disease treated with injections of either xylocaine or xylocaine plus a steroid using the ASES score (see Figure 37).

**Figure 37 Patient ASES score**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Duration</th>
<th>SMD (95% CI)</th>
<th>Plus Steroid</th>
<th>(SD); Xylocaine</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASES</td>
<td>2 weeks</td>
<td>0.31 (-0.21, 0.83)</td>
<td>30, 60.5 (20.1)</td>
<td>28, 54 (21)</td>
</tr>
<tr>
<td></td>
<td>6 weeks</td>
<td>0.15 (-0.37, 0.66)</td>
<td>30, 58.4 (20.7)</td>
<td>28, 55.2 (22.3)</td>
</tr>
<tr>
<td></td>
<td>13 weeks</td>
<td>0.12 (-0.39, 0.64)</td>
<td>30, 60.8 (21.1)</td>
<td>28, 58.1 (22.4)</td>
</tr>
<tr>
<td></td>
<td>26 weeks</td>
<td>0.08 (-0.44, 0.59)</td>
<td>30, 62.3 (22.9)</td>
<td>28, 60.4 (24.2)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size; MCII indicated by dashed line; MCII value was determined for patients with rotator cuff tears; this study was not sufficiently powered to detect the MCII. Therefore, its’ results are inconclusive.
**DASH**

One Level I study by Alvarez et al. assessed patients diagnosed as having rotator cuff disease treated with injections of either xylocaine or xylocaine plus a steroid using the DASH score (see Figure 38).

**Figure 38 Patient DASH score**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Duration</th>
<th>N, mean (SD)</th>
<th>N, mean (SD); Xylocaine</th>
<th>N, mean (SD); Xylocaine Plus Steroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASH</td>
<td>2 weeks</td>
<td>0.41 (-0.11, 0.93)</td>
<td>28, 86.1 (28.6)</td>
<td>30, 74.3 (28.6)</td>
</tr>
<tr>
<td></td>
<td>6 weeks</td>
<td>0.20 (-0.31, 0.72)</td>
<td>28, 80.2 (23.7)</td>
<td>30, 75.4 (22.9)</td>
</tr>
<tr>
<td></td>
<td>13 weeks</td>
<td>-0.18 (-0.69, 0.34)</td>
<td>28, 76.9 (25.6)</td>
<td>30, 81.4 (25)</td>
</tr>
<tr>
<td></td>
<td>26 weeks</td>
<td>0.01 (-0.50, 0.53)</td>
<td>28, 74.6 (28.8)</td>
<td>30, 74.3 (25.7)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size; MCII indicated by dashed line; MCII value was determined for patients with rotator cuff tears; this study was not sufficiently powered to detect the MCII. Therefore, its’ results are inconclusive.
QUALITY OF LIFE: WESTERN ONTARIO ROTATOR CUFF INDEX (WORC)

One Level I study by Alvarez et al. assessed patients diagnosed as having rotator cuff disease treated with injections of either xylocaine or xylocaine plus a steroid. Patient quality of life was measured using WORC (see Figure 39).

Figure 39 Patient quality of life as measured by WORC

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Duration</th>
<th>SMD (95% CI)</th>
<th>Plus Steroid (SD); Xylocaine</th>
<th>N, mean (SD); Xylocaine</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 weeks</td>
<td>0.42 (-0.10, 0.94)</td>
<td>30, 54.5 (24.4)</td>
<td>28, 44.3 (23.6)</td>
</tr>
<tr>
<td></td>
<td>6 weeks</td>
<td>0.33 (-0.19, 0.84)</td>
<td>30, 55.1 (25.1)</td>
<td>28, 47.1 (23.3)</td>
</tr>
<tr>
<td></td>
<td>13 weeks</td>
<td>0.71 (0.18, 1.24)</td>
<td>30, 56.3 (17)</td>
<td>28, 45.4 (13)</td>
</tr>
<tr>
<td></td>
<td>26 weeks</td>
<td>0.28 (-0.24, 0.79)</td>
<td>30, 59 (26)</td>
<td>28, 51 (31)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**QUALITY OF LIFE: WORC SPORTS DOMAIN**

One Level I study by Alvarez et al. assessed patients diagnosed as having rotator cuff disease treated with injections of either xylocaine or xylocaine plus a steroid. Authors report the sports domain of the quality of life assessment tool WORC (see Figure 40).

**Figure 40 Patient score on sports domain of WORC**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Duration</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Xylocaine</th>
<th>N, mean (SD); Xylocaine Plus Steroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORC: Sports Domain</td>
<td>2 weeks</td>
<td>0.13 (-0.38, 0.65)</td>
<td>30, 43.5 (29.5)</td>
<td>28, 39.8 (26)</td>
</tr>
<tr>
<td></td>
<td>6 weeks</td>
<td>0.07 (-0.45, 0.58)</td>
<td>30, 43.2 (30.2)</td>
<td>28, 41.3 (25)</td>
</tr>
<tr>
<td></td>
<td>13 weeks</td>
<td>0.30 (-0.22, 0.82)</td>
<td>30, 46 (24.1)</td>
<td>28, 38.3 (26.6)</td>
</tr>
<tr>
<td></td>
<td>26 weeks</td>
<td>0.10 (-0.42, 0.61)</td>
<td>30, 52.8 (27.8)</td>
<td>28, 49.8 (32.5)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**PAIN: VAS**

Two Level II studies assessed pain measured by VAS. Adebajo et al. treated patients diagnosed as having rotator cuff tendonitis with either steroid (injection of lidocaine with steroid plus a placebo pill) or placebo (placebo pill plus injection of lidocaine) and pain was measured using VAS. AAOS calculations found a statistically significant effect in favor of steroid treatment ($ES = 1.07, 95\% CI 0.40 – 1.73$; see Figure 41).

**Figure 41 Improvement in pain score in patients treated with steroid injection or placebo**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (, ,)</th>
<th>(SD); Steroid</th>
<th>(SD); Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: VAS</td>
<td>1.07 (0.40, 1.73)</td>
<td>20, 4.95 (3.31)</td>
<td>20, 1.35 (3.31)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
Withrington et al. assessed patients diagnosed as having supraspinatus tendinopathy. Patients received an injection of either cortisone with lidocaine or saline (placebo). Authors report no statistically significant difference between groups in pain scores at either two ($t = 1.57, p > 0.05$) or eight weeks ($t = 1.30, p > 0.05$; see Figure 42).

**Figure 42 Change in pain measured by VAS**

Authors do not provide dispersions for point estimates; authors report no statistically significant difference between groups ($p > 0.05$).
**COMPOSITE PAIN: VAS**

One Level II study by Vecchio et al. examined the effect of a cortisone injection with lidocaine or lidocaine alone in patients diagnosed with rotator cuff tendonitis. Pain was measured as the composite score of pain at rest, night and movement. Authors report no statistically significant difference between groups at two, four or twelve weeks using a non-parametric analysis ($p = 0.16, 0.36, 0.96$ respectively; see Figure 43).

**Figure 43 Median change in composite pain measured by VAS**

Dispersion shown as interquartile range; authors report no statistically significant difference between groups at any time point ($p = 0.16, 0.36, 0.96$ respectively).
**PAIN: LIKERT-LIKE SCALE**

One Level II study by Blair et al. assessed patients diagnosed as having subacromial impingement syndrome treated by corticosteroid injection. All patients participated in a physical therapy program and received either a steroid injection with lidocaine or a lidocaine only injection (control) with a final assessment at approximately 8.29 months (95% CI 8.03 – 8.55 months). Pain was measured on a four-point Likert-like scale ranging from 0 (no pain) to 3 (severe pain). Authors report a statistically significant difference between groups for pain at final assessment (see Figure 44).

**Figure 44 Pain as measured by a Likert-like scale**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: Likert-like</td>
<td>1.10 (0.40, 1.80)</td>
<td>21, 1.95 (.74)</td>
<td>16, 1.21 (.535)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**PAIN: AT REST**

One Level II study by Akgun et al. assessed patients diagnosed as having subacromial impingement syndrome treated with corticosteroid injection(s). Patients received two injections within a ten day interval of either: two steroid injections with lidocaine (group “2 steroid injections”), one steroid injection with lidocaine followed by one lidocaine only injection (group “1 steroid injection”) or two injections of lidocaine only (group “0 steroid injections”). Pain at rest was measured using a VAS (see Figure 45). Authors report no statistically significant differences at baseline ($p > 0.05$) and statistically significant improvements at one and three months in all of the groups ($p < 0.05$). Additionally, authors report no statistically significant difference between groups at three months ($p > 0.05$). Authors did not report between group comparisons at one month.

**Figure 45 Pain at rest measured by VAS**

Authors report no statistically significant difference between groups at zero or three months ($p > 0.05$). Between group comparisons at month one were not reported; authors report a statistically significant improvement at one and three months for all groups ($p < 0.05$).
**PAIN: ON ACTIVITY**

One Level II study by Akgun et al. assessed patients diagnosed as having subacromial impingement syndrome treated with corticosteroid injection(s). Patients received two injections within a ten day interval of either: two steroid injections with lidocaine (group “2 steroid injections”), one steroid injection with lidocaine followed by one lidocaine only injection (group “1 steroid injection”) or two injections of lidocaine only (group “0 steroid injections”). Pain on activity was measured using a VAS (see Figure 46). Authors report no statistically significant differences at baseline ($p > 0.05$) and statistically significant improvements at one and three months in all of the groups ($p < 0.05$). Authors report no statistically significant difference between groups at three months ($p > 0.05$); however, a between group comparison at month one was not reported.

**Figure 46 Pain on activity measured by VAS**

Authors report no statistically significant difference between groups at zero or three months ($p > 0.05$). Between group comparisons at month one were not reported; authors report a statistically significant improvement at one and three months in all of the groups ($p < 0.05$).
**PAIN: DISTURBING SLEEP**

One Level II study by Akgun et al. assessed patients diagnosed as having subacromial impingement syndrome treated with corticosteroid injection(s). Patients received two injections within a ten day interval of either: two steroid injections with lidocaine (group “2 steroid injections”), one steroid injection with lidocaine followed by one lidocaine only injection (group “1 steroid injection”) or two injections of lidocaine only (group “0 steroid injections”). Pain disturbing sleep was measured using a VAS (see Figure 47). Authors report no statistically significant differences at baseline ($p > 0.05$) and statistically significant improvements at one and three months in all of the groups ($p < 0.05$). Further, authors report greater improvement in patients receiving two steroid injections at one month than patients in the other two groups ($p < 0.001$); however, no statistically significant difference was found between groups at three months ($p > 0.05$).

**Figure 47 Pain disturbing sleep measured by VAS**

*Authors report statistically significantly greater improvement in patients receiving two steroid injections at one month than patients in the other two groups ($p < 0.001$); authors report no statistically significant differences between groups at zero or three months ($p > 0.05$); authors report a statistically significant improvement at one and three months in all of the groups ($p < 0.05$).*
**FUNCTION: CONSTANT-MURLEY SCORE**

One Level II study by Akgun et al. assessed patients diagnosed as having subacromial impingement syndrome treated with corticosteroid injection(s). Patients received two injections within a ten day interval of either: two steroid injections with lidocaine (group “2 steroid injections”), one steroid injection with lidocaine followed by one lidocaine only injection (group “1 steroid injection”) or two injections of lidocaine only (group “0 steroid injections”). Function was measured using the Constant-Murley score (daily living activities subscale; see Figure 48). Authors report no statistically significant differences at baseline ($p > 0.05$) and statistically significant improvements at one and three months in all of the groups ($p < 0.05$). Further, authors report greater improvement in patients receiving two steroid injections at one month than patients in the other two groups ($p < 0.001$); however, no statistically significant difference between groups at three months was found ($p > 0.05$).

**Figure 48 Function as measured by Constant subscale daily living activities**

*Authors report statistically significantly greater improvement in patients receiving two steroid injections at one month than patients in the other two groups ($p < 0.001$); authors report no statistically significant differences between groups at zero or three months ($p > 0.05$); authors report statistically significant improvements at one and three months in all of the groups ($p < 0.05$).
**FUNCTION: LIMITATIONS**

One Level II study by Adebajo et al. assessed patients diagnosed as having rotator cuff tendonitis. Patients were treated with either steroid (injection of lidocaine with steroid plus a placebo pill) or placebo (placebo pill plus injection of lidocaine). Authors reported patient function on a four point scale as: 0 = no limitation of function, 1 = mild limitation of function, 2 = moderate limitation of function, 3 = severe limitation of function. AAOS calculations found a statistically significant effect in favor of steroid treatment ($ES = 0.95$, $95\% CI 0.29 – 1.60$; see Figure 49).

**Figure 49 Patient function measured by Likert-like scale after receiving steroid injection or placebo**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>CI (. .)</td>
<td>(SD); Steroid</td>
<td>(SD); Placebo</td>
</tr>
<tr>
<td>Function</td>
<td>0.95 (0.29, 1.60)</td>
<td>20 (.85 (.671))</td>
<td>20 (.3 (.447))</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**CONSTANT-MURLEY SCORE**

One Level II study by Akgun et al. assessed patients diagnosed as having subacromial impingement syndrome treated with corticosteroid injection(s). Patients received two injections within a ten day interval of either: two steroid injections with lidocaine (group “2 steroid injections”), one steroid injection with lidocaine followed by one lidocaine only injection (group “1 steroid injection”) or two injections of lidocaine only (group “0 steroid injections”). Patient improvement was measured using the Constant-Murley score (daily living activities, range of motion and strength; see Figure 50). Authors report no statistically significant differences at baseline ($p > 0.05$) and statistically significant improvements at one and three months in all of the groups ($p < 0.05$). Authors report no statistically significant difference between groups at three months ($p > 0.05$). Between group comparisons at month one were not reported by the authors.

**Figure 50 Patient Constant-Murley score**

Authors report no statistically significant differences between groups at zero or three months ($p > 0.05$). Between group comparisons at month one were not reported; authors report a statistically significant improvement at one and three months in all of the groups ($p < 0.05$).
RESPONSE TO TREATMENT

One Level II study by Adebajo et al. assessed patients diagnosed as having rotator cuff tendonitis. Patients were treated with either steroid (injection of lidocaine with steroid plus a placebo pill) or placebo (placebo pill plus injection of lidocaine). Patients were considered to have responded to treatment if they improved in all three outcomes examined: pain, range of active abduction and limitation of function. AAOS calculations found a statistically significant effect in favor of steroid treatment ($OR = 91.46$, 95% CI $4.77 – 1754.50$; see Figure 51).

Figure 51 Patients responding to treatment after receiving steroid injection or placebo

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Injection</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responder</td>
<td>14/20</td>
<td>0/20</td>
</tr>
</tbody>
</table>

Favors Placebo  Favors Steroid Injection

AAOS calculated effect size
**ACETAMINOPHEN USE**

One Level II study by Withrington et al. treated patients with either an injection of cortisone with lidocaine or saline (placebo). Authors report no statistically significant difference between groups in acetaminophen consumption at two weeks (see Figure 52).

**Figure 52 Acetaminophen consumption**

![Bar chart showing acetaminophen consumption](chart)

Authors do not provide dispersions for point estimates; authors report no statistically significant difference between groups.
### PEMF

**SUPPORTING EVIDENCE - PEMF**

Tables relevant to this recommendation are: Table 23  
Figures relevant to this recommendation are: Figure 53 through Figure 60

#### Table 23 Results of patients treated with PEMF

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Final Visit*</th>
<th>2 weeks</th>
<th>4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binder et al.</td>
<td>II</td>
<td>29</td>
<td>PEMF vs. Sham</td>
<td>Pain: VAS</td>
<td></td>
<td>⚫p</td>
<td>⚫p</td>
</tr>
<tr>
<td>Aktas et al.</td>
<td></td>
<td>40</td>
<td></td>
<td>Pain: Constant-Murley Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aktas et al.</td>
<td></td>
<td>40</td>
<td></td>
<td>Pain: At Rest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aktas et al.</td>
<td></td>
<td>40</td>
<td></td>
<td>Pain: On Activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aktas et al.</td>
<td></td>
<td>40</td>
<td></td>
<td>Pain: Disturbing Sleep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aktas et al.</td>
<td></td>
<td>40</td>
<td></td>
<td>Function: Constant-Murley Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aktas et al.</td>
<td></td>
<td>40</td>
<td></td>
<td>Function: SDQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aktas et al.</td>
<td></td>
<td>40</td>
<td></td>
<td>Constant-Murley Score</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* = final visit not defined by authors  
\(\circ\) = no statistically significant difference  
\(\bullet\) = favoring PEMF treatment  
LoE = level of evidence  
PEMF = pulsed electromagnetic field  
SDQ = shoulder disability questionnaire
**PAIN: VAS**

One Level II study by Binder et al. examined the effect of pulsed electromagnetic field therapy (PEMF) compared to sham PEMF. Pain was assessed as the sum of pain at night, on movement and at rest. Authors report a statistically significant greater reduction in pain at weeks two and four in the PEMF group compared to the sham group ($p < 0.05$, $p < 0.02$ respectively; see Figure 53).

**Figure 53 Change in pain score measured by VAS**

*Authors report significant differences between groups, $p < .05$; ** Authors report significant differences between groups, $p < .02$; authors do not provide dispersions for point estimates.*
**PAIN: CONSTANT-MURLEY SCORE**

One Level II study by Aktas et al. assessed patients diagnosed as having subacromial impingement syndrome treated with PEMF. All patients received a three week treatment program that included either true PEMF or sham PEMF. Pain was measured using the subscale from the Constant-Murley score. Authors report there were no statistically significant differences noted between groups (see Figure 54).

**Figure 54 Pain measured by Constant-Murley score**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%) CI</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: Constant Score</td>
<td>0.13 (-0.49, 0.75)</td>
<td>20, 9.5 (3.59)</td>
<td>20, 9 (3.83)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**PAIN: AT REST**

One Level II study by Aktas et al. assessed patients diagnosed as having subacromial impingement syndrome treated with PEMF. All patients received a three week treatment program that included either true PEMF or sham PEMF. Pain at rest was measured by VAS. Authors report there were no statistically significant differences noted between groups (see Figure 55).

**Figure 55 Pain at rest measured by VAS**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD)</th>
<th>N, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: At Rest (VAS)</td>
<td>-0.03 (-0.65, 0.59)</td>
<td>20, .85 (1.56)</td>
<td>20, .9 (1.55)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
PAIN: ON ACTIVITY

One Level II study by Aktas et al. assessed patients diagnosed as having subacromial impingement syndrome treated with PEMF. All patients received a three week treatment program that included either true PEMF or sham PEMF. Pain on activity was measured by VAS. Authors report there were no statistically significant differences noted between groups (see Figure 56).

Figure 56 Pain on activity measured by VAS

AAOS calculated effect size
**PAIN: DISTURBING SLEEP**

Two Level II studies assessed pain disturbing sleep measured by VAS.

One Level II study by Aktas et al. assessed patients diagnosed as having subacromial impingement syndrome treated with PEMF. All patients received a three week treatment program that included either true PEMF or sham PEMF. Pain disturbing sleep was measured by VAS. Authors report there were no statistically significant differences noted between groups (see Figure 57).

**Figure 57 Pain disturbing sleep measured by VAS**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: Disturbing Sleep (VAS)</td>
<td>0.55 (-0.08, 1.19)</td>
<td>20, 2.25 (3.27)</td>
<td>20, .8 (1.59)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size.
**FUNCTION: CONSTANT-MURLEY SCORE**

One Level II study by Aktas et al. assessed patients diagnosed as having subacromial impingement syndrome treated with PEMF. All patients received a three week treatment program that included either true PEMF or sham PEMF. Function was assessed using the Constant-Murley score subscale daily living activities. Authors report there were no statistically significant differences noted between groups (see Figure 58).

**Figure 58 Function measured by Constant-Murley score subscale daily living activities**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (95%)</th>
<th>N, mean PEMF</th>
<th>N, mean Sham</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function: Constant</td>
<td>0.05 (-0.57, 0.67)</td>
<td>20, 15.1 (4.27)</td>
<td>20, 14.9 (3.27)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**FUNCTION: SHOULDER DISABILITY QUESTIONNAIRE (SDQ)**
One Level II study by Aktas et al. assessed patients diagnosed as having subacromial impingement syndrome treated with PEMF. All patients received a three week treatment program that included either true PEMF or sham PEMF. Function was assessed using the shoulder disability questionnaire (SDQ) which evaluates daily living activities. Authors report there were no statistically significant differences noted between groups (see Figure 59).

**Figure 59 Function as measured by SDQ**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Sham</th>
<th>N, mean (SD); PEMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDQ</td>
<td>0.02 (-0.60, 0.64)</td>
<td>20, 46.3 (25.2)</td>
<td>20, 45.8 (30.9)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size.
CONSTANT-MURLEY SCORE

One Level II study by Aktas et al. assessed patients diagnosed as having subacromial impingement syndrome treated with PEMF. All patients received a three week treatment program that included either true PEMF or sham PEMF. Patient improvement was measured by Constant-Murley score. Authors report there were no statistically significant differences noted between groups (see Figure 60).

Figure 60 Patient Constant-Murley score

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD) PEMF</th>
<th>N, mean (SD) Sham</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant Score</td>
<td>0.04 (-0.58, 0.66)</td>
<td>20, 72.7 (18)</td>
<td>20, 72 (12.8)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
RECOMMENDATION 4C: ROTATOR CUFF RELATED SYMPTOMS AND IONTOPHORESIS, PHONOPHOREIS, TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS), ICE, HEAT, MASSAGE, OR ACTIVITY MODIFICATION

We cannot recommend for or against the use of iontophoresis, phonophoresis, Transcutaneous Electrical Nerve Stimulation (TENS), ice, heat, massage, or activity modification for patients who have rotator cuff related symptoms in the absence of a full thickness tear.

Level of Evidence: None

Strength of Recommendation: Inconclusive

There were no studies identified examining iontophoresis, phonophoresis, TENS (transcutaneous electrical nerve stimulation), ice, heat, or massage as non-operative treatments in patients with rotator cuff-related symptoms.
RECOMMENDATION 5: ACUTE TRAUMATIC ROTATOR CUFF TEARS AND SURGERY

Early surgical repair after acute injury is an option for patients with a rotator cuff tear.

Level of Evidence: IV

Strength of Recommendation: Weak

Rationale:

Rotator cuff tears are a common cause of shoulder pain and dysfunction. The prevalence of rotator cuff tears, even asymptomatic tears, increases with advancing age. Treatment options for traumatic rotator cuff tears include a number of non-operative options as well as surgical repair. Delaying repair of acute traumatic rotator cuff tear may lead to the development of pathology associated with chronic rotator cuff tears including tendon retraction, and fatty infiltration and atrophy of the rotator cuff muscles with associated detrimental effects on upper extremity function. In earlier surgery after acute injury, the surgeon is more likely to encounter healthier tissue with better healing potential which may lead to better outcome.

