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The Efficacy of Physical Therapy Intervention versus Corticosteroid Injection for Management of Subacromial Impingement Syndrome

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Table of Contents

ABSTRACT

Background and Purpose: Subacromial impingement syndrome (SIS) is one of the most frequently reported causes of shoulder pain, and projects to become more prevalent as the population ages. Corticosteroid injections are a first-line treatment for SIS, however, the efficacy of corticosteroid use is controversial, and may not be superior to physical therapy treatment for long-term outcomes. This study compares the short-term and long-term outcomes of physical therapy and corticosteroid injections in the management of SIS, and aims to identify an optimal treatment strategy.

Case Description: A 55 year-old female presents to outpatient physical therapy for chronic right shoulder pain. The patient demonstrates positive results of the Neer impingement test, Hawkins impingement test, and the painful arc sign, as well as pain with shoulder elevation, weakness, difficulty sleeping on the right side, and tenderness to palpation. Following examination and conclusion of signs and symptoms, the patient was diagnosed with subacromial impingement syndrome. The patient was re-evaluated following 8 weeks of conservative treatment in physical therapy involving postural interventions, strengthening, stretching, and scapular and glenohumeral stabilization. The patient had clear preference for physical therapy over corticosteroid injections due to the invasiveness of the procedure. The patient did not report complete resolution of her symptoms, but improved significantly in her functional mobility and pain, and reported willingness to return to prior activities.

Outcomes: Nine articles were identified through literature searches and critically analyzed and evaluated. The literature supports a multitude of manual therapy and exercise-based treatments

for the effective management of SIS in long-term outcomes, and also supports some short-term use of corticosteroid injections.

Discussion: High quality research involving the use of physical therapy and corticosteroid injections for the management of subacromial impingement syndrome is lacking. Examination of short-term and long-term outcomes of each treatment needs further critical analyses, especially in the development of specific protocols. The long-term use of corticosteroid injections may be harmful, and alternative treatments, such as physical therapy, should be considered first when providing holistic care for chronic conditions such as SIS. Based on the review of the research, it can be inferred that physical therapy is a more safe and effective treatment for long-term recovery and management of SIS, and rotator cuff eccentrics, scapular stabilization, and shoulder girdle stretching show to be the most effective physical therapy treatments overall.

Section 1: Background and Purpose of PICO Question

Musculoskeletal disorders and pain of the shoulder are very common, with as many as 30.3% of adults complaining of shoulder pain each year (Abdulla, 2015). The most frequent cause of these reports is Subacromial Impingement Syndrome (SIS), accounting for 44-65% of all shoulder pain complaints (Aytar, 2015). Subacromial Impingement Syndrome is a painful condition resulting from decreased joint space and entrapment of the anatomical structures between the anteroinferior corner of the acromion and the greater tuberosity of the humerus (Santamato, 2009), which can be caused by inflammation of the subacromial bursa, rotator cuff tendons, and the long head of the biceps tendon (Akgun, 2004). There is a wide range in factors that can contribute to the inflammation involved in SIS, including anatomical abnormalities of the coracoacromial arch or humeral head, tension overload ischemia, repetitive eccentric overload, aberrant kinematic patterns due to poor rotator cuff or scapular muscle function, and poor posture and scapular kinematic abnormalities (Moezy, 2014).

A study published in the *World Journal of Orthopedics* concluded that there are four independent risk factors associated with subacromial impingement syndrome, including smoking, sleeping position, acromion shape, and occupation. (Tangtrakulwanich, 2012). Patients who smoked had 7x the risk for developing shoulder impingement than nonsmokers, which could be the result of impaired vasculature and healing time caused by nicotine consumption. Sleeping in the lateral decubitus position showed a 3.7x higher risk of developing SIS than sleeping in the supine position, and has been hypothesized that this is because the decubitus sleeping position is similar to the Hawkins provocation test which can aggravate the impingement process. The anatomical shape of the acromion can significantly impact the risk of

developing subacromial impingement syndrome, with a hooked (type III) acromion increasing risk 6.3x that of those with a flat acromion (type I), and a curved acromion (type II) somewhat increasing the risk as well (Tangtrakulwanich, 2012). Occupation, sports, and daily activities can also increase risk of developing SIS, especially activities that require repetitive, overhead motions that may be awkward, forceful, or leading to poor posture (Gebremariam, 2014).