Our systematic review did not identify any quality literature that addresses the issue of timing of surgery after acute rotator cuff injury. The evidence that we considered included five level IV case series of rotator cuff repair that focused on early surgical repair of rotator cuff tears. One study reported on a series of subjects with a history of a significant acute injury that were treated with surgery within three months of injury. This cohort represented less than 10 percent of the repairs that they performed in their overall experience, thus demonstrating that acute rotator cuff injuries are relatively uncommon. The patients repaired within 3 weeks of injury had better results than those repaired after 3 weeks. The second study reported the results of rotator cuff repair in a series of 26 patients who had a history of trauma with an acute onset of symptoms and a full thickness rotator cuff tear. All of the repairs were performed within 3 weeks of the injury. Similar to the findings of the first study, these cases only represented about 5 percent of the cases of full thickness rotator cuff tear that the authors treated. Although they reported a high rate of successful results (20 excellent, 4 good, 1 fair, and 1 poor) they did not determine whether the timing of surgery affected the outcome.

A third study reported the outcome of repair of traumatic anterior superior rotator cuff tears with combined subscapularis and supraspinatus tears. The patients had open repair at an average of 4.5 months after injury. Outcome assessment demonstrated restoration of subscapularis related function. The authors did not find a correlation between outcome and duration of symptoms. Two additional studies addressed repair of traumatic anterior superior rotator cuff tears with combined subscapularis and supraspinatus tears. One study reported on thirty patients with a traumatic tear who had open repair at an average of 4.5 months after injury and the other reported on twenty-four patients of which twenty-two recalled a specific incident at which the injury occurred. (See Table 26)
for the summary of these results.) One study reported there were no significant correlations between outcome and a number of preoperative factors including duration of symptoms. The other study did not provide statistical analyses.

Defining whether a rotator cuff tear is acute has relevance to this discussion. In evaluating patients, the surgeon should attempt to properly identify patients with acute tears as opposed to patients with pre-existing chronic tears that become symptomatic after an injury event. A discrete traumatic event is more suggestive of acute tear. Physical examination findings including supraspinatus and infraspinatus muscle atrophy as well as internal and external rotation lag signs may be indicative of larger and more chronic rotator cuff tears.

Evaluation of rotator cuff muscle quality with CT or MRI is an important consideration. Six Level IV case series addressed the MRI findings of fatty infiltration and muscle atrophy in relation to the outcome of rotator cuff repair. Chronic and larger tears are associated with muscle atrophy and fatty replacement, both of which correlate with inferior functional outcome after rotator cuff repair. It is thought that early repair of acute rotator cuff tears might mitigate the development of chronic tendon and muscle pathology and improve functional outcomes (see Recommendation 2: Full Thickness Tears and sympTomatic Patients: Supporting Evidence- MRI Tear Characteristics:

Tables relevant to this recommendation are: Table 7 through Table 10
Figures relevant to this recommendation are: Figure 4 through Figure 6

MRI Tear Characteristics Tables relevant to this recommendation are: Table 24 through Table 25
Figures relevant to this recommendation are: Figure 61 through Figure 66

**Table 24 Results of acute, traumatic rotator cuff tear repair**

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Surgical Repair</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bassett et al.</td>
<td>IV</td>
<td>37</td>
<td>3 - 12 weeks</td>
<td>Change from baseline</td>
<td>Pain: Likert-like Scale</td>
<td>5.9 years*</td>
</tr>
<tr>
<td>Bassett et al.</td>
<td></td>
<td>31</td>
<td>3 - 12 weeks</td>
<td>3 Weeks vs. 6-12 Weeks</td>
<td>Patient Satisfaction</td>
<td>7 years**</td>
</tr>
<tr>
<td>Lahteenmaki et al.</td>
<td></td>
<td>26</td>
<td>Within 3 Weeks</td>
<td>Change from baseline</td>
<td>Pain: UCLA</td>
<td></td>
</tr>
<tr>
<td>Lahteenmaki et al.</td>
<td></td>
<td>26</td>
<td>Within 3 Weeks</td>
<td>Change from baseline</td>
<td>Function: UCLA</td>
<td></td>
</tr>
<tr>
<td>Lahteenmaki et al.</td>
<td></td>
<td>26</td>
<td>Within 3 Weeks</td>
<td>Change from baseline</td>
<td>Complications</td>
<td></td>
</tr>
</tbody>
</table>

● = statistically significant result favoring treatment

↑ = improved

3 = statistically significant result favoring 3 weeks duration

LoE = level of evidence

nr = authors examined this outcome but did not report if the results were statistically significant

* = final visit 5.9 ± 0.70 years after baseline

** = final visit 7 ± 0.72 years after baseline
ACUTE TRAUMATIC TEARS

PAIN: LIKERT-LIKE SCALE

One Level IV study by Bassett and Cofield assessed patients receiving rotator cuff repair of acute, traumatic rotator cuff tear. Patients were asked to describe their pain at various durations of follow-up rated on a four-point Likert-like scale: none, slight, moderate, severe (see Figure 61).

Figure 61 Pain Reported by patient

*AAOS calculated OR = 3.4 (95% CI 1.3 - 8.9), $p = 0.012$; average patient follow-up of 7 ± 0.72 years from baseline.
**PATIENT SATISFACTION**

One Level IV study by Bassett and Cofield detailed the level of satisfaction with surgical repair as reported by the patient at various follow-up durations. The patients were divided into groups based on the duration from injury to surgery: within three weeks, three to six weeks, and six to twelve weeks. We are not reporting data pertaining to duration three to six weeks as less than ten patients were included in this group (n = 6). Patient satisfaction was rated on a four-point scale ranging from much better to worse. AAOS calculations found a statistically significant difference between patients treated within three weeks compared to patients treated after six to twelve weeks with the latter having poorer satisfaction scores ($p < 0.05$; see Figure 62).

**Figure 62 Patient satisfaction score at follow-up**

![Chart showing patient satisfaction scores at different durations](chart.png)

AAOS calculated independent t-test, $p < 0.05$; average patient follow-up of $7 \pm 0.72$ years from baseline.
**PAIN: UCLA**

One Level IV study by Lahteenmaki et al. used the UCLA Score to assess the results of patients undergoing surgical repair of rotator cuff tears within 3 weeks of injury. Change in UCLA pain subscale score pre-operatively to follow-up is statistically significant (p < 0.001) as determined by AAOS analysis (see Figure 63).

**Figure 63 Pain as measured by UCLA scale**

AAOS calculated independent t-test, p < 0.001; average patient follow-up of 5.9 ± 0.70 years from baseline; *Confidence interval at baseline used standard deviation estimated from a range.
FUNCTION: UCLA

One Level IV study by Lahteenmaki, et al. used the UCLA Score to assess the results of patients undergoing surgical repair of rotator cuff tears within 3 weeks of injury. Authors do not report variance at baseline or if change from baseline was statistically significant (see Figure 64).

Figure 64 Function as measured by UCLA

Average patient follow-up of 5.9 ± 0.70 years from baseline; *Dispersion of point estimate not reported by authors
**COMPLICATIONS**

One Level IV study by Lahteenmaki, et al. reported patient complications related to repair of acute, traumatic rotator cuff tears within 3 weeks of injury (see Table 24).

**Table 25 Patient complications**

<table>
<thead>
<tr>
<th>Complication</th>
<th>Percent of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial Wound Infection</td>
<td>4%</td>
</tr>
<tr>
<td>Major Complications</td>
<td>0%</td>
</tr>
</tbody>
</table>
**STRATIFICATIONS**

Lahteenmaki, et al. examined tear size in patients undergoing surgical rotator cuff repair within 3 weeks of injury. Tears were categorized into one of four categories as described by Post et al. We are not reporting data pertaining to medium tears as less than ten patients were included in this group (n = 6). The authors report statistically significant improvement in function in all three tear size groups (p < 0.05). Additionally, authors report size of the tear had no influence on relief of pain or overall results. No other statistical testing for change preoperatively to follow-up by tear size is reported. The authors report no statistically significant difference between tear size groups for function, strength, and overall UCLA score. UCLA results were categorized as excellent, good, fair, or poor for each tear size group (see Figure 66).

**Figure 65 UCLA scores by tear size at baseline and follow-up***

![UCLA scores by tear size at baseline and follow-up](image)

* Author reported statistically significant improvement, p < 0.05; average patient follow-up of 5.9 ± 0.70 years from baseline; baseline patient satisfaction not reported (nr).
Figure 66 UCLA ratings at follow-up* by tear size

*Average patient follow-up of 5.9 ± 0.70 years from baseline
SUPPORTING EVIDENCE- SUBSCAPULARIS TEARS

Tables relevant to this recommendation are: Table 26 through Table 28
Figures relevant to this recommendation are: Figure 67 through Figure 85
### SUBSCAPULARIS TEARS

Table 26 Results of subscapularis tear repair

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>29 months*</th>
<th>40 months**</th>
<th>56 months***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Namdari et al.</td>
<td>30</td>
<td>17</td>
<td>Pain: VAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lafosse et al.</td>
<td>17</td>
<td>30</td>
<td>Pain: Constant-Murley Score</td>
<td>●↑</td>
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<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>SF-36: Bodily Pain</td>
<td>●↑</td>
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<tr>
<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>SF-36: Physical Functioning</td>
<td>●↑</td>
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<td>Lafosse et al.</td>
<td>17</td>
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<td>Constant-Murley Score</td>
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<td>Namdari et al.</td>
<td>30</td>
<td>17</td>
<td>DASH</td>
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<td>Lafosse et al.</td>
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<td>24</td>
<td>UCLA Score</td>
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<td>van Riet et al.</td>
<td>24</td>
<td>24</td>
<td>UCLA Score</td>
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<td>van Riet et al.</td>
<td>24</td>
<td>24</td>
<td>ASES</td>
<td></td>
<td></td>
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<td>nr</td>
</tr>
<tr>
<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>SST</td>
<td>●↑</td>
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<tr>
<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>SF-36: Role-Physical</td>
<td>●↑</td>
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<td>Namdari et al.</td>
<td>30</td>
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<td>●↑</td>
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<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>SF-36: Vitality</td>
<td>●↑</td>
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<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>SF-36: Social Functioning</td>
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<tr>
<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>SF-36: Role-Emotional</td>
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<td>Namdari et al.</td>
<td>30</td>
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<td>SF-36: Mental Health</td>
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<tr>
<td>Lafosse et al.</td>
<td>17</td>
<td>30</td>
<td>Patient Satisfaction</td>
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<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>Patient Satisfaction-Current Symptoms</td>
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<td>Namdari et al.</td>
<td>30</td>
<td>30</td>
<td>Patient Satisfaction-Chosen Treatment</td>
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<tr>
<td>Lafosse et al.</td>
<td>17</td>
<td>30</td>
<td>Complications</td>
<td>nr</td>
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</table>

* ○ = no statistically significant difference  
● = statistically significant difference favoring treatment  
○ = statistically and clinically significant  
↑ = improved  
LoE = level of evidence  
DASH = disability of the arm, shoulder and hand  
ASES = American shoulder and elbow score  
SST = simple shoulder test  
* = final visit 29 ± 0.92 months after baseline  
** = final visit 40 ± 1.8 months after baseline  
*** = final visit 56 ± 1.43 months after baseline  
nr = authors examined this outcome but did not report if the results were statistically significant
**PAIN: VAS**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant reduction in pain measured by VAS ($p < 0.001$; see Figure 67).

**Figure 67 Change in pain score measured by VAS**

![Graph showing change in pain score measured by VAS](image)

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p < 0.001$.  

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**PAIN: CONSTANT-MURLEY SCORE**

One Level IV study by Lafosse, et al. used the Constant-Murley Score (CMS) pain subscale to assess pain before surgery and at various follow-up durations in patients with isolated subscapularis tears. The authors reported a statistically significant reduction in pain (Wilcoxon signed-rank, $p < 0.001$; see Figure 68).

**Figure 68 Pain measured by Constant-Murley subscale**

*Average patient follow-up of 29 ± 0.92 months from baseline; authors do not provide dispersions for point estimates; authors reported Wilcoxon signed-rank, $p < 0.001$. 
**SF-36: BODILY PAIN**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant difference in bodily pain as measured by SF-36 ($p < 0.001$; see Figure 69).

**Figure 69 Bodily pain as measured by SF-36**

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p < 0.001$. 
**SF-36: PHYSICAL FUNCTIONING**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant improvement in physical functioning as measured by SF-36 ($p < 0.001$; see Figure 70).

**Figure 70 Physical functioning as measured by SF-36**

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p < 0.001$. 
CONSTANT-MURLEY SCORE

One Level IV study by Lafosse, et al. used the Constant-Murley Score to assess the results of patients undergoing surgical repair of isolated subscapularis rotator cuff tears at various follow-up durations. The authors reported a statistically significant reduction in pain (Wilcoxon signed-rank, \( p < 0.001 \); see Figure 71).

**Figure 71 Constant Score**

*Average patient follow-up of 29 ± 0.92 months from baseline; authors do not provide dispersions for point estimates; authors reported Wilcoxon signed-rank, \( p < 0.001 \).
**DASH**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant improvement in patient DASH score ($p < 0.001$; see Figure 72).

**Figure 72 Patient DASH score**

![DASH Score Diagram]

*Average patient follow-up of 56 ± 1.43 months from baseline; AAOS calculated confidence interval at baseline used standard deviation estimated from a range; authors calculated paired t-test, $p < 0.001$. 

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* DASH: Disability of the Arm, Shoulder, and Hand.
**UCLA SCORE**

Two Level IV studies examined UCLA Score. Lafosse, et al. used the UCLA Score to assess the results of patients undergoing surgical repair of isolated subscapularis rotator cuff tears at various follow-up durations. The authors reported a statistically significant reduction in pain (Wilcoxon signed-rank, \( p < 0.001 \); see Figure 73).

**Figure 73 UCLA Score**

![UCLA Score graph](image)

*Average patient follow-up of 29 ± 0.92 months from baseline; authors do not provide dispersions for point estimates; authors calculated Wilcoxon signed-rank, \( p < 0.001 \).
Van Riet et al. assessed twenty-four patients after open repair of full-thickness subscapularis tears. Twelve of the patients had isolated subscapularis tears and twelve had anterosuperior tears. The post-operative UCLA Score was categorized as: excellent, good, fair or poor (see Figure 74). Authors report no statistical analyses pertaining to UCLA Score categorization and do not report baseline values.

**Figure 74 UCLA Score categorization by tear type**

Authors report no statistical analyses.
**SST**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant difference in patient SST score ($p < 0.001$; see Figure 75).

**Figure 75 Patient SST score**

*Average patient follow-up of $56 \pm 1.43$ months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p < 0.001$.  

![Graph showing SST scores](image-url)
ASES

One Level IV study by Van Riet et al. assessed twenty-four patients after open repair of full-thickness subscapularis tears. Twelve of the patients had isolated subscapularis tears and twelve had anterosuperior tears. Post-operative ASES scores were categorized as: excellent, good, fair or poor (see Figure 76). Authors report no statistical analyses pertaining to ASES categorization and do not report baseline values.

Figure 76 ASES Categorization

Authors report no statistical analyses.
**SF-36: ROLE-PHYSICAL**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant improvement in the physical role subscale of the SF-36 ($p < 0.001$; see Figure 77). The physical role assesses problems with work or other daily activities as a result of physical health.

**Figure 77 Physical role as measured by SF-36**

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p < 0.001$. 
**SF-36: GENERAL HEALTH**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported no statistically significant difference in general health as measured by SF-36 ($p < 0.001$, see Figure 78).

**Figure 78 General health as measured by SF-36**

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p = 0.990$. 
**SF-36: VITALITY**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant difference in vitality subscale of the SF-36 ($p = 0.005$; Figure 79). The vitality subscale assesses the degree to which patients feel tired or worn-out.

**Figure 79 Vitality as measured by SF-36**

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p = 0.005$. 
SF-36: SOCIAL FUNCTIONING

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant difference in social functioning as measured by SF-36 ($p = 0.025$; see Figure 80).

Figure 80 Social functioning as measured by SF-36

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p = 0.025$. 
**SF-36: ROLE-EMOTIONAL**

One Level IV study by Namdari et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported a statistically significant difference in the emotional role subscale of the SF-36 ($p = 0.001$; see Figure 81). The emotional role assesses problems with work or other daily activities as a result of emotional problems.

**Figure 81** Emotional role as measured by SF-36

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p = 0.001$. 
**SF-36: MENTAL HEALTH**

One Level IV study by NAMDARI et al. examined open repair of thirty patients with anterosuperior rotator cuff tears (a subscapularis tear in addition to a supraspinatus tear). Patients underwent repair an average of 4.5 months after injury. Authors reported no statistically significant difference in the mental health subscale of the SF-36 ($p = 0.640$; see Figure 82).

**Figure 82 Mental health as measured by SF-36**

*Average patient follow-up of 56 ± 1.43 months from baseline; authors do not provide dispersions for point estimates; authors calculated paired t-test, $p = 0.640$. 
PATIENT SATISFACTION

Two Level IV studies assessed patient satisfaction.

Lafosse, et al. reported the level of satisfaction with surgical repair as reported by the patient at various follow-up durations (see Figure 83). Authors reported no statistical analyses for this outcome.

Figure 83 Patient Satisfaction

*AAOS calculated OR = 240.00 (95% CI 13.746 – 4190.405); average patient follow-up of 29 ± 0.92 months from baseline.
As part of the MODEMS questionnaire, Namdari et al. asked patients, “If you had to spend the rest of your life with the symptoms you have right now, how would you feel about it?” Responses were made using a five-point Likert-like scale ranging from “very satisfied” to “very dissatisfied” (see Figure 84). Patients were also asked, “If you could go back in time and make the decision again, would you choose the same treatment for your musculoskeletal condition/problem?” Responses were made using a five-point Likert-like scale ranging from “definitely yes” to “definitely not” (see Figure 85). Authors reported no statistical analyses for this outcome.

**Figure 84 Patient satisfaction – current symptoms**

![Figure 84 Patient satisfaction – current symptoms](image_url)

*AAOS calculated OR = 5.44 (95% CI 1.804 – 16.427); average patient follow-up of 56 ± 1.43 months from baseline.*
Figure 85 Patient satisfaction – happy with chosen treatment

*AAOS calculated OR = 841.00 (95% CI 50.169 – 14000); average patient follow-up of 56 ± 1.43 months from baseline
COMPLICATIONS

One Level IV study by Lafosse, et al. reported patient complications related to arthroscopic repair of isolated subscapularis rotator cuff tears (see Table 26).

Table 27 Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Percent of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>0%</td>
</tr>
<tr>
<td>Complex Regional Pain Syndrome</td>
<td>12%</td>
</tr>
<tr>
<td>Structural Failure of Repair</td>
<td>12%</td>
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</table>
**STRATIFICATIONS**

Lafosse et al. and Namdari et al. examined stratifications pertaining to either: duration of symptoms, gender, age, size of tear, or hand dominance.

Lafosse et al. reported, "...multiple-regression analysis of our data did not reveal any relationship between age at the time of surgery, the duration of symptoms prior to surgery...and the ultimate clinical outcome. In addition...size of the rupture...did not have significant influence on the ultimate outcome in our study population."

Namdari et al. reported, "...there were no significant correlations between outcome and a number of preoperative factors including patient age, sex, medical comorbidities, duration of symptoms, involvement of the dominant extremity or extent of subscapularis tear."

**Table 28 Stratifications pertaining to subscapularis tears**

<table>
<thead>
<tr>
<th>Stratification</th>
<th>Namdari et al.</th>
<th>Lafosse et al.</th>
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</thead>
<tbody>
<tr>
<td>Duration of symptoms</td>
<td>ns</td>
<td>ns</td>
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<tr>
<td>Gender</td>
<td>ns</td>
<td>-</td>
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<td>Age</td>
<td>ns</td>
<td>ns</td>
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<tr>
<td>Size of tear</td>
<td>ns</td>
<td>ns</td>
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<tr>
<td>Hand dominance</td>
<td>ns</td>
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</tr>
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ns = not statistically significant  
- = not addressed by authors
RECOMMENDATION 6: PERIOPERATIVE INTERVENTIONS – CORTICOSTEROID INJECTIONS/NSAIDS

We cannot recommend for or against the use of perioperative subacromial corticosteroid injections or non-steroidal anti-inflammatory medications in patients undergoing rotator cuff surgery.

Level of Evidence: Insufficient

Strength of Recommendation: Inconclusive

Rationale:

After a systematic search of the literature, we found no clinical data that supported or refuted a negative or positive effect of subacromial corticosteroid injections on tendon healing or outcomes after rotator cuff repair. Therefore, the work group could not recommend for or against their use in the perioperative period as the evidence was inconclusive.

Non-steroidal anti-inflammatory medications have the potential benefits of limiting pain and swelling associated with rotator cuff repair surgery. While the clinical effects of NSAIDs have been evaluated in the non-operative treatment of patients with rotator cuff symptoms in the absence of a full-thickness tear, we found no evidence supporting or refuting their usage in the postoperative period after rotator cuff repair. Specifically, the work group was concerned about the possible negative affects of NSAIDs on tendon healing. There is no clinical data supporting or refuting a negative or positive affect on rotator cuff tendon healing therefore the group found that the evidence with regard to NSAIDs on healing was inconclusive. If NSAIDs are utilized, appropriate prudence should be exercised as this treatment modality is associated with potential adverse side effects including gastrointestinal bleeding, renal injury and platelet dysfunction.
RECOMMENDATION 7A: CONFOUNDING FACTORS - AGE, ATROPHY/FATTY DEGENERATION, AND WORKERS COMPENSATION STATUS

It is an option for physicians to advise patients that the following factors correlate with less favorable outcomes after rotator cuff surgery:

- Increasing Age
- MRI Tear Characteristics
- Worker’s Compensation Status

INCREASING AGE - RATIONALE

Level of Evidence: IV

Strength of Recommendation: Weak

Increasing patient age has been identified as a potential factor influencing outcomes and healing after rotator cuff surgery. Healing and strength (as indirectly measured by the Constant-Murley score) are critical factors in evaluating surgical success. Several studies determined that the Constant-Murley score (as a measure of shoulder strength) was negatively correlated with increasing age after rotator cuff repair.75, 51, 47, 54, 76 Similarly, numerous authors concluded that age was a negative predictor of posterosuperior rotator cuff healing after repair.77-79

Age has also been shown to correlate with subjective outcomes after rotator cuff repair although the associations are not as strong as those for healing and strength. A number of studies have found increasing age to be negatively associated with clinical outcomes after rotator cuff surgery.47, 76, 80, 79, 51, 77, 75, 81, 82, 83 However, some studies found no effect of increasing age on clinical outcomes49, 72, 73, 84, 86, 87, 88, 89, 90-92, 93

Out of all 23 studies included, one author reported a negative correlation between increasing age and a patient-reported outcome measure.81 This study reported on 80 patients at 2 years after rotator cuff repair and concluded that older age was associated with worse DASH scores. The authors did perform a multivariate analysis confirming the relationship; therefore, this should be recognized as a significant finding. One other author82 reported VAS pain and reported age ranges for comparison groups. The findings are statistically significant but the authors do not define the size or direction of the effect. A third author reported “Treatment Response”, but this outcome is a composite of pain and internal/external rotation. It is therefore a composite of a patient-oriented outcome and a surrogate measure making it difficult to interpret.
MRI TEAR CHARACTERISTICS - RATIONALE

Level of Evidence: IV

Strength of Recommendation: Weak

Rotator cuff muscle quality has been implicated as having a direct effect on the ability of a repair to heal and the functional outcome after a repair. Both fatty degeneration (comparative amount of muscle tissue to fat as determined by MRI or CT scan) and muscle atrophy (volume of rotator cuff muscle as determined by MRI or CT scan) have been evaluated in regards to their effects on tendon repair healing and outcomes. Based upon six Level IV studies, it is an option for a surgeon to advise a patient undergoing rotator cuff repair about the negative affects of supraspinatus and infraspinatus muscle atrophy and fatty degeneration on both tendon healing and clinical outcomes.

One study evaluated 38 patients prospectively who underwent a rotator cuff repair with MRI and outcome scores (ASES score, Constant-Murley score) at baseline and at 1 year postoperative. The authors reported that worse infraspinatus muscle atrophy and fatty degeneration were correlated with worse ASES and Constant-Murley scores. Also, worse fatty degeneration correlated with poorer infraspinatus healing. Worse supraspinatus atrophy correlated with worse ASES scores, Constant-Murley scores and tendon healing. Finally, worse supraspinatus fatty degeneration correlated with worse tendon healing.

A second study evaluated twenty-eight patients who underwent repair of a massive rotator cuff tear at 44 months postoperative with UCLA scores. Preoperative fatty degeneration of the infraspinatus correlated with inferior postoperative UCLA scores.

Several authors focused their evaluation on the correlation of just supraspinatus muscle quality to tendon healing and outcomes. One study evaluated twenty-seven patients after a mini open rotator cuff repair for an isolated supraspinatus tear with an MRI and Constant-Murley score at an average of 67 months postoperative. This study determined that preoperative supraspinatus muscle atrophy correlated negatively with postoperative Constant-Murley scores. Another study evaluated 53 patients after isolated arthroscopic supraspinatus repair with Constant-Murley scores and MRI at an average of 26 months postoperative. Preoperative supraspinatus fatty degeneration and muscle atrophy correlated with worse healing rates. A final study prospectively evaluated 30 chronic rotator cuff tears of varying sizes, which underwent an open rotator cuff repair, with an MRI at an average of 21 months postoperative. The authors determined that preoperative supraspinatus muscle atrophy correlated with poorer healing rates.

Based upon these studies, preoperative infraspinatus fatty degeneration and muscle atrophy correlated with worse outcomes and healing. Preoperative supraspinatus muscle atrophy correlated with worse outcomes and healing. Finally, preoperative supraspinatus fatty degeneration was correlated with worse healing, but not necessarily worse outcomes.
WORKERS' COMPENSATION STATUS - RATIONALE

Level of Evidence: II/III

Strength of Recommendation: Moderate

Several authors\(^94,95,96\) have evaluated the effect of Workers’ compensation on surgical treatment for rotator cuff disease including acromioplasty for tendonitis and repair of full-thickness tears. Based upon one Level II study\(^96\) and two Level III studies,\(^97,98\) the work group has determined that it is an option for physicians to advise their patients that workers’ compensation status correlates with less favorable outcomes after rotator cuff repair.

One study\(^96\) prospectively evaluated 107 shoulders (23 of which were receiving workers’ compensation) at an average of 45 months postoperative from an open rotator cuff repair with the UCLA score. Both groups were comparable with regards to patient age, sex, tear size, preoperative strength and active motion. At final follow-up, patients receiving workers’ compensation had significantly worse UCLA scores compared to those not receiving workers’ compensation. Another study\(^94\) prospectively evaluated 106 patients (40 of which were receiving workers’ compensation) at an average of 32 months after arthroscopic acromioplasty for rotator cuff tendonitis with the ASES score, the Simple Shoulder Test and a VAS pain scale. The authors report no statistically significant differences between groups with regards to each of these outcomes although the AAOS work group re-calculated the statistics and found workers’ compensation patients had significantly worse SST and VAS pain scores than those not receiving a claim. The last study\(^95\) prospectively evaluated 24 patients (12 receiving workers’ compensation) at an average of 3 years postoperative from an open acromioplasty for rotator cuff tendonitis with UCLA scores. At final evaluation, workers’ compensation patients had significantly worse improvements in pain compared to those not receiving Workers’ compensation.

Based upon the above data, shoulder function as evaluated by the UCLA score, the Simple Shoulder Test and VAS pain scores were all inferior in workers’ compensation patients treated surgically for acromioplasty for rotator cuff tendonitis or rotator repairs compared to a non-workers’ compensation group. This data supports the option of advising patients that workers’ compensation status correlates with less favorable outcomes after rotator cuff surgery.

SUPPORTING EVIDENCE- INCREASING AGE

Tables relevant to this recommendation are: Table 29 through Table 38
Figures relevant to this recommendation are: Figure 86 through Figure 92
### INCREASING AGE - DATA

**Table 29 Studies addressing the effect of age on outcome sorted by sample size (n)**

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Pain Measures</th>
<th>Function:</th>
<th>Constant Measures</th>
<th>Re-Tear</th>
<th>DASH</th>
<th>Work DASH</th>
<th>SF-36</th>
<th>UCLA</th>
<th>WORC</th>
<th>ASES Score</th>
<th>M-ASES</th>
<th>SPADI</th>
<th>SSI</th>
<th>SSRS</th>
<th>SST</th>
<th>Treatment Response*</th>
<th>Clinical Outcome**</th>
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<tr>
<td>Gerber et al.</td>
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<td>13</td>
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<td>Shen et al.</td>
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<td>Namdari et al.</td>
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<td>DeFranco et al.</td>
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### Table 30 Studies addressing the effect of age on outcome sorted by mean age

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Table 31 Studies addressing the effect of age on outcome sorted by age range length

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<td>IV</td>
<td>67.7</td>
<td>61 - 78</td>
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<td>Worland et al.</td>
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<td>75</td>
<td>70 - 90</td>
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<td>Lam et al.</td>
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<td>75</td>
<td>65 - 91</td>
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<td>Gerber et al.</td>
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<td>56</td>
<td>41 - 68</td>
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<td>Lichtenberg et al.</td>
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<td>60.9</td>
<td>46 - 74</td>
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<td>Lafoose et al.</td>
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<td>47</td>
<td>29 - 59</td>
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<td>43 - 73</td>
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<td>Lahteenmaki et al.</td>
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<td>53</td>
<td>35 - 71</td>
<td>○ ●</td>
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<td>Motycka et al.</td>
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<td>57.5</td>
<td>38.4 - 76.7</td>
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<td>IV</td>
<td>65.8</td>
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<td>35 - 77</td>
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<td>Cole et al.</td>
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<td>57</td>
<td>34 - 80</td>
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<td>DeFranco et al.</td>
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<td>Pai et al.</td>
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<td>Prasad et al.</td>
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<td>64</td>
<td>22 - 82</td>
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<td>Milano et al.</td>
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<td>60</td>
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<td>Liem et al.</td>
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</tbody>
</table>

○ = no statistically significant difference
● = statistically significant
* = performed by the AAOS
** = authors group treatment response at final outcome as excellent, satisfactory, unsatisfactory
= clinical outcome not defined
LoE = level of evidence

ASES = American shoulder and elbow surgeons
QOL = quality of life measure
SPADI = shoulder pain and disability index
SSI = shoulder severity index
SSRQ = subjective shoulder-rating scale
SST = simple shoulder test
DASH = disability of the arm, shoulder, and hand
**PAIN: VAS**

One Level IV study by Cole et al. assessed the effect of age in patients undergoing arthroscopic repair of a full-thickness rotator cuff tear. The authors report statistically significant difference in VAS pain scores when comparing age groups ≤49 vs. 60-69 (p = 0.036) and 50-59 vs. 60-69 (p = 0.037); however, no difference was found when comparing age group ≤49 vs. 50-59. Authors do not report size or direction of the effect.

**PAIN: UCLA SCORE**

One Level IV study by Lahteenmaki et al. assessed the effect of age in patients undergoing surgical repair of a full-thickness rotator cuff tear. Authors report no statistically significant relationship between patient age and post-operative UCLA pain score (p = 0.57).

**FUNCTION: UCLA**

One Level IV studies assessed function using the UCLA. Lahteenmaki et al. assessed the effect of age in patients undergoing surgical repair of a full-thickness rotator cuff tear. Authors report no statistically significant relationship between patient age and post-operative UCLA function score (p = 0.096).
**CONSTANT-MURLEY SCORE**

Eight Level IV studies examined the relationship between patient age and Constant-Murley score.

One Level IV study by Shen et al. assessed the effect of age in patients undergoing mini-open repair of a rotator cuff tear. AAOS calculations found a statistically significant, negative correlation between age and Constant-Murley score ($p < .05$; see Table 31).

<table>
<thead>
<tr>
<th>Age</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant-Murley score</td>
<td>-0.612</td>
<td>0.0007</td>
</tr>
</tbody>
</table>

AAOS calculated correlation

One Level IV study by Gerber et al. assessed the effect of age in patients undergoing surgical repair of a full-thickness supraspinatus tear. AAOS calculations found no statistically significant relationship between age and Constant-Murley score ($p > 0.05$; see Table 32).

<table>
<thead>
<tr>
<th>Age</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant-Murley score</td>
<td>-0.293</td>
<td>0.3308</td>
</tr>
</tbody>
</table>

AAOS calculated correlation

One Level IV study by Liem et al. assessed the effect of age in patients undergoing arthroscopic repair of an isolated supraspinatus tear. Authors report, “The only factor with significant influence on the clinical outcome was the patient’s age ($p = 0.002$).”

One Level IV study by Prasad et al. assessed the effect of age in patients undergoing open repair of a full-thickness tear. Authors report a statistically significant effect of patient age on post-operative Constant-Murley score ($p = 0.04$).

One Level IV study by Lam and Mak assessed the effect of age in patients undergoing open repair of a massive rotator cuff tear. Authors report a statistically significant negative correlation between patient age and post-operative Constant-Murley score ($p < 0.01$).

One Level IV study by Motycka et al. assessed the effect of age in patients undergoing open repair of a full-thickness rotator cuff tear. Authors report no statistically significant difference in post-operative Constant-Murley scores in patients under 60 years of age compared to those over 60 years (mean of 73.0 to 69.7 respectively).

One Level IV study by Milano et al. assessed the effect of age in patients undergoing repair of a full-thickness tear. Authors report no statistically significant of age on the Constant-Murley score using univariate analyses (see Table 33).
Table 34 Correlation between age and post-operative Constant-Murley score

<table>
<thead>
<tr>
<th>Age</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant-Murley Score</td>
<td>-0.051</td>
<td>0.672</td>
</tr>
</tbody>
</table>

As reported by authors.

One Level IV study by Boehm et al. assessed patients undergoing rotator cuff repair using bone tunnel technique. Using linear regression, authors report a statistically significant positive correlation between age and gender adjusted Constant-Murley score (see Table 34).

Table 35 Correlation between age and gender adjusted post-operative Constant-Murley score

<table>
<thead>
<tr>
<th>Age</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant-Murley Score</td>
<td>0.243</td>
<td>0.019</td>
</tr>
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</table>

As reported by authors
RETEAR

Four Level IV studies examined the relationship between patient age and re-tear occurrence.

One Level IV study by DeFranco et al. assessed the effect of age on re-tear rates in patients undergoing arthroscopic repair of an isolated supraspinatus tendon tear. Authors report that patients with re-tears were statistically significantly older than those with intact repairs ($p < 0.01$; see Figure 86).

**Figure 86 Age of re-tear and intact patient groups**

[Bar graph showing age distribution]

AAOS calculated independent t-test, $t = 3.19, p < .01$.

One Level IV study by Cole et al. assessed the effect of age in patients undergoing arthroscopic repair of a full-thickness rotator cuff tear. Authors report that a statistically significant correlation was found between re-tear and age group ($r = 0.407, p = 0.004$) and that patients with re-tears were significantly older than those with intact repairs (64 to 55 respectively, $p = 0.009$; see Figure 87).
Authors calculated correlation between re-tear and age group, $r = 0.407$, $p = 0.004$.

One Level IV study by Lichtenberg et al. assessed the effect of age in patients undergoing arthroscopic repair of an isolated full-thickness supraspinatus tear. Authors report that patients with re-tears were statistically significantly older than those with intact repairs (65.3 to 59.5 respectively, $p = 0.0122$; see Figure 88).
Authors report patients with re-tears were statistically significantly older, $p = 0.0122$.

One Level IV study by Gazielly et al. assessed the effect of age in patients undergoing surgical repair of a full-thickness rotator cuff tear. Authors report no statistically significant relationship between age and re-tear ($p = 0.063$).
**DASH**
One Level IV study by Milano et al. assessed the effect of age in patients undergoing repair of a full-thickness tear. Authors report a statistically significant relationship between age and the DASH score using univariate analyses (see Table 35).

**Table 36 Correlation between age and post-operative DASH score**

<table>
<thead>
<tr>
<th>Age</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASH</td>
<td>0.255</td>
<td>0.032</td>
</tr>
</tbody>
</table>

As reported by authors.

**WORK-DASH**
One Level IV study by Milano et al. assessed the effect of age in patients undergoing repair of a full-thickness tear. Authors report no statistically significant effect of age on the Work-DASH score using univariate analyses (see Table 36). The Work-DASH is an optional module of the DASH that measures work capacity.

**Table 37 Correlation between age and post-operative Work-DASH score**

<table>
<thead>
<tr>
<th>Age</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-Dash</td>
<td>0.127</td>
<td>0.292</td>
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</tbody>
</table>

As reported by authors.

**SF-36**
One Level IV study by Mckee et al. assessed the effect of age in patients undergoing surgical repair of rotator cuff disease (defined as impingement or tearing, or both). Authors report age was not a statistically significant predictor of post-operative SF-36 score ($p = 0.55$).
**UCLA SCORE**

Four Level IV studies examined the relationship between patient age and UCLA Score.

One Level IV study by Lahteenmaki et al. assessed the effect of age in patients undergoing surgical repair of a full-thickness rotator cuff tear. Authors report no statistically significant relationship between patient age and post-operative UCLA Score ($p = 0.41$).

One Level IV study by Rebuzzi et al. assessed the effect of age in patients undergoing arthroscopic repair of rotator cuff tear. Authors report no statistically significant difference between groups on post-operative UCL Score by age group ($p = 0.40$; see Figure 89).

**Figure 89 Post-operative UCLA Score by age group**

![Post-operative UCLA Score by age group](image)
One Level IV study by Pai et al. assessed the effect of age in patients undergoing surgical repair of a full-thickness rotator cuff tear. Authors report, “no significant correlation of poor outcome with old age” (see Table 37 and Figure 90).

**Table 38 Patient rating according to UCLA Scale by age group**

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>UCLA Results</th>
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<tbody>
<tr>
<td>&lt;40</td>
<td>2</td>
<td>Excellent 2</td>
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<td>Poor 0</td>
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<td>40-50</td>
<td>6</td>
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<td>Good 4</td>
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<td>Poor 1</td>
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<td>Good 6</td>
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<td>Fair 4</td>
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<td>Poor 1</td>
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**Figure 90 UCLA Score rating by age group**

One Level IV study by Gartsman et al. assessed the effect of age in patients undergoing arthroscopic repair of a full-thickness rotator cuff tear. Authors reported no statistically significant correlation between age and post-operative UCLA Score ($r = -0.157, ns$).
**WORC**

One Level IV study by Baysal et al. assessed the effect of age in patients undergoing mini-open repair of a full-thickness rotator cuff tear. Authors report no statistically significant difference between groups on post-operative WORC score by age group (see Figure 91).

**Figure 91 Post-operative WORC score by age group**

![Graph showing WORC scores by age group](image)

Authors report no statistically significant difference between groups.

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**Note:** The graph shows WORC scores for different age groups: <50, 50-59, and >=60. The scores are 86.5, 88.4, and 80.0, respectively, with confidence intervals indicated.
**ASES SCORE**

One Level IV study by Baysal et al. assessed the effect of age in patients undergoing mini-open repair of a full-thickness rotator cuff tear. Authors report no statistically significant difference between groups on post-operative ASES score by age group ($p > 0.05$; see Figure 92).

**Figure 92 Post-operative ASES score by age group**

Authors report no statistically significant difference between groups, $p > 0.05$. 
**MODIFIED AMERICAN SHOULDER & ELBOW SURGEONS (M-ASES)**

One Level IV study by Mckee et al. assessed the effect of age in patients undergoing surgical repair of rotator cuff disease (defined as impingement or tearing, or both). Authors report no statistically significant effect of age on the M-ASES score ($p = 0.43$ to $0.65$) [sic]. Authors assessed the effect of age on all outcomes and reported studies with no statistically significant results as a p-value range.

**SHOULDER PAIN & DISABILITY INDEX (SPADI)**

One Level IV study by Mckee et al. assessed the effect of age in patients undergoing surgical repair of rotator cuff disease (defined as impingement or tearing, or both). Authors report age was not a statistically significant predictor of post-operative SPADI score ($p = 0.43$ to $0.65$) [sic]. Authors assessed the effect of age on all outcomes and reported studies with no statistically significant results as a p-value range.

**SHOULDER SEVERITY INDEX (SSI)**

One Level IV study by Mckee et al. assessed the effect of age in patients undergoing surgical repair of rotator cuff disease (defined as impingement or tearing, or both). Authors report age was not a statistically significant predictor of post-operative SSI score ($p >0.40$).

**SUBJECTIVE SHOULDER-RATING SCALE (SSRS)**

One Level IV study by Mckee et al. assessed the effect of age in patients undergoing surgical repair of rotator cuff disease (defined as impingement or tearing, or both). Authors report age was not a statistically significant predictor of post-operative SSRS score ($p = 0.43$ to $0.65$) [sic]. Authors assessed the effect of age on all outcomes and reported studies with no statistically significant results as a p-value range.

**SST**

One Level IV study by Mckee et al. assessed the effect of age in patients undergoing surgical repair of rotator cuff disease (defined as impingement or tearing, or both). Authors report age was not a statistically significant predictor of post-operative SST score ($p = 0.43$ to $0.65$) [sic]. Authors assessed the effect of age on all outcomes and reported studies with no statistically significant results as a p-value range.

**TREATMENT RESPONSE**

One Level IV study by Hattrup et al. assessed the effect of age in patients undergoing surgical repair of a full-thickness rotator cuff tear. Surgical results were classified as excellent (no or mild discomfort, active abduction of at least $145^\circ$ and active external rotation of $55^\circ$), satisfactory (occasionl moderate discomfort, active abduction of more than $100^\circ$ and external rotation of $30^\circ$) or unsatisfactory (all other patients and those dissatisfied with their results). Authors report that patients with excellent results ($n = 88$) were statistically significantly younger than those with non-excellent results ($n = 16$; 69 years vs. 65 years respectively; Wilcoxon rank-sum, $p = 0.018$)
**CLINICAL OUTCOME**

One Level IV study by Lafosse et al. assessed the effect of age in patients undergoing arthroscopic repair of an isolated subscapularis tear. Utilizing multiple-regression analysis, the authors report no statistically significant relationship between age and the patients’ ultimate clinical outcome. Authors do not provide significance values or define “clinical outcome.”

One Level IV study by Murray et al. assessed the effect of age in patients undergoing arthroscopic repair of an isolated subscapularis tear. Authors report no statistically significant correlation between age and outcome scores ($r > 0.6$). Authors do not specify which outcome scores were examined.

One Level IV study by Namdari et al. assessed the effect of age in patients undergoing open repair of traumatic anterosuperior rotator cuff tears. Authors report no statistically significant correlation between age and outcome. Authors do not provide significance values or define “outcome.”

One Level IV study by Worland et al. utilized multivariate logistic regression in examining patients aged 80 or greater. All patients had undergone open repair of a massive rotator cuff tear. Authors reported, “The multivariate logistic regression analysis showed that no preoperative variable was independently associated with a favorable outcome.” Authors do not specify which outcome was examined or define favorable.
SUPPORTING EVIDENCE- MRI TEAR CHARACTERISTICS

Tables relevant to this recommendation are: Figure 93 through Figure 95
Figures relevant to this recommendation are: Table 39 through Table 42

MRI TEAR CHARACTERISTICS - DATA

ASES SCORE

One Level IV study by Gladstone et al. assessed patients undergoing open, mini-open or arthroscopic repair of a full thickness rotator cuff tear and patient pre-operative muscle quality (muscle atrophy and fatty infiltration). Muscle atrophy was graded using a system by Warner and fatty infiltration was graded using a system by Goutallier. The authors first examined the correlation between preoperative muscle quality and post-operative Constant-Murley score. The authors then performed a stepwise regression analysis and found muscle atrophy and fatty infiltration of the infraspinatus to be a statistically significant predictor of the ASES score ($p = 0.001$ and $p = 0.01$ respectively). Muscle atrophy and fatty infiltration of the supraspinatus was not a statistically significant predictor of the ASES score. The authors did not provide regression coefficients.

Table 39 Correlation of muscle quality and ASES score

<table>
<thead>
<tr>
<th>ASES Score</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infraspinatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>-0.364</td>
<td>0.027</td>
</tr>
<tr>
<td>MA</td>
<td>-0.401</td>
<td>0.014</td>
</tr>
<tr>
<td>Supraspinatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>-0.231</td>
<td>0.17</td>
</tr>
<tr>
<td>MA</td>
<td>-0.354</td>
<td>0.034</td>
</tr>
</tbody>
</table>

MA = muscle atrophy; FI = fatty infiltration
**CONSTANT-MURLEY SCORE**

Three Level IV studies assessed pre-operative muscle atrophy and fatty infiltration in relation to the post-operative Constant-Murley score.