Subacromial Impingement Syndrome can be classified in two different ways: in 3 stages, or as primary and secondary impingements. Stage I impingement is more acute, and is characterized by edema and hemorrhage of the subacromial bursa and rotator cuff, and is typically found in patients under 25 years old. Stage II represents irreversible changes, including fibrosis or tendinopathy of the rotator cuff and is typically found in patients 25-40 years old. Stage III is characteristic of more chronic changes, including complete or partial rotator cuff tears, and is usually seen in patients over 40 years old (Santamato, 2009). In the other classification system, primary impingement is generally due to more intrinsic factors, including rotator cuff weakness, chronic inflammation of the rotator cuff tendons and/or subacromial bursa, rotator cuff degeneration and tendinopathy, and posterior capsule tightness that can lead to abnormal anterosuperior translation of the humeral head. Primary impingement can also be due to extrinsic factors, including a curved or hooked acromion, acromial spurs, or postural dysfunction. Secondary shoulder impingement is defined as a relative decrease in the subacromial space due to glenohumeral joint instability or abnormal scapulothoracic kinematics (Aytar, 2015).

Patients with subacromial impingement syndrome generally complain of pain in the lateral shoulder, weakness in the affected side, pain with movement (especially shoulder elevation), and difficulty sleeping on the affected side (Rhon, 2014). Patients with SIS also

generally present with pain to palpation of the rotator cuff tendons, pain with resisted abduction, positive Hawkins impingement test, positive Neer impingement test, and positive painful arc sign (Aytar, 2015).

The anatomy, function, and mechanics of the shoulder girdle are highly dependent on 3 joint structures, the glenohumeral, acromioclavicular, and sternoclavicular joints, and additionally the pseudo-joint, scapulothoracic (Aytar, 2015). There is substantial evidence suggesting that discrepancies in posture, muscle lengths, the kinematics of the shoulder joints and spine, and scapulohumeral rhythm can lead to subacromial impingement (Moezy, 2014). Therefore, it is of utmost importance to complete a holistic investigation of the cervical and thoracic spine, posture, scapular musculature, scapulohumeral rhythm, and interactions of the joints in the shoulder girdle and spine when examining a patient with possible SIS (Koester, 2005).

The treatment for subacromial impingement syndrome is controversial, but 90-95% of cases are treated conservatively, with only the most severe or complex cases going to surgery (Moezy, 2014). In usual practice, pain relieving medications, including non-steroidal anti-inflammatory drugs (NSAIDs), physical therapy, and corticosteroid injections are the most utilized options for treatment (Gaujoux-Viala, 2009). Frequent physical therapy interventions include addressing posture and ergonomics, rest, superficial heat, ice, movement exercises, strengthening, stretching, dry needling, acupuncture, ultrasound therapy, and transcutaneous electrical nerve stimulation (TENS) (Akgun, 2004). The other most utilized option in management of SIS is a corticosteroid injection positioned into the subacromial space, and has frequently been used as a first-line treatment, or as a treatment following failure of other conservative methods (Akgun, 2004).

The treatment of SIS with physical therapy has shown effective over the long-term and short-term overall, with different modalities and strategies demonstrating varying degrees of effectiveness (Gebremariam, 2014). Specific modalities including acupuncture (Johansson, 2011) and high-intensity laser therapy (Santamato, 2009) have shown good outcomes for patients with SIS, and physical therapy interventions have little risk overall.

The use of corticosteroids has become a standard treatment by general practitioners, but remains to be extremely controversial, and the efficacy of long-term use of corticosteroid injections has been inconclusive (Johansson, 2011). Subacromial corticosteroid injections appear to relieve symptoms in the short-term (2-4 months), but long-term evidence has been conflicting with corticosteroid injections being no more effective than placebo after 9-12 months (Rhon, 2014). Additionally, it has been reported that long-term use of subacrominal injections of corticosteroids can cause harmful effects on the tendon structure, such as collagen necrosis, weakness, and possible tendon rupture, and it has been reported that corticosteroid injections are no more effective than NSAID use in the short-term (Akgun, 2004).