Gladstone et al. assessed patients undergoing open, mini-open or arthroscopic repair of a full thickness rotator cuff tear and patient pre-operative muscle quality (muscle atrophy and fatty infiltration). Muscle atrophy was graded using a system by Warner and fatty infiltration was graded using the Goutallier staging system. The authors first examined the correlation between preoperative muscle quality and post-operative Constant-Murley score. The authors then performed a stepwise regression analysis and found muscle atrophy (but not fatty infiltration) of the infraspinatus is a statistically significant predictor of the Constant-Murley score \( (p = 0.033) \). Muscle atrophy and fatty infiltration of the supraspinatus was not a statistically significant predictor of the Constant-Murley score. Regression coefficients were not provided by the authors.

**Table 40 Correlation of muscle quality and Constant-Murley score**

<table>
<thead>
<tr>
<th>Muscle Site</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infraspinatus</td>
<td>-0.359</td>
<td>0.029</td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>-0.236</td>
<td>0.160</td>
</tr>
<tr>
<td>MA</td>
<td>-0.402</td>
<td>0.015</td>
</tr>
</tbody>
</table>

MA = muscle atrophy; FI = fatty infiltration

Shen et al. assessed patients undergoing mini-open repair of a rotator cuff tear. Authors assessed atrophy by calculating a ratio between the atrophic and total area (A/T ratio). AAOS calculations found postoperative Constant-Murley score was statistically significantly correlated to pre-operative A/T ratios with greater atrophy of the supraspinatus and subscapularis being associated with a poorer outcome.

**Table 41 Correlation of muscle quality and Constant-Murley score**

<table>
<thead>
<tr>
<th>Muscle Site</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infraspinatus &amp; teres minor</td>
<td>0.1934</td>
<td>0.3339</td>
</tr>
<tr>
<td>Subscapularis</td>
<td>0.5612</td>
<td>0.0023</td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>0.6146</td>
<td>0.0006</td>
</tr>
</tbody>
</table>
Gerber et al. assessed patients undergoing surgical repair of a full-thickness supraspinatus tear. Authors assessed fatty infiltration according to the Goutallier staging system. AAOS calculations found no statistically significant correlation between pre-operative fatty infiltration and postoperative Constant-Murley.

Table 42 Correlation of fatty infiltration and Constant-Murley score

<table>
<thead>
<tr>
<th>Muscles</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infraspinatus</td>
<td>-0.264</td>
<td>0.384</td>
</tr>
<tr>
<td>Subscapularis</td>
<td>0.263</td>
<td>0.385</td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>-0.120</td>
<td>0.696</td>
</tr>
</tbody>
</table>

**UCLA SCORE**

One Level IV study by Mellado et al. correlated preoperative fatty degeneration and postoperative UCLA Score. Twenty-eight patients diagnosed as having massive rotator cuff tears were surgically repaired. Diagnosis was confirmed intraoperatively and complete repair was performed whenever possible. Prior to surgery muscle degeneration and atrophy were assessed using MRI. Authors report preoperative fatty degeneration of the infraspinatus muscle was negatively correlated with the postoperative UCLA Score ($r = -0.4$, $p = 0.03$). Authors report no additional preoperative muscle disease characteristics in relation to postoperative outcomes.
**RE-TEAR**

Three Level IV studies assessed pre-operative muscle atrophy and fatty infiltration in relation to post-operative re-tear rates.

Gladstone et al. assessed patients undergoing open or arthroscopic repair of a full thickness rotator cuff tear and patient pre-operative muscle quality (muscle atrophy and fatty infiltration). Muscle atrophy was graded using a system by Warner and fatty infiltration was graded using a system by Goutallier whereby higher scores indicate greater atrophy or infiltration. The authors examined pre-operative muscle quality scores and patients who develop re-tears post-operatively.

**Figure 93 Pre-operative muscle quality in patients with and without re-tears**

* Authors report, $p < .01$; ** Authors report, $p < .05$; MA = muscle atrophy; FI = fatty infiltration; AAOS calculated confidence intervals uses standard deviation estimated from range.
Liem et al. assessed patients undergoing arthroscopic repair of an isolated supraspinatus tear and pre-operative muscle quality. Supraspinatus atrophy was graded using a system by Thomazeau and fatty infiltration was graded using a system by Goutallier. Authors compared post-operative re-tear rates in patients with grade one supraspinatus atrophy to those with grade two and report a statistically significant effect favoring Grade 1 ($p = 0.018$; see Figure 5). Additionally, authors compared post-operative re-tear rates in patients with either stage zero or one to patients with stage two fatty infiltration and report a statistically significant effect favoring Stage 0 and 1 ($p = 0.021$); however, AAOS calculations failed to find a statistically significant effect.

**Figure 94 Re-tear occurrence by supraspinatus atrophy grade**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>OR (95% CI)</th>
<th>Events</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favors Grade 1</td>
<td>0.17 (0.04, 0.79)</td>
<td>5/35</td>
<td>5/10</td>
</tr>
<tr>
<td>Favors Grade 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
Figure 95 Re-tear occurrence by fatty infiltration stage

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (95%)</th>
<th>Grade</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retear</td>
<td>0.31 (0.07, 1.45)</td>
<td>0 &amp; 1</td>
<td>6/35</td>
</tr>
<tr>
<td></td>
<td>0.31 (0.07, 1.45)</td>
<td>Grade 2</td>
<td>4/10</td>
</tr>
</tbody>
</table>

AAOS calculated effect size

Thomazeau et al.\textsuperscript{52} report, “…preoperative atrophy of the supraspinatus muscle was the main anatomic predictive factor for a postoperative re-tear \((p = 0.0028)\).” The value of the correlation coefficient could not be determined.
### SUPPORTING EVIDENCE - WORKERS' COMPENSATION STATUS

Tables relevant to this recommendation are: Table 43
Figures relevant to this recommendation are: Figure 96 through Figure 102

### WORKERS' COMPENSATION STATUS - DATA

#### Table 43 Results of patients with or without workers' compensation

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>32 months*</th>
<th>36 months**</th>
<th>45 months***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicholson</td>
<td>II</td>
<td>106</td>
<td></td>
<td>Pain: VAS</td>
<td>⚫non</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nicholson</td>
<td>II</td>
<td>106</td>
<td></td>
<td>ASES</td>
<td>?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nicholson</td>
<td>II</td>
<td>106</td>
<td></td>
<td>SST</td>
<td>⚫non</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lopez et al.</td>
<td>III</td>
<td>23</td>
<td>Workers Compensation vs. Non-workers' Compensation</td>
<td>Pain: UCLA</td>
<td>⚫non</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lopez et al.</td>
<td>III</td>
<td>23</td>
<td></td>
<td>Function: UCLA</td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misamore et al.</td>
<td>III</td>
<td>103</td>
<td></td>
<td>UCLA Score</td>
<td>⚫non</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* = not sufficiently powered to detect MCII; neither statistically or clinically significant  
○ = no statistically significant difference  
● = statistically significant difference  
non = favors non-workers’ compensation patients  
ASES = American shoulder and elbow score  
SST = Simple shoulder test  
LoE = Level of Evidence  
* = final visit 32 ± 0.49 months after baseline  
** = final visit 36.8 ± 1.27 months after baseline  
*** = final visit 45 ± 0.64 months after baseline
**PAIN: VAS**

One Level II study by Nicholson compared pain scores (measured by VAS) in patients receiving workers’ compensation to those not receiving workers’ compensation after arthroscopic subacromial decompression. The author reports no statistically significant difference between groups in post-operative pain scores ($p = 0.0807$); however, AAOS calculations do not confirm this finding ($ES = 0.40, 95\% CI 0.001 – 0.79$; see Figure 96).

**Figure 96 Pain as measured by VAS in patients receiving or not receiving workers' compensation**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (, )</th>
<th>(SD); Workers Comp</th>
<th>Non-workers Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD (95%)</td>
<td>N, mean</td>
<td>mean (SD);</td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
ASES SCORE
One Level II study by Nicholson compared ASES scores in patients receiving workers’ compensation to those not receiving workers’ compensation after arthroscopic subacromial decompression. The author reports no statistically significant difference between groups in post-operative ASES scores (p = 0.1080; see Figure 97).

Figure 97 ASES score in patients receiving or not receiving workers’ compensation

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI</th>
<th>Non-workers Comp</th>
<th>Workers Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASES</td>
<td>0.37 (-0.03, 0.76)</td>
<td>66.88.9 (10.9)</td>
<td>40.83.8 (17.6)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size; MCII indicated by dashed line; this study was not sufficiently powered to detect the MCII therefore, its’ results are inconclusive.
**SST**

One Level II study by Nicholson compared SST scores in patients receiving workers’ compensation to those not receiving workers’ compensation after arthroscopic subacromial decompression. The author reports no statistically significant difference between groups in post-operative SST scores ($p = 0.0501$); however, AAOS calculations do not confirm this finding (ES = 0.47, 95% CI 0.07 – 0.86; see Figure 98).

**Figure 98 SST score in patients receiving or not receiving workers' compensation**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%)</th>
<th>N, mean (SD); Workers Comp</th>
<th>N, mean (SD); Non-workers Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CI) 0.47</td>
<td>0.47 (0.07, 0.86)</td>
<td>40, 9.36 (2.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>66, 10.3 (1.51)</td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
PAIN: UCLA SCORE

One Level III study by Lopez et al. assessed pain measured by UCLA Score in patients receiving workers’ compensation to those not receiving workers’ compensation after acromioplasty (performed either open or arthroscopically). The authors report a statistically significant difference between groups in post-operative pain ($p < 0.0003$; see Figure 99).

**Figure 99** Pain as measured by UCLA Score in patients receiving or not receiving workers' compensation

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI: (, .)</th>
<th>SMD (95% CI)</th>
<th>N. mean (SD)</th>
<th>N. mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain: UCLA</td>
<td>1.39 (0.46, 2.32)</td>
<td>12, 7.83 (2.48)</td>
<td>11, 4.5 (2.11)</td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**FUNCTION: UCLA SCORE**

One Level III study by Lopez et al. assessed function measured by UCLA Score in patients receiving workers’ compensation to those not receiving workers’ compensation after acromioplasty (performed either open or arthroscopically). The authors report a statistically significant difference between groups in post-operative function ($p < 0.0404$) [sic]; however, AAOS calculations do not confirm this finding (ES = 0.55, 95% CI -0.28 – 1.39; see Figure 100).

**Figure 100 Function as measured by UCLA Score in patients receiving or not receiving workers' compensation**

AAOS calculated effect size
**UCLA SCORE**

One Level III study by Misamore et al. compared overall surgical outcome (measured by UCLA Score) in patients receiving workers’ compensation to the outcomes of those not receiving workers’ compensation after rotator cuff repair (see Figure 101). The authors report a statistically significant difference between groups in post-operative UCLA Scores ($p < 0.0004$) [sic].

**Figure 101 UCLA Score in patients receiving or not receiving workers' compensation**

AAOS calculated effect size; 95% confidence interval calculated using a standard deviation estimated from range.
Misamore et al. categorized post-operative UCLA Scores as excellent (34-35), good (28-33), fair (21-27) or poor (0-20). An excellent or good result was considered a satisfactory result while a fair or poor result was considered an unsatisfactory result (see Figure 102). AAOS calculations, using authors’ groupings, found a statistically significant result with non-workers' compensation patients having greater satisfaction than patients with workers’ compensation (EOR= 9.19, 95% CI 3.01 – 28.03; see Figure 102).

**Figure 102 UCLA score categorized as satisfactory or unsatisfactory**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (95%)</th>
<th>Events</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-workers Comp</td>
<td>9.19 (3.01, 28.03)</td>
<td>76/83</td>
<td>13/24</td>
</tr>
<tr>
<td>Workers Comp</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
RECOMMENDATION 7B: CONFOUNDING FACTORS - DIABETES, CO-MORBIDITIES, SMOKING, INFECTION, AND CERVICAL DISEASE

We cannot recommend for or against advising patients in regard to the following factors related to rotator cuff surgery:

- Diabetes
- Co-morbidities
- Smoking
- Prior Shoulder Infection
- Cervical Disease

<table>
<thead>
<tr>
<th>Confounding Factor</th>
<th>Strength of Recommendation</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>Inconclusive</td>
<td>III</td>
</tr>
<tr>
<td>Co-morbidities</td>
<td>Inconclusive</td>
<td>IV</td>
</tr>
<tr>
<td>Smoking</td>
<td>Inconclusive</td>
<td>Insufficient</td>
</tr>
<tr>
<td>Infection</td>
<td>Inconclusive</td>
<td>Insufficient</td>
</tr>
<tr>
<td>Cervical Disease</td>
<td>Inconclusive</td>
<td>Insufficient</td>
</tr>
</tbody>
</table>

Rationale:

Various patient-related factors may influence clinical outcomes after rotator cuff surgery. These factors may affect functional outcomes or tendon healing, hence the work group systematically searched for data on diabetes, smoking, co-morbidities, prior shoulder infection and cervical disease.

Two Level III studies\(^\text{97, 98}\) compared the outcomes of diabetic and non-diabetic individuals after rotator cuff surgery. One study\(^\text{98}\) found no statistically significant difference between the two groups on postoperative stiffness using the Constant Murley Score at 46 months. The second study\(^\text{97}\) found a statistically significant difference and possible clinically important difference in the ASES score favoring patients without diabetes. This study found no statistically significant difference in the occurrence of infection between the two groups of patients. Since these studies assessed different outcomes with varying results, the work group found this evidence inconclusive.

One Level IV study\(^\text{73}\) assessed the effect of medical co-morbidities in patients undergoing open repair of traumatic anterosuperior rotator cuff tears. The authors reported no statistically significant correlation between medical co-morbidities and outcome. They did not provide significance values or define “outcome.” Again, the work group evaluated this as a single study that was weak evidence. They concluded overall that the evidence is inconclusive concerning the presence of medical co-morbidities and patient outcomes.

There were no studies found that addressed the effects of smoking, prior shoulder infection, or cervical disease as they relate to rotator cuff surgery outcomes.
Although we found no specific evidence demonstrating a significant effect for any of these factors, neither did we find evidence that the above factors had no effect on clinical outcomes after rotator cuff surgery. Therefore, the work group found there to be inconclusive evidence regarding the affects (either positive or negative) of these factors on outcomes after rotator cuff surgery.

**SUPPORTING EVIDENCE - DIABETES**

Tables relevant to this recommendation are: Table 44

Figures relevant to this recommendation are: Figure 103 through Figure 105

**DIABETES**

**Table 44 Results of patients with or without diabetes**

<table>
<thead>
<tr>
<th>Author</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>33 months*</th>
<th>46 months**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al.</td>
<td>III</td>
<td>60</td>
<td>Patients with diabetes vs. Patients without diabetes</td>
<td>ASES Score</td>
<td>☯</td>
<td>☯</td>
</tr>
<tr>
<td>Hsu et al.</td>
<td></td>
<td>43</td>
<td></td>
<td>Constant Score</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Chen et al.</td>
<td></td>
<td>60</td>
<td></td>
<td>Infection</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

○ = no statistically significant difference
● = statistically significantly and possibly clinically important
☯ = favoring patients without diabetes
*** = possibly clinically important

LoE = level of evidence
* = final visit 33 ± 1.01 months
** = final visit 46 ± 5.38 months
**ASES SCORE**

One Level III study by Chen et al. assessed post-operative ASES scores in patients with or without diabetes. All patients underwent open surgical repair of full-thickness rotator cuff tears. Authors report no statistically significant difference between groups on overall ASES scores; however, AAOS calculations fail to confirm this finding (ES = 0.72, 95% CI 0.19 – 1.24; see Figure 103).

**Figure 103 ASES score in patients with or without diabetes**

AAOS calculated effect size; MCII indicated by dashed line; this study was not sufficiently powered to detect the MCII, its’ results are possibly clinically important; 95% confidence interval calculated using a standard deviation estimated from range.
**CONSTANT-MURLEY SCORE**

One Level III study by Hsu et al. assessed post-operative Constant-Murley scores in patients with or without diabetes. All patients were diagnosed and surgically treated for a rotator cuff tear with concomitant shoulder stiffness. Authors report no statistically significant difference between groups post-operatively on the Constant-Murley score ($p = 0.123$; see Figure 104).

Figure 104 Constant-Murley score in patients with or without diabetes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (−, −)</th>
<th>With Diabetes</th>
<th>Without Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant Score</td>
<td>0.56 (−0.13, 1.26)</td>
<td>11.93 (5.31)</td>
<td>32, 88.3 (8.86)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
INFECTIONS

One Level III study by Chen et al.\textsuperscript{100} assessed occurrence of infection in patients with or without diabetes (see Figure 105). All patients underwent open surgical repair of full-thickness rotator cuff tears. One patient with diabetes experienced an infection (defined by local wound erythema and tenderness). No infectious complications were observed in patients without diabetes.

Figure 105 Occurrence of infection in patients with or without diabetes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (95%)</th>
<th>Diabetes</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>3.10 (0.12, 79.23)</td>
<td>1/30</td>
<td>0/30</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
SUPPORTING EVIDENCE- CO-MORBIDITIES

Tables relevant to this recommendation are: Table 45
Figures relevant to this recommendation are: None

MEDICAL CO-MORBIDITIES

Table 45 Studies addressing the effect of co-morbidities on outcome

<table>
<thead>
<tr>
<th>Author</th>
<th>LoE</th>
<th>n</th>
<th>Outcome</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Namdari et al.</td>
<td>IV</td>
<td>30</td>
<td>Clinical Outcome**</td>
<td>56 months*</td>
</tr>
</tbody>
</table>

○ = no statistically significant difference
* = final visit 56 ± 4 months after baseline
** = clinical outcome not defined
LoE = level of evidence

One Level IV study by Namdari et al. assessed the effect of medical co-morbidities in patients undergoing open repair of traumatic anterosuperior rotator cuff tears. Authors report no statistically significant correlation between medical co-morbidities and outcome. Authors do not provide significance values, define “outcome,” or specify co-morbidities considered.

SMOKING

There were no studies identified addressing smoking as it relates to rotator cuff surgery.

HISTORY OF INFECTION

There were no studies identified addressing a patient’s history of infection as it relates to rotator cuff surgery.

CERVICAL DISEASE

There were no studies identified addressing cervical disease as it relates to rotator cuff surgery.
RECOMMENDATION 8: SURGERY - ACROMIOPLASTY
We suggest that routine acromioplasty is not required at the time of rotator cuff repair.

Level of Evidence: II

Strength of Recommendation: Moderate

Rationale:

Acromioplasty and release of the coracoacromial ligament is often included as part of a rotator cuff repair. Theoretical benefits of an acromioplasty in the setting of a rotator cuff repair include increasing the subacromial space available to facilitate the repair and also relieving extrinsic compression on the repair after completion. Despite these theoretical benefits, one quality study\textsuperscript{101} suggests that an anterior acromioplasty has no effect on final outcomes after rotator cuff repair. Two studies\textsuperscript{89, 81} reviewed the results of removing acromial bone (Bigliani type II and III acromions) and did not find any benefit in postoperative functional results.

One Level II randomized prospective study\textsuperscript{89} performed a comparison of 47 patients treated with an arthroscopic rotator cuff repair plus an associated anterior acromioplasty and coracoacromial ligament release with 46 patients who underwent rotator cuff repair alone. All patients had isolated supraspinatus rotator cuff tears with Bigliani type II acromion. The patients were evaluated preoperatively and an average of 15 months postoperatively with the American Shoulder and Elbow Surgeons Score. The authors reported no significant difference between groups of both final ASES scores and improvement from baseline. While these results suggest there was no difference in ASES scores between groups, this study was not sufficiently powered to detect the minimally clinically important improvement.

Another randomized, prospective study\textsuperscript{81} compared 40 patients treated with an arthroscopic rotator cuff repair, anterior acromioplasty and coracoacromial ligament release with 40 patients who underwent rotator cuff repair alone. All patients had a repairable full thickness tear and either a Bigliani type II or III acromion. At two years postoperatively, the authors reported no significant differences in final Constant-Murley scores or DASH scores. The Constant-Murley scores are suggestive that acromioplasty has no effect on outcome. The work group considered the DASH result a true negative because this study was sufficiently powered to show the nonsignificant result was also not clinically significant. These results suggest that acromioplasty has little or no effect on postoperative clinical outcomes; therefore it is not required for the management of normal acromial bone (including type II and III morphology at the time of rotator cuff repair).

Acromial spurs are independent from normal acromial bone. Spurs have been identified as acquired ossifications of the coracoacromial ligament on the undersurface of the acromion. This ossification is considered in excess of normal acromial bone and may have a pathological role in the process of rotator cuff disease. The work group recognizes
that acquired acromial spurs are a topic of interest to many surgeons; however they are beyond the scope of the current guideline.

**SUPPORTING EVIDENCE- ROUTINE ACROMIOPLASTY**

Tables relevant to this recommendation are: Table 46 through Table 47

Figures relevant to this recommendation are: Figure 106 through Figure 109

**ROUTINE ACROMIOPLASTY**

Table 46 Results of repair with or without acromioplasty

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>6-12 Months</th>
<th>2 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gartsman et al.</td>
<td>II</td>
<td>93</td>
<td>Acromioplasty vs. No Acromioplasty</td>
<td>ASES Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milano et al.</td>
<td>II</td>
<td>80</td>
<td>Acromioplasty vs. No Acromioplasty</td>
<td>Normalized Constant-Murley Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milano et al.</td>
<td>II</td>
<td>80</td>
<td>Acromioplasty vs. No Acromioplasty</td>
<td>DASH Score</td>
<td></td>
<td>θ</td>
</tr>
<tr>
<td>Milano et al.</td>
<td>II</td>
<td>80</td>
<td>Acromioplasty vs. No Acromioplasty</td>
<td>Work DASH Score</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

○ = no statistically significant difference
θ = not statistically or clinically significant
LoE = level of evidence
ASES = American shoulder and elbow score
DASH = disability of the arm, shoulder and hand

**ASES SCORE**

In one Level II study by Gartsman et al., ninety-three patients with full thickness supraspinatus tendon tears and type 2 acromion were randomized to receive either arthroscopic rotator cuff repair with subacromial decompression or without subacromial decompression. Shoulders were assessed using the ASES scoring system at either a 6 month or 1 year follow up. Results are neither statistically significant or clinically important\(^3\) (see Figure 106).
Figure 106 ASES Score of patients with and without subacromional decompression

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); With SD</th>
<th>N, mean (SD); Without SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASES Score</td>
<td>0.18 (-0.23, 0.58)</td>
<td>49, 91.5 (10.3)</td>
<td>46, 89.2 (15.1)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size; Dashed line indicates MCII for ASES Score; This study was not sufficiently powered to detect the MCII therefore, its’ results are inconclusive.
NORMALIZED CONSTANT-MURLEY SCORE

In one Level II study by Milano et al. eighty patients were randomized to receive either: arthroscopic rotator cuff repair and subacromial decompression, consisting of anterior-inferior acromioplasty, release of the coracoacromial ligament and subacromial bursectomy or repair with subacromial bursectomy only. Shoulders were assessed using the Normalized Constant-Murley Scoring System two years postoperatively. The results showed no statistically significant difference between rotator cuff repair surgery including acromioplasty and repair without acromioplasty (see Figure 107).

Figure 107 Normalized Constant-Murley Score

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N, mean (SD) Without</th>
<th>N, mean (SD) With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acromioplasty</td>
<td>34.96 (20.9)</td>
<td>37.104 (17.5)</td>
</tr>
<tr>
<td>Acromioplasty</td>
<td>-0.39 (-0.86, 0.08)</td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**DASH SCORE**

In one Level II study by Milano et al. eighty patients were randomized to receive either: arthroscopic rotator cuff repair and subacromial decompression, consisting of anterior-inferior acromioplasty, release of the coracoacromial ligament and subacromial bursectomy or repair with subacromial bursectomy only. Shoulders were assessed using the DASH Score two years postoperatively (see Figure 108).

**Figure 108 DASH Score**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>CI (CI)</th>
<th>Acromioplasty</th>
<th>Acromioplasty</th>
</tr>
</thead>
<tbody>
<tr>
<td>N, mean</td>
<td>N, mean</td>
<td>SMD (SD) With</td>
<td>(SD) Without</td>
</tr>
<tr>
<td>-0.26 (-0.73, 0.20)</td>
<td>37, 18.2 (17.6)</td>
<td>34, 23.1 (19.3)</td>
<td></td>
</tr>
</tbody>
</table>

Favors With Acromioplasty Favors Without Acromioplasty

AAOS calculated effect size
**WORK-DASH SCORE**

In one Level II study by Milano et al., eighty patients were randomized to receive either: arthroscopic rotator cuff repair and subacromial decompression, consisting of anterior-inferior acromioplasty, release of the coracoacromial ligament and subacromial bursectomy or repair with subacromial bursectomy only. Shoulders were assessed using the Work-DASH score two years postoperatively (see Figure 109). The Work-DASH is an optional module of the DASH for work capacity.

**Figure 109 Work-DASH score**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95%)</th>
<th>(SD); With</th>
<th>(SD); Without</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acromioplasty</td>
<td>-0.10 (-0.56, 0.37)</td>
<td>37, 23.7 (25.3)</td>
<td>34, 26.2 (24.8)</td>
</tr>
<tr>
<td>Acromioplasty</td>
<td>N, mean</td>
<td>N, mean</td>
<td></td>
</tr>
</tbody>
</table>

Favors With Acromioplasty  Favors Without Acromioplasty

AAOS calculated effect size
STRATIFICATIONS

Milano et al. utilized univariate analysis in examining stratifications pertaining to: age, gender, tear location, hand dominance and muscle degeneration. Authors reported the outcomes: Constant-Murley score, DASH and Work-DASH (see Table 47).

Table 47 Stratifications pertaining to anterior inferior acromioplasty

<table>
<thead>
<tr>
<th>Stratification</th>
<th>Constant-Murley</th>
<th>DASH</th>
<th>Work-DASH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Linear Correlation</td>
<td>p-value</td>
<td>Linear Correlation</td>
</tr>
<tr>
<td>Age</td>
<td>-0.051</td>
<td>0.672</td>
<td>0.255</td>
</tr>
<tr>
<td>Gender</td>
<td>nr</td>
<td>0.603</td>
<td>nr</td>
</tr>
<tr>
<td>Tear location</td>
<td>nr</td>
<td>0.333</td>
<td>nr</td>
</tr>
<tr>
<td>Hand dominance</td>
<td>nr</td>
<td>0.216</td>
<td>nr</td>
</tr>
<tr>
<td>Muscle degeneration</td>
<td>-0.168</td>
<td>0.161</td>
<td>0.197</td>
</tr>
</tbody>
</table>

nr = not reported by authors
RECOMMENDATION 9: SURGERY - PARTIAL ROTATOR CUFF REPAIR, DEBRIDEMENT, OR MUSCLE TRANSFER

It is an option to perform partial rotator cuff repair, debridement, or muscle transfers for patients with irreparable rotator cuff tears when surgery is indicated.

Level of Evidence: IV

Strength of recommendation: Weak

Rationale:

Five Level IV 99-103 studies addressed the use of operative debridement, limited repair, or muscle transfer for an irreparable rotator cuff tear. These studies found an improvement in pain and function after repair of a portion of a chronic full thickness rotator cuff tear when a complete repair can not be achieved.99 They also found clinically important improvement with arthroscopic debridement without partial repair of the rotator cuff with or without release of the long head of the biceps102 and improvement in pain and function with transfer of the latissimus or teres major for irreparable tears involving the supraspinatus and infraspinatus tendons.100 Comparative studies on the superiority of one surgical technique or option over another for surgical management of irreparable full thickness rotator cuff tears have not been reported. All studies reported intermediate term results 3-4 years after surgical treatment. Long term results were not reported. Complications reported after muscle transfer include temporary Complex Regional Pain Syndrome and cosmetic deformity of the biceps.

SUPPORTING EVIDENCE- OPERATIVE DEBRIDEMENT, LIMITED REPAIR, OR MUSCLE TRANSFER

Tables relevant to this recommendation are: Table 48 through Table 49
Figures relevant to this recommendation are: Figure 110 through Figure 115
Table 48 Results of operative debridement, limited repair, or muscle transfer

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Celli et al.</td>
<td></td>
<td>20</td>
<td>Muscle Transfer: Change from baseline</td>
<td>Pain: Constant-Murley Score</td>
<td></td>
</tr>
<tr>
<td>Burkhart</td>
<td>IV</td>
<td>25</td>
<td>Debridement: Excellent/Good vs. Fair/Poor Results</td>
<td>UCLA Grade</td>
<td>nr</td>
</tr>
<tr>
<td>Celli et al.</td>
<td></td>
<td>20</td>
<td>Muscle Transfer: Change from baseline</td>
<td>Constant-Murley Score</td>
<td></td>
</tr>
<tr>
<td>Guven et al.</td>
<td></td>
<td>14</td>
<td>Muscle Transfer: Change from baseline</td>
<td>Constant-Murley Score</td>
<td></td>
</tr>
<tr>
<td>Klinger et al. 107</td>
<td></td>
<td>33</td>
<td>Debridement: Change from baseline</td>
<td>Constant-Murley Score</td>
<td></td>
</tr>
<tr>
<td>Klinger et al. 108</td>
<td></td>
<td>41</td>
<td>Debridement: Change from baseline</td>
<td>Constant-Murley Score</td>
<td></td>
</tr>
<tr>
<td>Guven et al.</td>
<td></td>
<td>14</td>
<td>Muscle Transfer: Change from baseline</td>
<td>Complications</td>
<td>nr</td>
</tr>
</tbody>
</table>

● = statistically significant result

↑ = improvement

LoE = level of evidence

nr = authors examined this outcome but did not report if the results were statistically significant
PAIN: CONSTANT-MURLEY SCORE

In one Level IV study by Celli et al., twenty patients underwent muscle transfer of the teres major for treatment of irreparable rotator cuff tear. Shoulders were assessed using the Constant-Murley Score and the Constant-Murley Pain Score after 36 months (see Figure 110).

Figure 110 Pain as measured by Constant-Murley

![Graph showing pain scores preoperatively and postoperatively](image)

AAOS calculated independent t-test, $p < 0.0001$
**UCLA SHOULDER SCALE**

In one Level IV study by Burkhart, twenty-five patients underwent arthroscopic debridement and decompression for irreparable rotator cuff tears. Shoulders were assessed using the UCLA shoulder rating system at an average of 30 months after surgery (see Figure 111).

**Figure 111 UCLA shoulder rating**
**CONSTANT-MURLEY SCORE**

In one Level IV study by Celli et al., twenty patients underwent muscle transfer of the teres major for treatment of irreparable rotator cuff tear. Shoulders were assessed using the Constant-Murley Score and the Constant-Murley Pain Score after 36 months (see Figure 112).

**Figure 112 Constant-Murley Score**

![Figure 112 Constant-Murley Score](image)

AAOS calculated independent t-test, *p* < 0.0001

In one Level IV study by Guven et al., fourteen irreparable rotator cuff tears were reconstructed with the biceps tendon. Shoulders were assessed 40.7 months after surgery using the Constant-Murley Score (see Figure 113).

**Figure 113 Constant-Murley Score**

![Figure 113 Constant-Murley Score](image)

AAOS calculated independent t-test, *p* < 0.0001
In one Level IV study by Klinger et al., thirty-three patients with massive irreparable rotator cuff tears underwent arthroscopic debridement. Patients were followed for 31 months. Their shoulders were assessed using the Constant-Murley Score (see Figure 114).

**Figure 114 Constant-Murley Score**

![Figure 114 Constant-Murley Score](image)

AAOS calculated independent t-test, \( p < .0001 \)

In one Level IV study by Klinger et al., 41 patients with arthroscopic debridement with and without long head of the biceps (LHB) tenotomy were followed for 31 months. AAOS classified this study as level IV because we examined each treatment group independently (this recommendation compares arthroscopic debridement to other surgical treatments). Accordingly, we are analyzing these data as if they were derived from a case series. Patients were assessed using the Constant-Murley Score (see Figure 115).

**Figure 115 Constant-Murley Score**

![Figure 115 Constant-Murley Score](image)

AAOS calculated independent t-test, change from baseline; debridement with LHB tenotomy, \( p < .0001 \), debridement without LHB tenotomy, \( p < 0.001 \)
**COMPLICATIONS**

Complications were reported in one Level IV study by Guven et al., in patients with irreparable rotator cuff repairs reconstructed with the biceps tendon (see Table 48).

**Table 49 Complications**

<table>
<thead>
<tr>
<th>Complication</th>
<th>Percent of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary Complex Regional Pain Syndrome</td>
<td>7%</td>
</tr>
<tr>
<td>Cosmetic Deformity of Biceps</td>
<td>4%</td>
</tr>
</tbody>
</table>
RECOMMENDATION 10A: SURGERY - TENDON TO BONE HEALING

It is an option for surgeons to attempt to achieve tendon to bone healing of the cuff in all patients undergoing rotator cuff repair.

Level of Evidence: IV

Strength of Recommendation: Weak

Rationale:

While the primary clinical goal of rotator cuff repair surgery is improvement in pain, strength and function, a primary biological goal of the surgery is to achieve healing of the tendon to bone. Three Level IV\textsuperscript{77, 83, 104} studies addressed tendon to bone healing of the cuff in patients with full thickness rotator cuff tears. The first study\textsuperscript{77, 77, 83, 104} reported on MRI-confirmed status of the integrity of rotator cuff repairs in 63 subjects at two years from surgery. Patients with intact cuff repairs demonstrated improved outcomes over those found to have re-tears. The authors also reported a significant negative correlation with age but did not report magnitude of the correlation. Similarly, the second study\textsuperscript{104} reported superior outcomes, favoring intact cuffs over re-tears in a cohort of 49 subjects who underwent open repair with nonabsorbable suture at four year follow-up. In the last study, the rating of the tendon after repair was correlated with the UCLA score after surgery, but the authors did not report if the results were statistically significant for the outcome.

SUPPORTING EVIDENCE- TENDON TO BONE HEALING

Tables relevant to this recommendation are: Table 50 through Table 51
Figures relevant to this recommendation are: Figure 116 through Figure 119

Table 50 Results of studies addressing tendon to bone healing

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lichtenberg et al.</td>
<td>IV</td>
<td>53</td>
<td>Re-tear vs. intact group</td>
<td>Normalized Constant-Murley Score</td>
<td>26.4</td>
</tr>
<tr>
<td>Lichtenberg et al.</td>
<td>IV</td>
<td>53</td>
<td>Re-tear vs. intact group</td>
<td>Strength: Normalized Constant-Murley Score</td>
<td>48</td>
</tr>
<tr>
<td>Boehm et al.</td>
<td>IV</td>
<td>44</td>
<td>PDS: Re-tear vs. intact group</td>
<td>Normalized Constant-Murley Score</td>
<td></td>
</tr>
<tr>
<td>Boehm et al.</td>
<td>IV</td>
<td>49</td>
<td>Ethibond: Re-tear vs. intact group</td>
<td>Normalized Constant-Murley Score</td>
<td></td>
</tr>
<tr>
<td>Worland et al.</td>
<td></td>
<td>69</td>
<td>Tendon to bone repair: good vs. fair vs. poor</td>
<td>UCLA Score</td>
<td>nr</td>
</tr>
</tbody>
</table>

= no statistically significant results
= statistically significant results
i = favoring intact group
nr = authors examined this outcome but did not report if results were statistically significant
LoE = level of evidence
**CONSTANT-MURLEY SCORE**

In one Level IV study by Lichtenberg et al. fifty-three patients with full-thickness tears of the supraspinatus tendon were assessed 26.4 months after repair surgery. Examiners used a MRI to detect re-tear and compared the normalized Constant-Murley Score (see Figure 116) and the normalized Constant-Murley Strength Score (see Figure 117) with re-tear and intact tendons.

**Figure 116 Mean normalized Constant-Murley Score**

Authors reported a statistically significant difference between groups, Mann-Whitney test, $p = 0.0095$

**Figure 117 Mean normalized Constant-Murley strength score**

Authors reported a statistically significant difference between groups, Mann-Whitney test, $p = 0.0043$
In one Level IV study by Boehm et al., patients with full-thickness tears were treated using open, transosseous repair. Forty-nine patients were treated using No. 3 Ethibond while forty-four patients were treated using a 1.0 mm polydioxanone cord (PDS). AAOS classified this study as Level IV because each group of this study is examined independently (this recommendation pertains to muscle integrity). Accordingly, we are analyzing these data as if they were derived from a case series. Patients were assessed two years post-operatively using the normalized Constant-Murley Score (see Figure 118).

**Figure 118 Normalized Constant-Murley Score**

![Normalized Constant-Murley Score](image)

The number of patients in tear group and intact group was not reported by authors; Authors calculated Chi Squared difference between tear integrity within groups: PDS group, $p = 0.646$, Ethibond group, $p = 0.005$. 
**UCLA Score**

In one Level IV study by Worland et al. the rating of the tendon after repair was correlated with the UCLA score after surgery (see Figure 119). Tendons were rated as a good repair if a fluid-tight reconstruction was achieved or 100% of the tear was repaired. A fair bone-tendon repair was repaired between 50% and 99% of the tear size, and a poor repair was defined as less than 50% of the tendon could be repaired.

**Figure 119 Mean UCLA Score**

Authors reported no statistical analyses
**STRATIFICATIONS**

Lichtenberg et al. examined stratifications pertaining to age and tear size. The authors calculated correlations according to Pearson (see Table 50).

**Table 51 Stratifications pertaining to re-tear**

<table>
<thead>
<tr>
<th>Stratification</th>
<th>Linear Correlation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>nr</td>
<td>0.012</td>
</tr>
<tr>
<td>Tear size</td>
<td>0.0906</td>
<td>0.5187</td>
</tr>
</tbody>
</table>

nr = not reported by authors
RECOMMENDATION 10B: SURGERY - SUTURE ANCHORS AND BONE TUNNELS
We cannot recommend for or against the preferential use of suture anchors versus bone tunnels for repair of full thickness rotator cuff tears.

Level of Evidence: IV

Strength of Recommendation: Inconclusive

Rationale:
The primary technical goal of rotator cuff repair surgery is the stable fixation of the torn tendon to the tuberosity of the humerus. Numerous repair techniques have been described, the two most common of which rely upon the use of bone tunnels (trans-osseous technique) or suture anchors. We identified no studies that specifically compared suture anchor to bone tunnel fixation in rotator cuff repair surgery. Three studies\textsuperscript{105, 106, 107} address the use of suture anchors while one study\textsuperscript{83} addresses bone tunnel technique. Since no comparative studies were identified and since the four studies found were evaluated as weak evidence, we cannot recommend one fixation technique over another. Based on the available evidence, either fixation technique, when applied properly, can result in favorable outcomes.

SUPPORTING EVIDENCE- SUTURE ANCHORS AND BONE TUNNELS
Tables relevant to this recommendation are: Table 52 through Table 53
Figures relevant to this recommendation are: Figure 120 through Figure 125
Table 52 Results of tendon repair using bone tunnel (transosseous) or suture anchor techniques

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Final Visit*</th>
<th>Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charousset et al.</td>
<td>66</td>
<td>66</td>
<td>Suture Anchors: Change from baseline</td>
<td>Pain: Constant-Murley Score</td>
<td></td>
<td>22.5 28 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Activity: Constant-Murley Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anderson et al.</td>
<td>48</td>
<td>48</td>
<td>Suture Anchors: Change from baseline</td>
<td>L'Insinsatus Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Patient Reported Satisfaction</td>
<td>nr</td>
<td></td>
</tr>
<tr>
<td>Francheschi et al.</td>
<td>IV</td>
<td>52</td>
<td>Suture Anchors: Change from baseline</td>
<td>UCLA Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charousset et al.</td>
<td>66</td>
<td>66</td>
<td>Suture Anchors: Change from baseline</td>
<td>Constant-Murley Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Activity Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charousset et al.</td>
<td>66</td>
<td>66</td>
<td>Suture Anchors: Change from baseline</td>
<td>Mobility Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charousset et al.</td>
<td>66</td>
<td>66</td>
<td>Suture Anchors: Change from baseline</td>
<td>Constant-Murley Strength Score</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

● = statistically significant result  
↑ = improvement  

nr = authors examined this outcome but did not report if the results were statistically significant  
LoE = level of evidence  
* = final visit not defined by the authors
**PAIN: CONSTANT-MURLEY SCORE**

One Level IV study by Charousset et al. assessed shoulder pain using the Constant-Murley Score when either single or double row suture anchors were used (see Figure 120). This study was classified as Level IV because AAOS examined data in each treatment group independently (this recommendation compares suture anchors to transosseous repair). Accordingly, we are analyzing these data as if they were derived from a case series.

**Figure 120 Mean Constant-Murley Pain Score**

![Graph showing mean constant pain score](image)

AAOS calculated independent t-test, change from baseline in both groups, $p < 0.001$
**ACTIVITY: CONSTANT-MURLEY SCORE**

One Level IV study by Charousset et al. assessed patient activity using the Constant-Murley Score when either single or double row suture anchors were used (see Figure 121). This study was classified as Level IV because AAOS examined data in each treatment group independently (this recommendation compares suture anchors to transosseous repair). Accordingly, we are analyzing these data as if they were derived from a case series.

**Figure 121 Mean Constant-Murley Activity Score**

![Graph showing mean Constant-Murley Activity Score](image)

AAOS calculated independent t-test, change from baseline in both groups, \( p < 0.001 \)
**L’INSALATA SCORE**

In one Level IV study by Anderson et al. forty-eight patients with full thickness rotator cuff tears were treated with arthroscopic rotator cuff repair using medial and lateral row of suture anchors. Patients were assessed using the L’Insalata Score preoperatively and at 30 months postoperatively (see Figure 122).

**Figure 122 Mean L’Insalata Score**

![Figure 122 Mean L'Insalata Score](image)

AAOS calculated independent t-test, $p < 0.0001$
**SELF REPORTED RESULTS**

In a Level IV study by Boehm et al. ninety-eight patients reported their post-operative satisfaction after open, transosseous repair of a full-thickness tear (see Figure 123). Surgical repair was performed using either No. 3 Ethibond or a 1.0 mm polydioxanone cord (PDS). AAOS classified this study as Level IV because we examined each treatment group independently (this recommendation compares suture anchors to transosseous repair). Accordingly, we are analyzing these data as if they were derived from a case series. Post-operative satisfaction was measured on a scale from one to six with one being excellent and six being poor.

**Figure 123 Self Reported Results**

Authors report no statistical analyses
**UCLA SCORE**

One study by Franceschi et al. reported UCLA scores in patients with single row and double row suture anchors preoperatively and 2 years postoperatively (see Figure 124). AAOS classified this study as Level IV because we examined the data within two treatment groups independently (this recommendation compares suture anchors to transosseous repair). Accordingly, we are analyzing these data as if they were derived from a case series.

**Figure 124 Mean UCLA Score**

AAOS calculated independent t-test, change from baseline in Single Row and Double Row, $p < 0.001$. 
**CONSTANT-MURLEY SCORE**

One study by Charousset et al. assessed shoulders using the Constant-Murley Scores preoperatively and 6 months postoperatively (see Figure 125). This study was classified as Level IV because AAOS examined data in each treatment group independently (this recommendation compares suture anchors to transosseous repair). Accordingly, we are analyzing these data as if they were derived from a case series.

**Figure 125 Mean Constant-Murley Score**

AAOS calculated independent t-test, change from baseline in both groups, $p < 0.001$
STRATIFICATIONS

Boehm et al. utilized linear regression analysis in examining stratifications pertaining to: age, gender, hand dominance, and size of tear. Authors reported regression coefficients in terms of the Constant-Murley score (see Table 52).

Table 53 Stratifications pertaining to tendon-to-bone repair

<table>
<thead>
<tr>
<th>Stratification</th>
<th>β Coefficient</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.243</td>
<td>0.019</td>
</tr>
<tr>
<td>Gender</td>
<td>0.212</td>
<td>0.044</td>
</tr>
<tr>
<td>Hand dominance</td>
<td>-0.027</td>
<td>0.792</td>
</tr>
<tr>
<td>Size of tear</td>
<td>-0.131</td>
<td>0.212</td>
</tr>
</tbody>
</table>
RECOMMENDATION 10C: SURGERY - ARTHROSCOPIC, OPEN, MINI-OPEN
We cannot recommend for or against a specific technique (arthroscopic, mini-open or open repair) when surgery is indicated for full thickness rotator cuff tears.

Level of Evidence: III
Strength of Recommendation: Inconclusive

Rationale:
A recent trend in rotator cuff repair surgery has been an apparent evolution from open repair techniques to “mini-open” repairs and, most recently, to arthroscopic repairs. The systematic review found no single comparative study that included all three techniques. One Level II\(^{108}\) and two Level III\(^{109, 110}\) studies address arthroscopic versus open rotator cuff repair in patients with full thickness tears.