Despite how common the condition of subacrominal impingement syndrome is, there is a great deal of controversy surrounding what the best management strategy is. Because of this controversy, the following PICO question arose: In a patient with subacromial impingement syndrome, what is the effectiveness treatment of physical therapy vs corticosteroid injections, and which treatment shows better long-term outcomes? And secondly, is there a specific physical therapy related intervention that best treats SIS? This study will further examine specific effects of physical therapy and corticosteroid treatments to gain better understanding of their use, advantages, and disadvantages in the management of subacromial impingement syndrome.

Section 2: Case Description

Introduction

The patient is a 55 year-old female who presents to an outpatient physical therapy clinic complaining of right shoulder pain of 7/10. Patient reports that she has had right shoulder pain for about 2 years, but it has become increasingly worse in the last month or so. She denies any mechanism of injury. She reports sharp pain when she tries to reach overhead, and often has pain when sleeping on her right side, although pain can be alleviated by moving out of painful positions. The patient has never had physical therapy before and arrives with a referral for treatment of inflammation and subacromial impingement. The patient chooses to pursue physical therapy treatment instead of a corticosteroid injection due to the invasiveness of the injection.

Examination

History: The patient currently works ~30 hours a week as a house cleaner, which involves significant amounts of overhead reaching, pushing/pulling motions, and circumduction of the upper extremities. The patient is currently not involved in any exercise program, but played tennis 2x a week about 5 years ago. Pt would like to return to playing tennis and become more active.

Past Medical History: The patient had left thumb surgery 20 years ago. She denies any other significant PMH, including surgeries or injuries. She is in good overall health and is not on any medications at this time.

Current Condition: Patient reports increased worsening of insidious onset right shoulder pain over the last 2 years. She reports that the pain is generally sharp and 7/10, and is located at the tip of the right shoulder and sometimes radiates toward the lateral edge. Pain is worse with overhead positioning, and especially painful during the motion of elevation around 90 degrees. Pain is alleviated by keeping her arm at her side, keeping it completely elevated above her head, or resting it. Pain is worse if she sleeps on her right shoulder, and is better when she lies on her back. There is no edema, ecchymosis, or visible abnormality of the right shoulder upon visual examination.

Systems Review:

- Musculoskeletal: Decreased ROM and strength of RUE.
- Neuromuscular: Pt denies any distal symptoms or any numbness or tingling. Sensation to light touch is intact.
- Cardiopulmonary: Pt presents with no signs of acute fatigue, and denies any cardiovascular history. Resting vitals include: 80bpm, 97% Sp02, 118/78 BP.
- Integumentary: Intact skin throughout extremities. No edema, ecchymosis, or discoloration. Skin is warm and well perfused.
- Communication/Cognition: Pt is alert and oriented. No signs of cognitive or communicative decline.

Imaging: Plain films taken 2 weeks prior to physical therapy evaluation and indicate decreased joint space between the right caracoacromial arch, supraspinatus tendon, and subacromial bursa. Pt has a type II acromion. No other significant abnormalities noted on plain film.

Tests and Measures:

- Aerobic Capacity/Endurance: Aerobic endurance not assessed during evaluation. No labored breathing or cardiovascular deficits noted.
- Balance: Sitting/standing balance within normal limits.
- Gait: No significant gait abnormalities noted at this time.
- Mobility: Patient is independent with all mobility.
- Muscle Performance: Gross muscle testing 5/5 globally, except R shoulder elevation (abduction and flexion) 4/5 secondary to pain. Right shoulder flexion and abduction strong and painful at 90 degrees of elevation. Painful R shoulder resisted internal rotation.
- Posture: Forward head and shoulder posture. Notable thoracic kyphosis.
- Range of Motion: All extremity ROM is within normal limits. Patient reports painful arc from 85-110 degrees in right shoulder abduction. The patient reports mild pain in flexion and scaption, and decreased pain when arm is passively raised to full 180º elevation.
- Special Tests:
    - Hawkins Test +
    - Drop Arm Test –
    - Lift Off Test –
    - Empty Can Test –
    - Painful Arc Test +
    - Neer Impingement Test +
    - Cross-Arm Adduction Test –
    - Speeds Test –

Evaluation

Diagnosis: M75.4 - Impingement syndrome of the shoulder.