The first study\(^{108}\) compared open acromioplasty and rotator cuff repair to arthroscopic subacromial decompression with mini-open repair in a randomized trial with 73 patients. This study found early results favoring the mini-open technique up to one year after surgery (ASES, Rotator Cuff – Quality of Life Scale, and Shoulder Rating Questionnaire), but no statistically significant differences at 2-year follow-up. The second study\(^{109}\) reported no statistically significant differences at 49 month follow-up on results of a non-randomized comparison of open and arthroscopic repair techniques. Lastly, in a non-randomized but controlled study comparing arthroscopic to mini-open repairs, the third author\(^{110}\) reported no differences at 36 months in the ASES and UCLA scores. The lack of comparisons between all three techniques makes it difficult to determine if any one technique should be preferred over another. Additionally, the apparent disagreement between the results of the included studies makes it difficult to recommend for or against a specific technique.

SUPPORTING EVIDENCE- ARTHROSCOPIC, OPEN, AND MINI-OPEN
Tables relevant to this recommendation are: Table 54
Figures relevant to this recommendation are: Figure 126 through Figure 131
Table 54 Results of surgery performed open or arthroscopic

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>3 months</th>
<th>6 months</th>
<th>1 year</th>
<th>36.3 months</th>
<th>49 months</th>
<th>2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mohtadi et al.</td>
<td>II</td>
<td>73</td>
<td>Arthroscopic/Mini-Open* vs.</td>
<td>Rotator Cuff-Quality of Life</td>
<td>● a</td>
<td>● a</td>
<td>● a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Open repair</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Mohtadi et al.</td>
<td>II</td>
<td>73</td>
<td>Arthroscopic/Mini-Open* vs.</td>
<td>ASES</td>
<td>○ a</td>
<td>○ a</td>
<td>?</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td>Open repair</td>
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</tr>
<tr>
<td>Mohtadi et al.</td>
<td>II</td>
<td>73</td>
<td>Arthroscopic/Mini-Open* vs.</td>
<td>Shoulder Rating Questionnaire</td>
<td>○ a</td>
<td>○ a</td>
<td>● a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Open repair</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ide et al.</td>
<td>III</td>
<td>100</td>
<td>Open vs. Arthroscopic repair</td>
<td>UCLA Score</td>
<td>○ a</td>
<td>○ a</td>
<td>● a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Youm et al</td>
<td>III</td>
<td>84</td>
<td>Mini-Open vs. Arthroscopic</td>
<td>ASES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Repair</td>
<td></td>
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</tr>
<tr>
<td>Youm et al.</td>
<td>III</td>
<td>84</td>
<td>Mini-Open vs. Arthroscopic</td>
<td>UCLA Score</td>
<td></td>
<td></td>
<td></td>
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<td>Repair</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- LoE = level of evidence
- ● = statistically significant difference
- ○ = statistically and clinically significant
- ● = statistically significant and possibly clinically important
- ? = not sufficiently powered to detect the MCII; neither statistically or clinically significant
- a = favoring arthroscopic repair
- UCLA Score = American shoulder and elbow score
- ASES = American shoulder and elbow score
- * = arthroscopic acromioplasty and mini-open rotator cuff repair
**ROTATOR CUFF – QUALITY OF LIFE (RC-QOL)**

In one Level II study by Mohtadi et al. seventy three patients with full thickness rotator cuff tears were randomized to receive either open acromioplasty and rotator cuff repair or arthroscopic acromioplasty and mini-open rotator cuff repair. Shoulders were assessed using the Rotator Cuff-Quality of Life Scale at 3, 6, 12, and 24 months (see Figure 126).

**Figure 126 RC-QOL**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N. mean (SD);</th>
<th>Arthroscopic and MO-RCR</th>
<th>N. mean (SD);</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC-QOL</td>
<td>7.65 (6.31, 8.39)</td>
<td>21, 71.3 (1.94)</td>
<td>29, 56.6 (2.01)</td>
</tr>
<tr>
<td>6 Months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC-QOL</td>
<td>5.63 (4.64, 7.02)</td>
<td>21, 82.3 (1.41)</td>
<td>29, 72.4 (1.92)</td>
</tr>
<tr>
<td>1 Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC-QOL</td>
<td>2.17 (1.63, 2.82)</td>
<td>21, 86.6 (1.48)</td>
<td>29, 86 (1.7)</td>
</tr>
<tr>
<td>2 Years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC-QOL</td>
<td>0.17 (-0.33, 0.68)</td>
<td>21, 87.2 (1.81)</td>
<td>29, 86.9 (1.56)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size

**ASES**

In one Level II study by Mohtadi et al. seventy three patients with full thickness rotator cuff tears were randomized to receive either open acromioplasty and rotator cuff repair or arthroscopic acromioplasty and mini-open rotator cuff repair. Shoulders were assessed using the American Shoulder and Elbow and Society Scale at 3, 6, 12, and 24 months. Results at 3 and 6 months are statistically significant and clinically important and results at 1 and 2 years are neither statistically significant nor clinically important (see Figure 127).
Figure 127 ASES Scale

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Arthroscopic and MO-RCR</th>
<th>N, mean; Open and RCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASES</td>
<td>1.31 (0.65, 1.76)</td>
<td>31, 71.8 (8.47)</td>
<td>29, 61.6 (7.86)</td>
</tr>
<tr>
<td>6 Months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASES</td>
<td>1.34 (0.78, 1.91)</td>
<td>31, 80.7 (8.98)</td>
<td>29, 68.9 (8.3)</td>
</tr>
<tr>
<td>1 Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASES</td>
<td>0.10 (-0.41, 0.60)</td>
<td>31, 86.1 (9.38)</td>
<td>29, 85.2 (9.23)</td>
</tr>
<tr>
<td>2 Years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASES</td>
<td>0.25 (-0.26, 0.76)</td>
<td>31, 88.9 (9.48)</td>
<td>29, 87.5 (9.35)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size; Dashed line indicates MCII for ASES Score; this study was not sufficiently powered to detect the MCII at 1 and 2 years.
In one Level III study by Youm et al., eighty-four patients with full thickness rotator cuff tears received either all arthroscopic repairs or a mini-open repair. Shoulders were assessed using the American Shoulder and Elbow Society Scale 36.3 months postoperatively (see Figure 128). Results are neither statistically significant nor clinically important.

**Figure 128 ASES Scale**

AAOS calculated effect size; Dashed line indicates MCII for ASES Score; this study was not sufficiently powered to detect the MCII.
**SHOULDER RATING QUESTIONNAIRE (SRQ)**

In one Level II study by Mohtadi et al. seventy three patients with full thickness rotator cuff tears were randomized to receive either open acromioplasty and rotator cuff repair or arthroscopic acromioplasty and mini-open rotator cuff repair. Shoulders were assessed using the Shoulder Rating Questionnaire at 3, 6, 12, and 24 months. Results at 3 and 6 months are clinically important, results at 1 and 2 years are possibly important (see Figure 129).

**Figure 129 SRQ**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SRQ</th>
<th>N, mean (SD)</th>
<th>N, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Months</td>
<td>3.38 (2.58, 4.19)</td>
<td>31, 89.6 (1.88)</td>
<td>29, 83.3 (1.7)</td>
</tr>
<tr>
<td>6 Months</td>
<td>3.77 (2.01, 4.69)</td>
<td>31, 79.6 (1.6)</td>
<td>29, 73.6 (1.65)</td>
</tr>
<tr>
<td>1 Year</td>
<td>1.16 (0.61, 1.72)</td>
<td>31, 82.2 (1.41)</td>
<td>29, 83.6 (1.44)</td>
</tr>
<tr>
<td>2 Years</td>
<td>0.52 (0.01, 1.04)</td>
<td>31, 88.0 (1.64)</td>
<td>29, 88.1 (1.67)</td>
</tr>
</tbody>
</table>
**UCLA SCORE**

In one Level III study by Ide et al., one hundred patients with full thickness rotator cuff tears received either an open rotator cuff repair or arthroscopic rotator cuff repair. Shoulders were assessed using the UCLA scoring system 49 months postoperatively (see Figure 130).

**Figure 130 UCLA Score in patients with open or arthroscopic repair**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCLA</td>
<td>0.23 (-0.16, 0.63)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
In one Level III study by Youm et al., eighty-four patients with full thickness rotator cuff tears received either an all arthroscopic repair or a mini-open repair. Shoulders were assessed using the UCLA Scale 36.3 months postoperatively (see Figure 131).

**Figure 131 UCLA Score**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Arthroscopic</th>
<th>N, mean (SD); Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCLA</td>
<td>0.23 (-0.16, 0.63)</td>
<td>50, 32 (1.87)</td>
<td>50, 31.6 (1.5)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size; SMD = Standardized mean difference
RECOMMENDATION 11A: SURGERY - NON-CROSSLINKED, PORCINE SMALL INTESTINE SUBMUCOSAL XENOGRAFTS
We suggest surgeons not use a non-cross linked, porcine small intestine submucosal xenograft patch to treat patients with rotator cuff tears.

Level of Evidence: III

Strength of Recommendation: Moderate

Rationale:
One level II study\textsuperscript{111} and one level III\textsuperscript{112} study evaluated the results of open repair of medium to massive rotator cuff tears with and without the use of a non cross linked, porcine small intestine submucosal xenograft as augmentation to the primary tendon to bone repair. In these studies, there was less favorable outcome (pain and function) with the use of this graft when compared to primary repair alone. The complication rate of hypersensitivity reaction was approximately 20-30% of cases with the use of this graft.\textsuperscript{114} Based on these results, the work group suggests that non-cross linked, porcine small intestine submucosal xenograft patches not be used to treat patients with rotator cuff tears.

SUPPORTING EVIDENCE- NON-CROSSLINKED PORCINE SMALL INTESTINE SUBMUCOSAL XENOGRAFTS
Tables relevant to this recommendation are: Table 55
Figures relevant to this recommendation are: Figure 132 through Figure 138

Table 55 Summary of results for porcine SIS ortho-biological patch use

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>14 Months</th>
<th>3 Months</th>
<th>2 Years</th>
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</thead>
<tbody>
<tr>
<td>Iannotti et al.</td>
<td>II</td>
<td>30</td>
<td>Xenograft vs. Control</td>
<td>UPenn Score</td>
<td>?</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Upenn Function</td>
<td>●,c</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>UPenn Pain</td>
<td>○</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Upenn Satisfaction</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Healed Rotator Cuff Tear</td>
<td>○</td>
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<td></td>
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<tr>
<td>Walton et al.</td>
<td>III</td>
<td>31</td>
<td>Xenograft vs. Control</td>
<td>Pain: During Activity</td>
<td></td>
<td>●,c</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Patient Satisfaction</td>
<td></td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>

○ = no statistically significant difference
● = statistically significant results
? = not sufficiently powered to detect the MCII; neither statistically or clinically significant
●,c = favoring control group
LoE = level of evidence
**UPENN SCORE**
In one Level II study by Iannotti et al., fifteen patients who received a xenograft and fifteen controls were assessed with the UPenn shoulder-specific questionnaire fourteen months postoperatively.

**Figure 132 UPenn Score**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N, mean</th>
<th>SMD (95% CI)</th>
<th>(SD); Xenograft</th>
<th>(SD); Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upenn Score</td>
<td></td>
<td>-0.10 (-0.80, 0.59)</td>
<td>16, 82 (70)</td>
<td>16, 90 (81)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**UPENN FUNCTION SUBSCALE**

In one Level II study by Iannotti et al.,\textsuperscript{113} fifteen patients who received a xenograft and fifteen controls were assessed with the UPenn shoulder-specific questionnaire fourteen months postoperatively. Function subscale results are reported in Figure 133.

**Figure 133 Median UPenn Function Score**

![Median UPenn Function Score](image)

Authors reported a statistically significant difference between groups, Fisher exact test, \( p = 0.03 \)
**UPENN PAIN SUBSCALE**

In one Level II study by Iannotti et al., fifteen patients who received a xenograft and fifteen controls were assessed with the UPenn shoulder-specific questionnaire fourteen months postoperatively. Pain subscale results are reported in Figure 134.

**Figure 134 Median UPenn Pain Score**

![Bar chart showing median UPenn Pain Score for Control and Xenograft groups.](chart)

Authors reported no statistically significant difference between groups, Fisher exact test, p=.18
UPENN SATISFACTION SUBSCALE

In one Level II study by Iannotti et al., fifteen patients who received a xenograft and fifteen controls were assessed with the UPenn shoulder-specific questionnaire fourteen months postoperatively. Pain subscale results are reported in Figure 135

Figure 135 Median UPenn Satisfaction Score

Authors reported no statistically significant difference between groups, Fisher exact test, $p = 0.09$
**PERCENT OF PATIENTS WITH HEALED ROTATOR CUFF**

In one Level II study by Iannotti et al., fifteen patients who received a xenograft and fifteen controls were assessed using a magnetic resonance imaging scan with intra-articular gadolinium. The status of the rotator cuff was recorded as healed, partially healed, or not healed (see Figure 136).

**Figure 136 Percent of patients with a healed rotator cuff**

Authors reported no statistically significant difference between groups, Fisher exact test, $p = 0.11$
**PAIN: DURING ACTIVITY**

In one Level III study by Walton et al., pain during activity was assessed using a modified L’Insalata Questionnaire in fifteen patients who received a xenograft and sixteen controls (see Figure 137).

**Figure 137 Pain during activity as measured by modified L’Insalata questionnaire**

AAOS calculated effect size
**PATIENT SATISFACTION**

One Level II study by Walton et al. reported patient satisfaction at two years in fifteen xenograft treated patients and sixteen controls (see Figure 138).

**Figure 138 Patient Satisfaction**

Authors reported Mann-Whitney rank sum test, $p = 0.43$
RECOMMENDATION 11B: SURGERY - ALLOGRAFTS AND XENOGRAFTS
We cannot recommend for or against the use of soft tissue allografts or other xenografts to treat patients with rotator cuff tears.

Level of Evidence: IV

Strength of Recommendation: Inconclusive

Rationale:

The work group recognizes that different graft materials and different methods of graft processing have different biologic and mechanical properties which may result in differences in clinical effectiveness or complications between graft materials. Two level IV studies\(^\text{113, 114}\), one addressing the use of xenograft and one addressing the use of allografts, were included. In both cases the graft was used to close an irreparable rotator cuff defect. These studies had small treatment groups (n=10 and n=16 respectively) and were of low quality. Based on the evidence, the work group had insufficient data to make specific recommendations for or against the use of other xenografts or allografts to treat reparable or irreparable full thickness rotator cuff tears.

SUPPORTING EVIDENCE- ALLOGRAFTS AND XENOGRAFTS
Tables relevant to this recommendation are: Table 56
Figures relevant to this recommendation are: Figure 139 through Figure 144

Table 56 Results of patients treated with xenografts or allografts

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badhe et al.</td>
<td>IV</td>
<td>10</td>
<td>Xenograft change from baseline</td>
<td>Pain: Constant Murley Score</td>
<td>26.7 Months ▲</td>
</tr>
<tr>
<td>Badhe et al.</td>
<td>IV</td>
<td>10</td>
<td>Xenograft change from baseline</td>
<td>Activities of Daily Living:</td>
<td>3-5 Years ○</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Constant Murley Score</td>
<td></td>
</tr>
<tr>
<td>Badhe et al.</td>
<td>IV</td>
<td>10</td>
<td>Xenograft change from baseline</td>
<td>Constant Murley Score</td>
<td>▲</td>
</tr>
<tr>
<td>Bond et al.</td>
<td>IV</td>
<td>16</td>
<td>Allograft: Change from baseline</td>
<td>Pain: UCLA Score</td>
<td>▲</td>
</tr>
<tr>
<td>Bond et al.</td>
<td>IV</td>
<td>16</td>
<td>Allograft: Change from baseline</td>
<td>Constant Murley Score</td>
<td>▲</td>
</tr>
</tbody>
</table>

\(\text{LoE} = \text{level of evidence}\)
**PAIN: CONSTANT-MURLEY SCORE**

In one Level IV study by Badhe et al. ten patients were treated for an extensive rotator cuff tear using a dermal xenograft. Pain was assessed preoperatively and between 3-5 years postoperatively using the Constant-Murley Score (see Figure 139).

**Figure 139 Pain as measured by Constant-Murley Score**

Authors reported change from baseline, $p = 0.0003$
**ACTIVITIES OF DAILY LIVING: CONSTANT-MURLEY SCORE**

In one Level IV study by Badhe et al. ten patients were treated for an extensive rotator cuff tear using a dermal xenograft. Activities of daily living were assessed preoperatively and between 3-5 years postoperatively using the Constant-Murley Score (see Figure 140).

**Figure 140 Activities of daily living as measured by Constant-Murley Score**

Authors reported change from baseline, \( p = 0.3 \)
**CONSTANT-MURLEY SCORE**

In one Level IV study by Badhe et al. ten patients were treated for an extensive rotator cuff tear using a dermal xenograft. Shoulders were assessed preoperatively and between 3-5 years postoperatively using the Constant-Murley Score (see Figure 141).

**Figure 141 Mean Constant-Murley Score**

Author reported change from baseline, \( p = 0.0004 \)
**PAIN: UCLA SCORE**

In one level IV study by Bond et al. sixteen patients with massive rotator cuff tears, defined as tears ≥ 5cm or involving 2 tendons, were treated with arthroscopic allograft procedures. Shoulders were assessed preoperatively and at 26.7 months (range, 12 to 38 months) using the UCLA pain score (see Figure 142).

**Figure 142 Mean Pain measured by UCLA**

Author reported change from baseline, $p < 0.0001$
**UCLA SCORE**

In one level IV study by Bond et al. sixteen patients with massive rotator cuff tears, defined as tears $\geq 5$cm or involving 2 tendons, were treated with arthroscopic allograft procedures. Shoulders were assessed preoperatively and at 26.7 months (range, 12 to 38 months) using the UCLA score (see Figure 143).

**Figure 143 Mean UCLA Score**

Author reported change from baseline, $p < 0.001$
CONSTANT-MURLEY SCORE

In one level IV study by Bond et al. sixteen patients with massive rotator cuff tears, as defined as tears $\geq 5$cm or involve 2 tendons, were treated with arthroscopic allograft procedures. Shoulders were assessed preoperatively and at 26.7 months (range, 12 to 38 months) using the Constant-Murley score (see Figure 144).

Figure 144 Constant-Murley Score

Author reported change from baseline, $p < 0.001$
RECOMMENDATION 12: POST-OPERATIVE - COLD THERAPY
In the absence of reliable evidence, it is the opinion of the work group that local cold therapy is beneficial to relieve pain after rotator cuff surgery.

Level of Evidence: None

Strength of Recommendation: Consensus

Rationale:

One of the primary objectives of patient care is the alleviation of pain and suffering. Pain has been coined one of the ‘vital signs’ of patient management. It is therefore reasonable to encourage pain control methods, especially when there is broad experience with their application in general clinical practice across multiple specialties.

Cold therapy has been utilized in the postoperative setting for a variety of orthopaedic procedures, including shoulder surgery, to aide in pain control and possibly to decrease tissue swelling. Based on these observations, there may be beneficial effects of cold therapy after shoulder surgery; however, there is no compelling or strong, quality evidence that pertains specifically to rotator cuff repair. Studies evaluating the effect of cold therapy are limited by a lack of standardized methodology and by variability in the methods of cold application.

Based upon the expert opinion of the work group, local cold therapy is a reasonable treatment for pain control after rotator cuff surgery. Surgeons should be aware of the possibilities of local tissue injury and generalized hypothermia related to excessive cold application, although these complications are quite rare.

We found no quality studies to help decipher any potential clinical differences between intermittent crushed ice, continuous cold therapy, and other forms of cryotherapy after rotator cuff surgery.
RECOMMENDATION 13A: POST-OPERATIVE - SLING, SHOULDER IMMOBILIZER, ABDUCTION PILLOW, OR ABDUCTION BRACE
We cannot recommend for or against the preferential use of an abduction pillow versus a standard sling after rotator cuff repair.

Level of Evidence: Insufficient

Strength of Recommendation: Inconclusive

Rationale:

After a systematic search, no clinical data was found supporting or refuting a negative or positive effect of a sling, shoulder immobilizer, abduction pillow, and/or abduction brace after repair of a full thickness rotator cuff tear on tendon healing or outcomes after rotator cuff repair. Therefore, the work group could not recommend for or against their use in the post-operative period.
RECOMMENDATION 13B: POST-OPERATIVE REHABILITATION - RANGE OF MOTION EXERCISES
We cannot recommend for or against a specific time frame of shoulder immobilization without range of motion exercises after rotator cuff repair.

Level of Evidence: Insufficient

Strength of Recommendation: Inconclusive

Rationale:
After a systematic search, no clinical data was found supporting or refuting a negative or positive effect of range of motion exercises (passive, active or active assisted) for post-operative rehabilitation after repair of a full thickness rotator cuff tear on tendon healing or outcomes after rotator cuff repair. Therefore, the work group could not recommend for or against the timing of range of motion exercises in the post-operative period.
RECOMMENDATION 13C: POST-OPERATIVE REHABILITATION
- ACTIVE RESISTANCE EXERCISES

We cannot recommend for or against a specific time interval prior to initiation of active resistance exercises after rotator cuff repair.

Level: Insufficient

Strength: Inconclusive

Rationale:

After a systematic search, no clinical data was found supporting or refuting a negative or positive effect of active resistance exercises for post-operative rehabilitation after repair of a full thickness rotator cuff tear on tendon healing or outcomes after rotator cuff repair. Therefore, the work group could not recommend for or against the timing of active resistance exercises in the post-operative period.
RECOMMENDATION 13D: POST-OPERATIVE REHABILITATION - HOME BASED EXERCISE AND FACILITY BASED REHABILITATION

We cannot recommend for or against home-based exercise programs versus facility-based rehabilitation after rotator cuff surgery.

Level of Evidence: II

Strength of Recommendation: Inconclusive

Rationale:

Our systematic search of the literature yielded two quality studies115, 116 providing data comparing the efficacy of a home based exercise program to referral to a facility based rehabilitation program following rotator cuff repair. Both studies reported large loss to follow-up at longer durations (24 and 52 weeks) and found conflicting results among the outcomes reported at shorter durations (6 and 12 weeks). Further, patient compliance was not measured in both studies. Based on the conflicting results and varied outcomes reported, the work group could not recommend for or against a specific post-operative rehabilitation protocol.