Narrative Assessment: The patient is a 55 year-old female referred to physical therapy for subacromial impingement and inflammation of the right shoulder joint. The patient complains of increasing right shoulder pain that worsens with elevation past 90 degrees. The patient states that the pain gets better with rest, and hurts least when her arm is by her side or passivly raised to full elevation. The patient demonstrates a positive painful arc test, and signs and symptoms show consistency with subacromial impingement syndrome. Continued skilled physical therapy is recommended for strengthening, posture training, range of motion, and functional mobility.

Clinical Judgments and Problem List

Impairments:

- Painful R shoulder elevation 85-110 degrees.
- R shoulder elevation strength 4/5.
- Forward head posture and thoracic kyphosis.

Activity Limitations:

- Unable to initiate and maintain active RUE overhead positioning without pain.
- Unable to reach into high cabinets.

Participation Restrictions:

- Unable to fully participate in her job as a house cleaner secondary to painful motion above 90 degrees of R shoulder elevation.
- Unable to participate in tennis activities in the community.

Prognosis, Plan of Care, Goals

- Prognosis:
    - Patient has good prognosis due to motivation for return to prior level of function, and her lack of comorbidities.
- Plan of Care:
    - Patient will be seen 2x week for 8 weeks until discharge. Interventions will include strengthening, range of motion, manual therapy for joint mobilization to thoracic spine and shoulder girdle joints, stretching, education on correct posture and functional positioning, and a home exercise program.
- Goals:
    - Patient will demonstrate correct neck/thoracic posturing throughout entirety of physical therapy treatment in clinic without verbal cueing within 8 weeks.
    - Patient will report 0/10 pain during right shoulder elevation within 8 weeks.
    - Patient will demonstrate 5/5 strength in right shoulder flexion, internal rotation, and abduction within 8 weeks.
    - Patient will demonstrate understanding and correct execution of home exercise program within 3 weeks.

Interventions

Patient Related Instruction:

- Plan of care and goals for physical therapy
- Home exercise program
- Functional mobility

Coordination and Communication with Other Healthcare Professionals:

- Progress note with referring physician

Direct Interventions:

- Manual Therapy and Therapeutic Exercise
    - Mobilize and address restrictions of cervical spine, ribs, thoracic spine, scapulothoracic, sternoclavicular, and acromioclavicular joints.
    - Address any instability of the glenohumeral joint, and assess all osteokinematic and arthrokinematic motions.
    - Stretching muscles that interfere with normal scapulothoracic mobility, including levator scapulae, pectoralis major/minor, and latissimus dorsi.
    - Facilitation and strengthening of muscles to combat imbalances, including supraspinatus, infraspinatus, teres minor, subscapularis, serratus anterior, and lower trapezius.
    - Increase ROM with functional elevation movements and correct posture to reduce painful arc.
- Home Exercise Program
    - Self-mobilization, strengthening, stretching, posture, and functional mobility re-training.

Outcomes

Patient was discharged from outpatient physical therapy clinic with home exercise program following 8 weeks of 2x/week treatment. Pt reported near return to prior level of function with minimal pain during right shoulder elevation. She experienced a decrease in her painful arc and only felt 2/10 pain occurring at ~90 degrees in the abduction plane about 50% of the time. Although the patient did not achieve complete resolution of symptoms, the patient reports improved mobility and posture overall, and plans to return to tennis and complete her fulltime workday.

Section 3: Evidence Based Analysis

Methodology of Search: The following search methodology sought to answer this PICO question: In a patient with subacromial impingement syndrome, what is the effectiveness treatment of physical therapy vs corticosteroid injections, and which treatment shows better long-term outcomes? The following major databases and journal collections were searched, including PubMed, CINAHL, and PEDro. Search terms were established and a Boolean search format was used for all databases. The search terms that were used include: "subacromial impingement syndrome", "physical therapy", "subacromial impingement syndrome AND physical therapy AND steroid", "(steroid) AND (physical therapy) AND (shoulder impingement)", "subacrominal impingement syndrome AND physical therapy", and "shoulder impingement physical therapy." See Table 1 and Table 2 in Appendix A for further details of the database searches and articles that were included/excluded from the reference list. The inclusion and exclusion criteria for the reference list can be found in Table 3 of Appendix A.

The following articles were selected and included for analysis. For detailed article worksheets, see Appendix B.

1. Abdulla, S. Y., et al. (2015)
2. Akgun, K., et al. (2004)
3. Aytar, A., et al. (2015)
4. Gaujoux-Viala, C., et al. (2008)
5. Gebremariam, L., et al. (2014)
6. Johansson, K., et al. (2011)
7. Moezy, A., et al. (2014)
8. Rhon, D.I., et al. (2014)
9. Santamato, A., et al. (2009)

Reference #1 (reference #1 in reference list):
Abdulla, S. Y., Southerst, D., Côté, P., Shearer, H. M., Sutton, D., Randhawa, K., . . . Taylor-Vaisey, A. (2015). Is exercise effective for the management of subacromial impingement syndrome and other soft tissue injuries of the shoulder? A systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) Collaboration. *Manual Therapy, 20*(5), 646-656.

Level of Evidence

- **Oxford:** 1a
- **PEDro:** N/A

Purpose: The purpose of this systematic review was to evaluate the effectiveness of exercise therapy (e.g. stretching, strengthening, aerobic exercises) compared to other interventions, placebo or sham interventions, or no intervention for improving self-rated recovery, functional recovery, pain intensity, health-related quality of life, or psychological outcomes in adults or children with soft tissue injuries of the shoulder (e.g. grade I-II sprain/strains, tendinopathy, subacromial impingement). This review targeted studies of adults and/or children with subacromial impingement syndrome and other soft tissue injuries of the shoulder.

Methods: To be eligible, studies had to include one of the following outcomes: self-rated recovery, functional recovery (e.g. disability, return to activities, work, or school), pain intensity, health-related quality of life, psychological outcomes such as depression or fear, or adverse events. This SR restricted review to studies that tested the effectiveness of exercise. Exercise was defined as any series of movements with the aim of training or developing the body or as physical training to promote good physical health. Studies were excluded that listed exercise as one component of a multimodal intervention, because the effectiveness of exercise could not be isolated. The search strategy was developed with a health sciences librarian. A second librarian reviewed the search strategy for completeness and accuracy using the Peer Review of Electronic Search Strategies (PRESS) Checklist. A two-phase screening process to select eligible studies was used. In phase one, random pairs of independent reviewers screened citation titles and

abstracts to determine eligibility. Phase I screening resulted in studies being classified as relevant, possibly relevant, and irrelevant. In phase II, the same pairs of reviewers independently screened possibly relevant articles to determine eligibility. Reviewers met to resolve disagreements and reach consensus on the eligibility of studies. A third reviewer was used if consensus could not be reached. Additionally, random pairs of independent reviewers critically appraised the internal validity of eligible studies using the Scottish Intercollegiate Guidelines Network (SIGN) criteria.

Results: This SR found that for variable duration subacromial impingement syndrome: 1) supervised strengthening leads to greater short-term improvement in pain and disability over wait listing; and 2) supervised and home-based strengthening and stretching leads to greater short-term improvement in pain and disability compared to no treatment. For persistent subacromial impingement syndrome: 1) supervised and home-based strengthening leads to similar successful outcomes as surgery; and 2) home-based heavy load eccentric training does not add benefits to home-based rotator cuff strengthening and physiotherapy. For variable duration low-grade nonspecific shoulder pain, supervised strengthening and stretching leads to similar successful short-term outcomes as corticosteroid injections or multimodal care.

Critique: Overall, the evidence of this SR suggests that supervised progressive shoulder exercises alone or combined with home-based shoulder exercises are effective over the short-term for the management of subacromial impingement syndrome of variable duration, and have similar results as decompression surgery in the long-term for SIS. The screening process used in this SR was thoroughly and critically appraised for bias, and the selected articles were also analytically assessed for low risk of bias. More research in this area is needed for specific different conditions and exercises to pinpoint the best treatment and duration.