SUPPORTING EVIDENCE- SUPERVISED PHYSICAL THERAPY

Tables relevant to this recommendation are: Table 57 through Table 58
Figures relevant to this recommendation are: Figure 145 through Figure 151
Table 57 Results of home-based or supervised physical therapy

<table>
<thead>
<tr>
<th>Authors</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Duration</th>
<th>6 weeks</th>
<th>12 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roddey et al.</td>
<td></td>
<td>128</td>
<td>Video vs. Supervised PT</td>
<td>SPADI</td>
<td></td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Roddey et al.</td>
<td></td>
<td>128</td>
<td>Video vs. Supervised PT</td>
<td>UPENN</td>
<td></td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Hayes et al.</td>
<td>II</td>
<td>58</td>
<td>PT vs. Home Exercise</td>
<td>Physical Symptoms</td>
<td></td>
<td></td>
<td>●pt</td>
</tr>
<tr>
<td>Hayes et al.</td>
<td></td>
<td>58</td>
<td>PT vs. Home Exercise</td>
<td>Work Subscale</td>
<td></td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Hayes et al.</td>
<td></td>
<td>58</td>
<td>PT vs. Home Exercise</td>
<td>Lifestyle</td>
<td>○</td>
<td>●h</td>
<td></td>
</tr>
<tr>
<td>Hayes et al.</td>
<td></td>
<td>58</td>
<td>PT vs. Home Exercise</td>
<td>Overall Shoulder Status</td>
<td></td>
<td></td>
<td>●h</td>
</tr>
<tr>
<td>Roddey et al.</td>
<td></td>
<td>128</td>
<td>Video vs. Supervised PT</td>
<td>Patient Compliance</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

○ = no statistically significant difference
● = statistically significant difference
? = neither statistically or clinically significant
pt = favoring physical therapy treatment
h = favoring home exercise treatment
LoE = level of evidence
PT = physical therapy
**SPADI**

In one Level II study by Roddey et al. one hundred and twenty-eight patients were randomized to receive either exercise instruction via a videotape or 4 separate one-on-one instruction sessions with a physical therapist. Shoulders were assessed using the SPADI scale at 12, 24, and 52 weeks post surgery. However, data for weeks 24 and 52 follow-up is not reported due to an attrition rate greater than 20% (see Figure 145).

**Figure 145 SPADI**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N. mean</th>
<th>N. mean (SD);</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMD (95% CI)</td>
<td>(SD); PT</td>
</tr>
<tr>
<td>12 week</td>
<td>SPADI</td>
<td>-0.27 (-0.67, 0.12)</td>
</tr>
</tbody>
</table>

Favors Home Exercise  Favors PT

AAOS calculated effect size
**UPENN**

In one Level II study by Roddey et al. one hundred and twenty-eight patients were randomized to receive either exercise instruction via a videotape or 4 separate one-on-one instruction sessions with a physical therapist. Shoulders were assessed using the UPenn scale at 12, 24, and 52 weeks post surgery. Data for weeks 24 and 52 follow-up is not reported due to attrition rate. Results at 12 weeks were inconclusive (see Figure 146).

**Figure 146 UPenn**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N, mean</th>
<th>N, mean (SD);</th>
<th>SMD (95% CI)</th>
<th>(SD); PT</th>
<th>Home Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 week</td>
<td></td>
<td></td>
<td>0.24 (-0.16, 0.63)</td>
<td>53, 66.2 (17.5)</td>
<td>48, 62 (17.7)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size; Dashed line indicates MCII for the UPenn Scale; this study was sufficiently powered to detect the MCII therefore, its’ results are inconclusive.
**MODIFIED L'INSALATA QUESTIONNAIRE**

In one Level II study by Hayes et al., fifty-eight subjects were randomized after surgery to receive either individualized physiotherapy or standardized home exercise. The physiotherapy group received sixteen treatments (plus or minus 11) over seventeen weeks (plus or minus 9). The authors did not attempt however, to monitor compliance of the home exercise group. Shoulders were assessed by physical symptoms, work, lifestyle, and overall shoulder status at baseline, 6 weeks, 12 weeks, and 24 weeks. Because loss to follow-up is greater than 20%, only the following outcomes and durations are reported: physical symptom, 12 weeks; work, 12 weeks; lifestyle, 6 and 12 weeks; and overall shoulder status, 12 weeks (see Figure 147 to Figure 150).

**Figure 147 Physical Symptoms**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Duration</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD); Favors Home Exercise, N, mean (SD); PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Symptoms</td>
<td>12 weeks</td>
<td>1.92 (1.24, 2.59)</td>
<td>26, 35 (2)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**Figure 148 Work Status**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean</th>
<th>N, mean (SD);</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 weeks Work</td>
<td>-0.45 (-1.02, 0.12)</td>
<td>23, 47 (2.23)</td>
<td>26, 48 (2.12)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size

**Figure 149 Lifestyle Subscale**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean</th>
<th>N, mean (SD);</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 weeks Lifestyle</td>
<td>-0.43 (-1.00, 0.14)</td>
<td>20, 55 (2.3)</td>
<td>30, 56 (2.3)</td>
</tr>
<tr>
<td>12 weeks Lifestyle</td>
<td>-0.90 (-1.48, -0.32)</td>
<td>23, 39 (2)</td>
<td>28, 41 (2.34)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
### Figure 150 Overall Shoulder Status

<table>
<thead>
<tr>
<th>Outcome</th>
<th>SMD (95% CI)</th>
<th>N, mean (SD)</th>
<th>Favoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Shoulder Status</td>
<td>-2.71 (-3.49, -1.92)</td>
<td>23, 24 (2.12)</td>
<td>Home Exercise</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
**PATIENT COMPLIANCE**

One Level II study by Roddey et al. assessed patient compliance level for those receiving either video physiotherapy or one-on-one instruction (see Figure 151). Three *a priori* compliance levels were determined (see Table 57).

### Table 58 Compliance levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Compliant</td>
<td>Subject returned all 4 logs and reported completing exercises &gt;70% of the time.</td>
</tr>
<tr>
<td>Partially Compliant</td>
<td>Subject returned 3-4 logs and reported completing exercises 50%-69% of the time.</td>
</tr>
<tr>
<td>Noncompliant</td>
<td>Subject either returned less than 3 logs or reported completing the exercises less than 50% of the time.</td>
</tr>
</tbody>
</table>

### Figure 151 Patient Compliance

Author reported between-group ANOVA, *p* = 0.18
RECOMMENDATION 14: POST-OPERATIVE - INFUSION CATHETERS
We cannot recommend for or against the use of an indwelling subacromial infusion catheter for pain management after rotator cuff repair.

Level of Evidence: Insufficient

Strength of Recommendation: Inconclusive

Rationale:
Post-operative pain control is an important objective for improving the patient’s overall surgical experience. For this recommendation, we only considered studies of indwelling infusion catheters for the management of pain after rotator cuff repair. We did not consider evidence related to possible benefits of infusion catheters after shoulder procedures without rotator cuff repair.

One Level II study\(^{117}\) compared intravenous injection of fentanyl and ketorolac tromethamine with subacromial infusion of bupivacaine up to 120 hours after rotator cuff repair. There was no statistically significant difference in pain measured by visual analog score between the two groups. Impact on long term clinical outcome was not measured. The authors did not compare these treatments against a clinically-relevant control group (for example oral analgesic medications only). It is not possible to extrapolate the findings of this study to typical clinical situations, since intravenous fentanyl and ketorolac are not routinely used in general orthopaedic practice. Therefore, we can not provide specific recommendations about the use of subacromial indwelling infusion catheters, particularly in the setting of outpatient rotator cuff repair. The work group did not consider risks or benefits of infusion catheter utilization in other clinical conditions.

SUPPORTING EVIDENCE- PAIN CATHETER USE
Tables relevant to this recommendation are: Table 59
Figures relevant to this recommendation are: Figure 152 through Figure 153
Table 59 Results of pain catheter use

<table>
<thead>
<tr>
<th>Author</th>
<th>LoE</th>
<th>n</th>
<th>Comparison</th>
<th>Outcome</th>
<th>Duration (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cho et al.</td>
<td>II</td>
<td>40</td>
<td>Intravenous injection vs. Subacromial infusion</td>
<td>Pain: At Rest</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain: During Motion</td>
<td>0</td>
</tr>
</tbody>
</table>

○ = no statistically significant difference
LoE = level of evidence
**PAIN: AT REST**

In one Level II study by Cho et al. forty patients with full thickness rotator cuff tears were randomized to receive either a subacromial infusion with bupivacaine or intravenous injection with fentanyl and ketorolac tromethamin. Pain at rest was evaluated every 12 hours after surgery for 120 hours (see Figure 152).

**Figure 152 Pain at rest as measured by VAS**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Duration</th>
<th>SMD (95% CI)</th>
<th>(SD); Infusion</th>
<th>N, mean</th>
<th>(SD); Intravenous</th>
<th>N, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vas Pain at Rest</td>
<td>0 hours postop</td>
<td>0.04 (-0.58, 0.66)</td>
<td>20, 7.6 (4.49)</td>
<td>20, 7.4 (4.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>-0.14 (-0.76, 0.48)</td>
<td>20, 5.8 (3.63)</td>
<td>20, 6.4 (4.49)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>-0.14 (-0.76, 0.48)</td>
<td>20, 4.9 (2.78)</td>
<td>20, 5.5 (5.13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>-0.05 (-0.67, 0.57)</td>
<td>20, 4.9 (3.63)</td>
<td>20, 5.1 (4.91)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>-0.17 (-0.80, 0.45)</td>
<td>20, 4.4 (2.99)</td>
<td>20, 5.1 (4.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>-0.05 (-0.67, 0.57)</td>
<td>20, 4.5 (3.42)</td>
<td>20, 4.7 (4.27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>-0.05 (-0.67, 0.57)</td>
<td>20, 4.5 (3.42)</td>
<td>20, 4.7 (4.27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>84</td>
<td>-0.09 (-0.71, 0.53)</td>
<td>20, 4.2 (3.63)</td>
<td>20, 4.5 (3.63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>-0.03 (-0.65, 0.59)</td>
<td>20, 3.8 (3.42)</td>
<td>20, 3.9 (3.63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>108</td>
<td>0.03 (-0.59, 0.65)</td>
<td>20, 3.2 (2.78)</td>
<td>20, 3.1 (3.42)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>120</td>
<td>0.03 (-0.59, 0.65)</td>
<td>20, 2.6 (3.63)</td>
<td>20, 2.5 (2.14)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AAOS calculated effect size
PAIN: DURING MOTION

In one Level II study by Cho et al. forty patients with full thickness rotator cuff tears were randomized to receive either a subacromial infusion with bupivacaine or intravenous injection with fentanyl and ketorolac tromethamin. Pain during motion was evaluated every 12 hours after surgery for 120 hours (see Figure 153).

Figure 153 Pain during motion as measured by VAS

<table>
<thead>
<tr>
<th>Duration</th>
<th>Infusion SMD (95% CI)</th>
<th>Intravenous SMD (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 hours postop</td>
<td>0.04 (-0.58, 0.66)</td>
<td>0.04 (-0.58, 0.66)</td>
</tr>
<tr>
<td>12</td>
<td>-0.16 (-0.78, 0.46)</td>
<td>-0.16 (-0.78, 0.46)</td>
</tr>
<tr>
<td>24</td>
<td>-0.02 (-0.64, 0.60)</td>
<td>-0.02 (-0.64, 0.60)</td>
</tr>
<tr>
<td>36</td>
<td>-0.03 (-0.65, 0.59)</td>
<td>-0.03 (-0.65, 0.59)</td>
</tr>
<tr>
<td>48</td>
<td>-0.12 (-0.74, 0.50)</td>
<td>-0.12 (-0.74, 0.50)</td>
</tr>
<tr>
<td>60</td>
<td>-0.10 (-0.72, 0.52)</td>
<td>-0.10 (-0.72, 0.52)</td>
</tr>
<tr>
<td>72</td>
<td>-0.18 (-0.80, 0.44)</td>
<td>-0.18 (-0.80, 0.44)</td>
</tr>
<tr>
<td>84</td>
<td>0.13 (-0.49, 0.75)</td>
<td>0.13 (-0.49, 0.75)</td>
</tr>
<tr>
<td>96</td>
<td>0.03 (-0.59, 0.65)</td>
<td>0.03 (-0.59, 0.65)</td>
</tr>
<tr>
<td>108</td>
<td>0.11 (-0.51, 0.73)</td>
<td>0.11 (-0.51, 0.73)</td>
</tr>
<tr>
<td>120</td>
<td>0.03 (-0.59, 0.65)</td>
<td>0.03 (-0.59, 0.65)</td>
</tr>
</tbody>
</table>

AAOS calculated effect size
FUTURE RESEARCH

The process for development of this guideline included preliminary “framing” of the clinically-important questions by a team of knowledgeable and experienced shoulder surgeons. Following a comprehensive search of the English literature, seventy-four studies were of sufficient evidence-based quality to be utilized in the current guidelines. The high number of studies that did not meet inclusion criteria suggests considerable future opportunities for research with higher levels of evidence. That was not to say that our present level of scientific and clinical literature was without value - quite the contrary. Many of the non-included articles were both important and clinically-relevant, but fell below the quality criteria for evidence-based guidelines. This huge mass of non-included published information, combined with clinical experience and basic science knowledge, formed the basis for guidelines arrived by expert consensus; however, clinical and surgical tradition are clearly not the ideal methods for defining treatment guidelines. Therefore, one of the most important consequences of developing this guideline is better appreciation and understanding for areas that should be rigorously investigated in the future to establish evidence-based clinical treatment algorithms (see below).

We recognize the many logistical, financial, and ethical challenges imposed when conducting high quality, prospective, randomized clinical research. We believe that some of these studies must be strategically encouraged by carefully-allocated research funding and programmatic support. In addition, while our evidence-based guidelines were based upon clinical research only, we understand that basic research will also play a fundamental role in the clinical development of rotator cuff treatment.

Recommended Focus Areas:

- The basic biology for mechanisms of rotator cuff tendon degeneration, tendon healing, and muscle-tendon disease after tear.

- Epidemiology and demographics of natural history of tendinosis, partial thickness cuff tears, asymptomatic full thickness cuff tears, and symptomatic rotator cuff tears.

- Development of non-invasive methods (i.e., advanced imaging modalities, biomarkers) for assessment of disease state, healing, and treatment impact.

- Rigorous correlation of these non-invasive methods with validated clinical outcome variables to create objective “surrogate” outcome variables for prospective clinical research.

- Effects of timing of intervention, particularly timing of surgery, upon disease progression and clinical outcome.

- Impact of surgical approach (open, mini-open, arthroscopic), rehab methods and fixation methods upon rates of rotator cuff healing.
• Studies investigating the impact of lack of healing on long-term clinical outcome.

• Clinical efficacy and cost-benefit of office-based physical therapy versus home exercise programs for non-surgical and post-surgical management of rotator cuff disease.

• Operative indications and intervention strategies for massive rotator cuff tears with advanced muscle disease.

• Intervention strategies to halt or reverse muscle atrophy or fatty degeneration.

• Impact of NSAIDs and corticosteroid injections upon rotator cuff tendon – bone healing and clinical outcome.

• Impact of healing augmentation strategies (i.e., platelet rich plasma, growth factors, structural patches, matrix delivery) on rotator cuff healing and clinical outcome.
IV. APPENDIXES
APPENDIX I:
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Patrick Sluka MPH, Research Analyst

Kristin Hitchcock MLS, Medical Librarian
APPENDIX II
AAOS BODIES THAT APPROVED THIS CLINICAL PRACTICE GUIDELINE

Guidelines and Technology Oversight Committee
The AAOS Guidelines and Technology Oversight Committee (GTOC) consists of sixteen AAOS members. The overall purpose of this Committee is to oversee the development of the clinical practice guidelines, performance measures, health technology assessments and utilization guidelines.

Evidence Based Practice Committee
The AAOS Evidence Based Practice Committee (EBPC) consists of ten AAOS members. This Committee provides review, planning and oversight for all activities related to quality improvement in orthopaedic practice, including, but not limited to evidence-based guidelines, performance measures, and outcomes.

Council on Research, Quality Assessment, and Technology
To enhance the mission of the AAOS, the Council on Research, Quality Assessment, and Technology promotes the most ethically and scientifically sound basic, clinical, and translational research possible to ensure the future care for patients with musculoskeletal disorders. The Council also serves as the primary resource to educate its members, the public, and public policy makers regarding evidenced-based medical practice, orthopaedic devices and biologics regulatory pathways and standards development, patient safety, occupational health, technology assessment, and other related areas of importance.

The Council is comprised of the chairs of the AAOS Biological Implants, Biomedical Engineering, Evidence Based Practice, Guidelines and Technology Oversight, Occupational Health and Workers’ Compensation, Patient Safety, Research Development, and US Bone and Joint Decade committees. Also on the Council are the AAOS second vice-president, representatives of the Diversity Advisory Board, the Women's Health Issues Advisory Board, the Women's Health Issues Advisory Board, the Board of Specialty Societies (BOS), the Board of Councilors (BOC), the Communications Cabinet, the Orthopaedic Research Society (ORS), the Orthopedic Research and Education Foundation (OREF), and three members at large.

Board of Directors
The 17 member AAOS Board of Directors manages the affairs of the AAOS, sets policy, and determines and continually reassesses the Strategic Plan.
DOCUMENTATION OF APPROVAL

AAOS Work Group Draft Completed      May 20, 2010

REVIEW PROCESS

 Peer Review Completed                 June 30, 2010
Public Commentary Completed           September 30, 2010

APPROVAL PROCESS

AAOS Guidelines and Technology Oversight Committee  November 18, 2010
AAOS Evidence Based Practice Committee        November 18, 2010
AAOS Council on Research Quality Assessment   November 19, 2010
                                      and Technology
AAOS Board of Directors                  December 04, 2010
APPENDIX III
LITERATURE SEARCHES

The search for eligible literature began with a search of the following databases on October 6, 2008:

- PubMed (from 1966 through October 1, 2008)
- EMBASE (from 1966 through October 1, 2008)
- CINAHL (from 1982 through October 1, 2008)
- The Cochrane Central Register of Controlled Trials (through October 1, 2008)

This initial search (after removal of duplicates) yielded 5644 articles, of which 388 were retrieved and evaluated. The full search strategies are listed below.

All literature searches were supplemented with manual screening of bibliographies in publications accepted for inclusion into the evidence base. In addition, the bibliographies of recent systematic reviews and other review articles were searched for potentially relevant citations.

SEARCH STRATEGIES

The search for relevant studies using PubMed included the follow search strategy:

rotator cuff OR shoulder impingement OR supraspinatus tendonitis OR subacromial bursitis OR glenohumeral instability OR cuff tear OR cuff tears OR supraspinatus atrophy OR subacromial atrophy OR ((infraspinatus OR supraspinatus OR subscapularis OR teres minor) AND (tear or impingement OR augmentation)) NOT "comment"[Publication Type] NOT "editorial"[Publication Type] NOT "letter"[Publication Type] NOT "Addresses"[Publication Type] NOT "News"[Publication Type] NOT "Newspaper Article"[Publication Type] NOT "Case Reports"[Publication Type] AND (("1"[PDat]:"2008/10/01"[PDat]) AND (Humans[Mesh]) AND (English[lang]))

The search for relevant studies using EMBASE included the follow search strategy:

'rotator cuff' OR 'shoulder impingement' OR 'supraspinatus tendonitis' OR 'subacromial bursitis' OR 'glenohumeral instability' OR 'cuff tear' OR 'cuff tears' OR 'supraspinatus atrophy' OR 'subacromial atrophy' OR ((infraspinatus OR supraspinatus OR subscapularis OR teres minor) AND (tear OR impingement OR augmentation)) AND ((article]/lim OR [conference paper]/lim OR [review]/lim) AND [english]/lim AND [humans]/lim AND [embase]/lim NOT [10-01-2008]/sd
The search for relevant studies using CINAHL included the following search strategy:

'rotator cuff' OR 'shoulder impingement' OR 'supraspinatus tendonitis' OR 'subacromial bursitis' OR 'glenohumeral instability' OR 'cuff tear' OR 'cuff tears' OR 'supraspinatus atrophy' OR 'subacromial atrophy' OR ((infraspinatus OR supraspinatus OR subscapularis OR teres AND minor) AND (tear OR impingement OR augmentation)), limited to ENGLISH.

The search for relevant studies in the Cochrane Central Register of Controlled Trials included the following search strategy:

'rotator cuff' OR 'shoulder impingement' OR 'supraspinatus tendonitis' OR 'subacromial bursitis' OR 'glenohumeral instability' OR 'cuff tear' OR 'cuff tears' OR 'supraspinatus atrophy' OR 'subacromial atrophy' OR ((infraspinatus OR supraspinatus OR subscapularis OR teres AND minor) AND (tear OR impingement OR augmentation))
APPENDIX IV
STUDY ATTRITION FLOWCHARTS

5664 citations identified by literature searches

5276 citations not retrieved

388 articles retrieved for full-text review

116 articles did not meet inclusion criteria

272 articles considered for guideline recommendations

197 articles excluded (see individual guideline recommendation inclusion/exclusion list)

75 articles included (see individual guideline recommendation inclusion/exclusion list)
# APPENDIX V

## LEVEL OF EVIDENCE

Levels of Evidence For Primary Research Question

<table>
<thead>
<tr>
<th>Types of Studies</th>
<th>Therapeutic Studies — Investigating the results of treatment</th>
<th>Prognostic Studies — Investigating the effect of a patient characteristic on the outcome of disease</th>
<th>Diagnostic Studies — Investigating a diagnostic test</th>
<th>Economic and Decision Analyses — Developing an economic or decision model</th>
</tr>
</thead>
</table>
| Level I          | • High quality randomized trial with statistically significant difference or no statistically significant difference but narrow confidence intervals  
• Systematic Review of Level I RCTs (and study results were homogenous)  
  | • High quality prospective study (all patients were enrolled at the same point in their disease with ≥ 80% follow-up of enrolled patients)  
• Systematic review of Level I studies  
  | • Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference “gold” standard)  
• Systematic review of Level I studies  
  | • Sensible costs and alternatives; values obtained from many studies; with multiway sensitivity analyses  
• Systematic review of Level I studies  
  |
| Level II         | • Lesser quality RCT (e.g. < 80% follow-up, no blinding, or improper randomization)  
• Prospective comparative study  
• Systematic review of Level II studies or Level I studies with inconsistent results  
  | • Retrospective study  
• Untreated controls from an RCT  
• Lesser quality prospective study (e.g. patients enrolled at different points in their disease or <80% follow-up.)  
• Systematic review of Level II studies  
  | • Development of diagnostic criteria on consecutive patients (with universally applied reference “gold” standard)  
• Systematic review of Level II studies  
  | • Sensible costs and alternatives; values obtained from limited studies; with multiway sensitivity analyses  
• Systematic review of Level II studies  
  |
| Level III        | • Case control study  
• Retrospective comparative study  
• Systematic review of Level III studies  
  | • Case control study  
  | • Study of non-consecutive patients; without consistently applied reference “gold” standard  
• Systematic review of Level III studies  
  | • Analyses based on limited alternatives and costs; and poor estimates  
• Systematic review of Level III studies  
  |
| Level IV         | Case Series  
  | Case series  
• Case-control study  
• Poor reference standard  
  | • Analyses with no sensitivity analyses  
  |
| Level V          | Expert Opinion  
  | Expert Opinion  
  | Expert Opinion  
  | Expert Opinion  

1. A complete assessment of quality of individual studies requires critical appraisal of all aspects of the study design.
2. A combination of results from two or more prior studies.
3. Studies provided consistent results.
4. Study was started before the first patient enrolled.
5. Patients treated one way (e.g. cemented hip arthroplasty) compared with a group of patients treated in another way (e.g. uncemented hip arthroplasty) at the same institution.
6. The study was started after the first patient enrolled.
7. Patients identified for the study based on their outcome, called “cases”; e.g. failed total arthroplasty, are compared to those who did not have outcome, called “controls”; e.g. successful total hip arthroplasty.
8. Patients treated one way with no comparison group of patients treated in another way.
APPENDIX VI
DATA EXTRACTION ELEMENTS

The data elements below were extracted into electronic forms in Microsoft® Access. The extracted information includes:

Study Characteristics (for all relevant outcomes in a study)
• methods of randomization and allocation
• use of blinding (patient, caregiver, evaluator)
• funding source/conflict of interest
• intention to treat analysis
• duration of the study
• number of subjects and follow-up percentage
• experimental and control groups
• a priori power analysis
• patient inclusion/exclusion criteria

Results (for all relevant outcomes in a study)
• outcome measure (including adverse events)
• is the outcome measure patient-oriented? validated? objective/subjective?
• duration at which outcome measure was evaluated
• statistic reported (for dichotomous results)
• mean value and measure and value of dispersion (continuous results)
• statistical test used, value of test statistic, and p-value
• verification of calculations
APPENDIX VII
FORM FOR ASSIGNING GRADE OF RECOMMENDATION (INTERVENTIONS)

GUIDELINE RECOMMENDATION__________________________________________

PRELIMINARY GRADE OF RECOMMENDATION:______________________________________

STEP 1: LIST BENEFITS AND HARMS

Please list the benefits (as demonstrated by the systematic review) of the intervention

Please list the harms (as demonstrated by the systematic review) of the intervention

Please list the benefits for which the systematic review is not definitive

Please list the harms for which the systematic review is not definitive

STEP 2: IDENTIFY CRITICAL OUTCOMES

Please circle the above outcomes that are critical for determining whether the intervention is beneficial and whether it is harmful

Are data about critical outcomes lacking to such a degree that you would lower the preliminary grade of the recommendation?