Reference #2 (reference #2 in reference list):
Akgün, K., Birtane, M., & Akarırmak, Ü. (2004). Is local subacromial corticosteroid injection beneficial in subacromial impingement syndrome? *Clinical Rheumatology, 23*(6), 496-500.

Level of Evidence

- **Oxford:** 1b
- **PEDro:** 8/10

Purpose: The purpose of this study was to clarify whether or not corticosteroid injections provide additional benefit when used with NSAIDs and isometric/isotonic strengthening in a group of patients with stage 2 subacromial impingement syndrome.

Methods: Single-blinded, randomized controlled trial. 48 subjects allocated into 3 separate groups; no significant differences between groups. All subjects received a NSAID injection into the subacromial space (lignocaine), but only groups 1 and 2 received an additional corticosteroid injection (methylprednisolone). Outcomes for pain and function measured using VAS and Constant scale.

Results: Subacromial corticosteroid injections significantly reduced pain and allowed for more functional use ($p < .05$) within the 1st month of receiving the injection, however there were no lasting effects when assessments were made at month 3.

Critique: This study effectively demonstrated positive short-term effects of corticosteroid injections relating to pain control, sleeping, and functional use for ADLs. However, this study has limitations including possible inaccurate needle placement, lack of blinding of injection administrator, and small sample size. This study makes note of concerns with long-term corticosteroid injection use, and emphasizes the need for ongoing and additional long-term research.

Reference #3 (reference #3 in reference list):
Aytar, A., Baltaci, G., Uhl, T., Tuzun, H., Oztop, P., & Karatas, M. (2015). The Effects of Scapular Mobilization in Patients with Subacromial Impingement Syndrome: A Randomized, Double-Blind, Placebo-Controlled Clinical Trial. *Journal of Sport Rehabilitation, 24*(2), 116-129.

Level of Evidence

- **Oxford:** 1b
- **PEDro:** 7/10

Purpose: The purpose of this study was to determine the immediate and lasting effects of scapular mobilization in patients with subacromial impingement syndrome.

Methods: This study was a double-blind randomized, placebo-controlled clinical trial which consisted of 3 groups of 22 subjects; no significant differences between groups. Subjects were given sham treatment, scapular mobilization, or supervised exercise over the course of 3 weeks with 8 week follow-up.

Results: Results were based on function, pain at rest, pain at night, pain with activity and shoulder flexion, and internal and external range of motion. Results revealed that there was a main effect for time in all variables studied, indicating that over the course of treatment, regardless of the treatment group, patients improved, and there were no significant differences found between groups.

Critique: This study has limitations including small sample sizes and possible gender biases. This study found no significant differences in long-term outcomes between groups receiving scapular mobilizations, sham treatment, or supervised exercise. All groups showed improvements during the 3 week treatment, and plateaued at follow-up, with no worsening of symptoms at 11 weeks. This shows that improvements can be made with many different treatments, as well as rest alone in patients with SIS, which demonstrates a need for further research and multimodal approaches to management of this condition.

Reference #4 (reference #7 in reference list):
Gaujoux-Viala, C., Dougados, M., & Gossec, L. (2008). Efficacy and safety of steroid injections for shoulder and elbow tendonitis: a meta-analysis of randomised controlled trials. *Annals of the Rheumatic Diseases, 68*(12), 1843-1849.

Level of Evidence
- **Oxford:** 1a
- **PEDro:** N/A

Purpose: The objective of this SR was to assess the efficacy on pain and functional disability, and to assess the safety of steroid injections for patients with tendonitis of the shoulder and elbow in published randomized controlled trials (RCTs). The clinical question considered was whether or not steroid injections were effective compared with other commonly used treatments (''wait and see'', NSAIDs, physiotherapy) or placebo in terms of improvement of pain and functional ability in tendinosis (ie, epicondylitis, rotator cuff tendonitis or subacromial impingement).

Methods: The trials were initially selected on the basis of their titles and abstract, then on the full texts. The inclusion criteria were all RCTs reporting the efficacy on pain and/or function, and/or the safety of steroid injections versus placebo, ''wait and see'', NSAIDs or physiotherapy in patients with epicondylitis, rotator cuff tendonitis or subacromial impingement. Articles reporting no interpretable results (data required included mean (SD)) for any of the three outcome measures (pain, function and safety) were not analyzed. One investigator (CGV) selected the articles and collected the data using a predetermined form. The following methodological features were collected: blinding, intention to treat analysis or not, and number of participants who completed follow-up. The Jadad scale was applied. 20 RCTs were selected, 16 were specifically selected for efficacy, and 19 selected for safety of corticosteroid injections.

Results: The evidence of this SR concluded that subacromial corticosteroid injections show reduction of pain and increase in function for short-term results, and the long term effect is unknown.

Critique: The findings of this SR report that subacromial corticosteroid injections are effective for pain relief and increase in function in the short term (<9-12 months). The RCTs selected for this SR were heterogeneous and may have effected results, but many statistical analyses were used to obtain accurate information. This SR also found that NSAIDs are as effective as corticosteroid injections for short-term use. This paper demonstrates that corticosteroid use may be beneficial, but only for a short time at the first onset of symptoms, and much more research is needed for long-term effects of repeated corticosteroid use and alternative therapies including physical therapy.

Reference #5 (reference #8 in reference list):
Gebremariam, L., Hay, E. M., Sande, R. V., Rinkel, W. D., Koes, B. W., & Huisstede, B. M. (2013). Subacromial impingement syndrome—effectiveness of physiotherapy and manual therapy. *British Journal of Sports Medicine, 48*(16), 1202-1208.

Level of Evidence

- **Oxford:** 1a
- **PEDro:** N/A

Purpose: This article concentrated on the effectiveness of physiotherapy and manual therapy as treatment for patients with subacromial impingement syndrome (SIS). To help physicians select the most appropriate non-surgical intervention and to identify gaps in scientific knowledge, this paper explored the effectiveness of these interventions.

Methods: SRs and RCTs were included if they fulfilled all of the following criteria: (A) SIS, not caused by an acute trauma or any systemic disease, (B) an intervention for treating SIS was evaluated, (C) results on pain, function or recovery were reported and (D) a follow-up period of ≥2 weeks was reported. There were no language restrictions. After the full-text articles were included, the included studies were divided into different treatment groups for which separate reviews could be conducted. One of these groups was concerned with physiotherapeutic interventions. In this review, only studies were included in which physiotherapeutic interventions were compared to placebo, no treatment or another non surgical treatment. Two reviewers independently applied the inclusion criteria (Furlan's 12 Criteria) to select potentially relevant studies from the title, abstracts and full-text articles, respectively. A consensus method was used to solve any disagreements concerning inclusion of studies, and a third reviewer was consulted if disagreement persisted.

Results: Various levels of evidence were found for different treatment methods, including exercise vs laser placebo (moderate evidence in favor of exercise), exercise vs controls (moderate evidence in favor of exercise), exercise vs hyperthermia (moderate evidence in short-

term for hyperthermia), exercise vs shoulder brace (no evidence), exercise vs ultrasound (no evidence), mobilization as an add on to therapeutic exercise (conflicting evidence), manual therapy plus self-training vs self-training (limited evidence in favor of manual therapy plus self-training), physiotherapy vs self-training (no evidence), ultrasound vs placebo (no evidence), ultrasound vs hyperthermia (moderate evidence in short-term favoring hyperthermia), ultrasound plus iontophoresis (no evidence), ultrasound vs corticosteroid injection (no evidence), ultrasound vs acupuncture (no evidence), laser vs placebo (conflicting evidence), and laser vs ultrasound (limited evidence favoring laser therapy).

Critique: Overall, this SR found that some form of exercise and manual therapy is more effective than placebo or modalities such as laser or ultrasound, but there is limited literature looking purely at manual therapy as a modality for SIS, and much more research is needed on this topic. There is conflicting evidence when comparing exercise to corticosteroid injections, which has been the trend in the literature. This SR found that it is more effective to have patients with SIS participate in some form of manual therapy, exercise, or use an anti-inflammatory, than to simply let the condition get better with time.