What is the resulting grade of recommendation?

STEP 3: EVALUATE APPLICABILITY OF THE EVIDENCE

Is the applicability of the evidence for any of the critical outcomes so low that substantially worse results are likely to be obtained in actual clinical practice?

Please list the critical outcomes backed by evidence of doubtful applicability:

Should the grade of recommendation be lowered because of low applicability?

What is the resulting grade of recommendation?

STEP 4: BALANCE BENEFITS AND HARMS

Are there trade-offs between benefits and harms that alter the grade of recommendation obtained in STEP 3?

What is the resulting grade of recommendation?
STEP 5  CONSIDER STRENGTH OF EVIDENCE

Does the strength of the existing evidence alter the grade of recommendation obtained in STEP 4?

What is the resulting grade of recommendation?

NOTE: Because we are not performing a formal cost analyses, you should only consider costs if their impact is substantial.
APPENDIX VIII
VOTING BY THE NOMINAL GROUP TECHNIQUE

Voting on guideline recommendations and performance measures will be conducted using a modification of the nominal group technique (NGT), a method previously used in guideline development.42 Briefly each member of the guideline work group ranks his or her agreement with a guideline recommendation or performance measure on a scale ranging from 1 to 9 (where 1 is “extremely inappropriate” and 9 is “extremely appropriate”). Consensus is obtained if the number of individuals who do not rate a measure as 7, 8, or 9 is statistically non-significant (as determined using the binomial distribution). Because the number of work group members who are allowed to dissent with the recommendation depends on statistical significance, the number of permissible dissenters varies with the size of the work group. The number of permissible dissenters for several work group sizes is given in the table below:

<table>
<thead>
<tr>
<th>work group Size</th>
<th>Number of Permissible Dissenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤3</td>
<td>Not allowed. Statistical significance cannot be obtained</td>
</tr>
<tr>
<td>4-5</td>
<td>0</td>
</tr>
<tr>
<td>6-8</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1 or 2</td>
</tr>
</tbody>
</table>

The NGT is conducted by first having members vote on a given recommendation/performance measure without discussion. If the number of dissenters is “permissible”, the recommendation/measure is adopted without further discussion. If the number of dissenters is not permissible, there is further discussion to see whether the disagreement(s) can be resolved. Three rounds of voting are held to attempt to resolve disagreements. If disagreements are not resolved after three voting rounds, no recommendation/measure is adopted.

OPINION-BASED RECOMMENDATIONS

A guideline can contain recommendations that are backed by little or no data. Under such circumstances, work groups often issue opinion-based recommendations. Although doing so is sometimes acceptable in an evidence-based guideline (expert opinion is a form of evidence), it is also important to avoid constructing a guideline that liberally uses expert opinion; research shows that expert opinion is often incorrect.
Opinion-based recommendations are developed only if they address a vitally important aspect of patient care. For example, constructing an opinion-based recommendation in favor of taking a history and physical is warranted. Constructing an opinion-based recommendation in favor of a specific modification of a surgical technique is seldom warranted. To ensure that an opinion-based recommendation is absolutely necessary, the AAOS has adopted rules to guide the content of the rationales that underpin such recommendations. These rules are based on those outlined by the US Preventive Services Task Force (USPSTF). Specifically, rationales based on expert opinion must:

- Not contain references to or citations from articles not included in the systematic review that underpins the recommendation.
- Not contain the AAOS guideline language “We Recommend”, “We suggest” or “treatment x is an option”.
- Contain an explanation of the potential preventable burden of disease. This involves considering both the incidence and/or prevalence of the disease, disorder, or condition and considering the associated burden of suffering. To paraphrase the USPSTF, when evidence is insufficient, provision of a treatment (or diagnostic) for a serious condition might be viewed more favorably than provision of a treatment (or diagnostic) for a condition that does not cause as much suffering. The AAOS (like the USPSTF) understand that evaluating the “burden of suffering” is subjective and involves judgment. This evaluation should be informed by patient values and concerns. The considerations outlined in this bullet make it difficult to recommend new technologies. It is not appropriate for a guideline to recommend widespread use of a technology backed by little data and for which there is limited experience. Such technologies are addressed in the AAOS’ Technology Overviews.
- Address potential harms. In general, “When the evidence is insufficient, an intervention with a large potential for harm (such as major surgery) might be viewed less favorably than an intervention with a small potential for harm (such as advice to watch less television).”
- Address apparent discrepancies in the logic of different recommendations. Accordingly, if there are no relevant data for several recommendations and the work group chooses to issue an opinion-based recommendation in some cases but chooses not to make a recommendation in other cases, the rationales for the opinion-based recommendations must explain why this difference exists. Information garnered from the previous bullet points will be helpful in this regard.
- Consider current practice. The USPSTF specifically states that clinicians justifiably fear that not doing something that is done on a widespread basis will lead to litigation. The consequences of not providing a service that is neither widely available nor widely used are less serious than the
consequences of not providing a treatment accepted by the medical profession and thus expected by patients. Discussions of available treatments and procedures rely on mutual communication between the patient’s guardian and physician, and on weighing the potential risks and benefits for a given patient. The patient’s “expectation of treatment” must be tempered by the treating physician’s guidance about the reasonable outcomes that the patient can expect.

- Justify, why a more costly device, drug, or procedure is being recommended over a less costly one whenever such an opinion-based recommendation is made.

Work group members write the rationales for opinion based recommendations on the first day of the final work group meeting. When the work group re-convenes on the second day of its meeting, it will vote on the rationales. The typical voting rules will apply. If the work group cannot adopt a rationale after three votes, the rationale and the opinion-based recommendation will be withdrawn, and a “recommendation” stating that the group can neither recommend for or against the recommendation in question will appear in the guideline.

Discussions of opinion-based rationales may cause some members to change their minds about whether to issue an opinion-based recommendation. Accordingly, at any time during the discussion of the rationale for an opinion-based recommendation, any member of the work group can make a motion to withdraw that recommendation and have the guideline state that the work group can neither recommend for or against the recommendation in question.

**CHECKLIST FOR VOTING ON OPINION-BASED RECOMMENDATIONS**

When voting on the rationale, please consider the following:

1. Does the recommendation affect a substantial number of patients or address treatment (or diagnosis) of a condition that causes death and/or considerable suffering?

2. Does the recommendation address the potential harms that will be incurred if it is implemented and, if these harms are serious, does the recommendation justify;
   a. why the potential benefits outweigh the potential harms and/or
   b. why an alternative course of treatment (or diagnostic workup) that involves less serious or fewer harms is not being recommended?

3. Does the rationale explain why the work group chose to make a recommendation in the face of minimal evidence while, in other instances, it chose to make no recommendation in the face of a similar amount of evidence?
4. Does the rationale explain that the recommendation is consistent with current practice?

5. If relevant, does the rationale justify why a more costly device, drug, or procedure is being recommended over a less costly one?
APPENDIX IX
STRUCTURED PEER REVIEW FORM

ALL REVIEW COMMENTS, OUR RESPONSES AND REVIEWER COI WILL BE AVAILABLE FOR REVIEW ON OUR WEBSITE FOLLOWING BOD APPROVAL OF THIS DOCUMENT.

Review of any AAOS confidential draft allows us to improve the overall guideline but does not imply endorsement by any given individual or any specialty society who participates in our review processes. The AAOS review process may result in changes to the documents; therefore, endorsement cannot be solicited until the AAOS Board of Directors officially approves the final guideline.

Please note that if you return a review:
Your review will be published on the AAOS website with our explanation of why we did nor did not change the draft document in response to your comments.
Your conflicts of interest will be published on the AAOS website with your review.

Reviewer Information:
Name of Reviewer_________________________________________
Address_________________________________________________
City________________________ State_________________ Zip Code___________
Phone ___________________________Fax ___________________E-mail_______________________
Specialty Area/Discipline: _______________________________________
Work setting: _______________________Credentials: ______________________

May we list you as a Peer Reviewer in the final Guidelines (GL)?

☐ Yes  ☐ No

PLEASE READ: If you do not wish to be listed, your name will be removed for identification purposes.
However, your review comments, our responses and your COI will still be available for public review on our website with the posted Guideline if you complete this review.

Are you reviewing this guideline as a representative of a professional society?

☐ Yes  ☐ No

If yes, may we list your society as a reviewer of this guideline?

☐ Yes  ☐ No

Society Name: ___________________________________________
(Listing the specialty society as a reviewing society does not imply or otherwise indicate endorsement of this guideline.)

Conflicts of Interest (COI): All Reviewers must declare their conflicts of interest.
If the boxes below are not checked and/or the reviewer does not attach his/her conflicts of interest, the reviewer’s comments will not be addressed by the AAOS nor will the reviewer’s name or society be listed as a reviewer of this GL. If a committee reviews the guideline, only the chairperson/or lead of the review must declare their relevant COI.

☐ I have declared my conflicts of interest on page 2 of this form.

☐ I have declared my conflicts of interest in the AAOS database; my customer # is __________

☐ I understand that the AAOS will post my declared conflicts of interest with my comments concerning review of this guideline or technology overview on the AAOS website.
**REVIEWER CONFLICT OF INTEREST - The Orthopaedic Disclosure Program**

Each item below requires an answer. Please report information for the last 12-months as required by the Accreditation Council for Continuing Medical Education (ACCME) guidelines.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
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<tbody>
<tr>
<td>Do you or a member of your immediate family receive royalties for any pharmaceutical, biomaterial or orthopaedic product or device?</td>
<td></td>
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<tr>
<td>If YES, please identify product or device:</td>
<td></td>
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<tr>
<td>Within the past twelve months, have you or a member of your immediate family served on the speakers bureau or have you been paid an honorarium to present by any pharmaceutical, biomaterial or orthopaedic product or device company?</td>
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<tr>
<td>If YES, please identify company:</td>
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<tr>
<td>Are you or a member of your immediate family a PAID EMPLOYEE for any pharmaceutical, biomaterial or orthopaedic device or equipment company, or supplier?</td>
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<tr>
<td>If YES, please identify company or supplier:</td>
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<tr>
<td>Are you or a member of your immediate family a PAID CONSULTANT for any pharmaceutical, biomaterial or orthopaedic device or equipment company, or supplier?</td>
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<tr>
<td>If YES, please identify company or supplier:</td>
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<tr>
<td>Are you or a member of your immediate family an UNPAID CONSULTANT for any pharmaceutical, biomaterial or orthopaedic device or equipment company, or supplier?</td>
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<tr>
<td>If YES, please identify company or supplier:</td>
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</table>
American Academy of Orthopaedic Surgeons  
[Optimizing the Treatment of Rotator Cuff Problems]  
Guidelines Peer Review Form

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you or a member of your immediate family own stock or stock options in any pharmaceutical, biomaterial or orthopaedic device or equipment company, or supplier (excluding mutual funds)</td>
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<tr>
<td>If YES, please identify company or supplier:</td>
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<tr>
<td>Do you or a member of your immediate family receive research or institutional support as a principal investigator from any pharmaceutical, biomaterial or orthopaedic device or equipment company, or supplier?</td>
<td>☐ Yes ☐ No</td>
<td></td>
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<tr>
<td>If YES, please identify company or supplier:</td>
<td></td>
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<tr>
<td>Do you or a member of your immediate family receive any other financial or material support from any pharmaceutical, biomaterial or orthopaedic device and equipment company or supplier?</td>
<td>☐ Yes ☐ No</td>
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<tr>
<td>If YES, please identify company or supplier:</td>
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<tr>
<td>Do you or a member of your immediate family receive any royalties, financial or material support from any medical and/or orthopaedic publishers?</td>
<td>☐ Yes ☐ No</td>
<td></td>
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<tr>
<td>If YES, please identify publisher:</td>
<td></td>
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<tr>
<td>Do you or a member of your immediate family serve on the editorial or governing board of any medical and/or orthopaedic publication?</td>
<td>☐ Yes ☐ No</td>
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<tr>
<td>If YES, please identify:</td>
<td></td>
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<tr>
<td>Do you or a member of your immediate family serve on the Board of Directors or a committee of any medical and/or orthopaedic professional society?</td>
<td>☐ Yes ☐ No</td>
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<tr>
<td>If YES, please identify:</td>
<td></td>
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</table>
Reviewer Instructions
Please read and review this Draft Clinical Practice Guideline and its associated Technical Report with particular focus on your area of expertise. Your responses are confidential and will be used only to assess the validity, clarity and accuracy of the interpretation of the evidence. If applicable, please specify the draft page and line numbers in your comments. Please feel free to also comment on the overall structure and content of the guideline and Technical Report. If you need more space than is provided, please attach additional pages.

Please complete and return this form electronically in WORD format to wies@aaos.org; please contact Jan Wies at (847) 384-4311 if you have any questions. Thank you in advance for your time in completing this form and giving us your feedback. We value your input and greatly appreciate your efforts. Please send the completed form and comments in WORD format by end of day June 30, 2010.

Please indicate your level of agreement with each of the following statements by placing an “X” in the appropriate box.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Somewhat Disagree</th>
<th>Somewhat Disagree</th>
<th>Agree</th>
<th>Agree</th>
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<tbody>
<tr>
<td>1. The recommendations are clearly stated</td>
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<tr>
<td>2. There is an explicit link between the recommendations and the supporting evidence</td>
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<td>3. Given the nature of the topic and the data, all clinically important outcomes are considered</td>
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<tr>
<td>4. The guideline’s target audience is clearly described</td>
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<td>5. The patients to whom this guideline is meant to apply are specifically described</td>
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<td>6. The criteria used to select articles for inclusion are appropriate</td>
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<td>7. The reasons why some studies were excluded are clearly described</td>
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<td>8. All important studies that met the article inclusion criteria are included</td>
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<td>9. The validity of the studies is appropriately appraised</td>
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<td>10. The methods are described in such a way as to be reproducible.</td>
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<td>11. The statistical methods are appropriate to the material and the</td>
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<tr>
<td>objectives of this guideline</td>
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<tr>
<td>12. Important parameters (e.g., setting, study population, study design) that could affect study results are systematically addressed</td>
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<td>13. Health benefits, side effects, and risks are adequately addressed</td>
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<td>14. The writing style is appropriate for health care professionals.</td>
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<tr>
<td>15. The grades assigned to each recommendation are appropriate</td>
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</table>
COMMENTS

Please provide a brief explanation of both your positive and negative answers in the preceding section. If applicable, please specify the draft page and line numbers in your comments. Please feel free to also comment on the overall structure and content of the guideline and Technical Report.

OVERALL ASSESSMENT

Would you recommend these guidelines for use in practice? (check one)

☐ Strongly recommend

☐ Recommend (with provisions or alterations)

☐ Would not recommend

☐ Unsure
PEER REVIEW

Participation in the AAOS peer review process does not constitute an endorsement of this guideline by the participating organization.

The following three organizations participated in peer review of this clinical practice guideline and gave their explicit consent to have their names listed in this document:

American Society for Surgery of the Hand (ASSH)
American Society of Shoulder and Elbow Therapists (ASSET)
American Physical Therapy Association (APTA)

Individuals who participated in the peer review of this document and gave their consent to be listed as reviewers in this document are:

John P. Basti, PT
James Breivis, MD
Juan J. Canoso, MD, FACP MACR
James L. Carey, MD
Blair C. Filler, MD
Michael H. Heggeness, MD
Harvey Insler, MD
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A period of public commentary follows the peer review of the draft guideline. If significant non-editorial changes are made to the document as a result of public commentary, these changes are also documented and forwarded to the AAOS bodies that approve the final guideline.

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APPENDIX X
CONFLICT OF INTEREST
All members of the AAOS work group disclosed any conflicts of interest prior to the
development of the recommendations for this guideline. Conflicts of interest are
disclosed in writing with the American Academy of Orthopaedic Surgeons via a private
on-line reporting database and also verbally at the recommendation approval meeting.
For blinding purposes, work group members are identified by number only.

Christopher S Ahmad, MD 
3B (Acumed, LLC; Arthrex, Inc); 5 (Stryker); 6 (Zimmer);
Submitted on: 09/29/2010. *

Robert T Burks, MD 
1 (Arthrex, Inc); 2 (Arthrex, Inc); 3B (Arthrex, Inc); 9
(Arthroscopy Association of North America); Submitted on: 10/06/2010. *

Evan L Flatow, MD 
1 (Zimmer); 2 (Zimmer); 3C (Zimmer); 5 (Wyeth); 7 (Wolters
Kluwer Health - Lippincott Williams & Wilkins); 9 (American Shoulder and Elbow
Surgeons; Arthroscopy Association of North America); Submitted on: 04/25/2010 and
last confirmed as accurate on 09/24/2010. *

Andrew Green, MD 
1 (Tornier); 2 (DJ Orthopaedics); 3B (IlluminOss; Tornier); 4
(IlluminOss Medical; Pfizer); 5 (Arthrex, Inc; Smith & Nephew; Wyeth); 7 (Elsevier); 8
(Journal of Bone and Joint Surgery - American; Journal of Orthopaedics and
Traumatology); 9 (AAOS); Submitted on: 10/06/2010. *

Joseph P Iannotti, MD, PhD 
1 (DePuy, A Johnson & Johnson Company); 3B (DePuy,
A Johnson & Johnson Company; Tornier; Wyeth); 7 (Wolters Kluwer Health - Lippincott
Williams & Wilkins); 8 (Journal of Shoulder and Elbow Surgery); Submitted on:
10/05/2010. *

Bruce S Miller, MD 
8 (American Journal of Sports Medicine; Journal of Knee Surgery);
9 (American Orthopaedic Society for Sports Medicine); Submitted on: 09/13/2010 and
last confirmed as accurate on 10/14/2010. *

Robert A Pedowitz, MD 
7 (Springer; Wolters Kluwer Health - Lippincott Williams &
Wilkins); 8 (Arthroscopy); 9 (AAOS; American Orthopaedic Society for Sports
Medicine; Arthroscopy Association of North America); Submitted on: 09/15/2010. *

Robert Tashjian, MD (Salt Lake City, UT): (n). Submitted on: 02/19/2008.

William Charles Watters III, MD 
3B (Stryker); 4 (Intrinsic Orthopedics); 8 (Official
Disability Guidelines; Spine; The Spine Journal); 9 (American Board of Spine Surgery;
North American Spine Society); Submitted on: 05/26/2010 and last confirmed as accurate
on 09/14/2010. *

Ken Yamaguchi, MD 
8 (AAOS Now; Journal of Bone and Joint Surgery - American);
Submitted on: 04/30/2010 and last confirmed as accurate on 10/15/2010. *
* Disclosure Items Answered: (n) = Respondent answered 'No' to all items indicating no conflicts. 1= Royalties from a company or supplier; 2= Speakers bureau/paid presentations for a company or supplier; 3A= Paid employee for a company or supplier; 3B= Paid consultant for a company or supplier; 3C= Unpaid consultant for a company or supplier; 4= Stock or stock options in a company or supplier; 5= Research support from a company or supplier as a PI; 6= Other financial or material support from a company or supplier; 7= Royalties, financial or material support from publishers; 8= Medical/Orthopaedic publications editorial/governing board; 9= Board member/committee appointments for a society.

Disclosure Items: (n) = Respondent answered 'No' to all items indicating no conflicts. 1=Board member/owner/officer/committee appointments; 2= Medical/Orthopaedic Publications; 3= Royalties; 4= Speakers bureau/paid presentations; 5A= Paid consultant; 5B= Unpaid consultant; 6= Research or institutional support from a publisher; 7= Research or institutional support from a company or supplier; 8= Stock or Stock Options; 9= Other financial/material support from a publisher; 10= Other financial/material support from a company or supplier.
APPENDIX XI
REFERENCES

* For a list of included articles applicable to each recommendation, please consult the accompanying evidence tables.

Reference List


Ref Type: Online Source


Ref Type: Generic


(61) Adebajo AO, Nash P, Hazleman BL. A prospective double blind dummy placebo controlled study comparing triamcinolone hexacetonide injection with oral
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EXCLUDED ARTICLES


Haahr JP, Andersen JH. Exercises may be as efficient as subacromial decompression in patients with subacromial stage II impingement: 4-8-years' follow-up in a prospective, randomized study. Scand J Rheumatol 2006 May;35(3):224-8.


Rapp SM. Avoiding NSAID use may aid healing of rotator cuff tears. Orthopedics Today 2005 September;25(9):56.