Reference #6 (reference #11 in reference list):
Johansson, K., Bergstrom, A., Schroder, K., & Foldevi, M. (2011). Subacromial corticosteroid injection or acupuncture with home exercises when treating patients with subacromial impingement in primary care--a randomized clinical trial. *Family Practice, 28*(4), 355-365.

Level of Evidence

- **Oxford:** 1b
- **PEDro:** 7/10

Purpose: The aim of this study was to compare the efficacy of two standardized interventions for patients with SIS performed by different primary care professionals: subacromial injection of corticosteroids (by a physician) or a series of manual acupunctures (by a physical therapist) combined with home exercises.

Methods: This was a randomized clinical trial with 2 treatment groups; 1 group received subacromial corticosteroid injections, and the other received acupuncture and home exercise. Treatment was provided over 6 weeks with a 1 year follow-up. Outcomes were based on pain and functionality of the shoulder.

Results: There were no significant differences in the primary outcome, pain and shoulder function measured by AL-score (Adolfsson–Lysholm shoulder assessment score). Neither was there a difference in the secondary outcome, HRQL (Health Related Quality of Life), between the treatment groups. However, both treatment groups reported a significant improvement over time regarding pain and shoulder function ($P < 0.001$). HRQL improved significantly within the respective treatment groups ($P < 0.001$) compared with baseline both for the EQ-5D (The EuroQol-five dimension self-report questionnaire) descriptive system and for the EQ-VAS (EuroQol Visual Analogue Scale).

Critique: This study has limitations including small sample size, lack of blinding, and possible placebo effect due to additional treatments for the acupuncture group compared to the corticosteroid group. It is also difficult to achieve 100% accuracy between patients for placement

of subacromial corticosteroid injection. Overall, this study shows no significant differences between groups, but all groups showed improvement over time. This indicates that there are multiple possible successful ways to improve the condition of patients with SIS over time, and invasive approaches may not always be necessary.

Reference #7 (reference #16 in reference list):
Moezy, A., Sepehrifar, S., & Dodaran, M. (2014). The effects of scapular stabilization based exercise therapy on pain, posture, flexibility and shoulder mobility in patients with shoulder impingement syndrome: a controlled randomized clinical trial. *Medical Journal of the Islamic Republic of Iran, 28*(87), 1-15.

Level of Evidence
- **Oxford:** 1b
- **PEDro:** 6/10

Purpose: The purpose of this study was to compare the effectiveness of two treatment approaches for impingement syndrome of the shoulder: (1) a 6-week scapular stabilization based exercises (named exercise therapy or ET), and (2) a ROM exercise program combined with physical modalities on pain, posture, flexibility and mobility of SIS patients (named physical therapy or PT).

Methods: This study was a randomized clinical trial with 72 subjects and a 6-week intervention period. Subjects were split into 2 groups. 1 group received specific scapular stabilization therapy, and the other received more general physical therapy including ROM, flexibility, posture, and modalities including ultrasounds, TENS, and infrared.

Results: There was significantly more improvement of shoulder abduction and external rotation ranges, postural parameters (forward shoulder translation, forward head posture, mid-thoracic curve and pectoralis minor length) in ET group than the PT group. There was no statistical significance between groups for pain, although both groups reported improved pain over time. Results also showed no benefit to ultrasound therapy alone for patients with SIS.

Critique: This study demonstrates that scapula specific stabilization exercises and mobility may be more beneficial than a more global physical therapy approach in patients with SIS. This study did not have a follow-up, however, which leaves room for error in assumption of lasting results.

This study also lacked pre/post strength testing of scapular musculature, and looked purely at other mechanics.

Reference #8 (reference #18 in reference list):
Rhon, D. I., Boyles, R. B., & Cleland, J. A. (2014). One-Year Outcome of Subacromial Corticosteroid Injection Compared With Manual Physical Therapy for the Management of the Unilateral Shoulder Impingement Syndrome. *Annals of Internal Medicine, 161*(3), 161-170.

Level of Evidence

- **Oxford:** 1b
- **PEDro:** 8/10

Purpose: The objective of this study was to compare the 1-year effectiveness of corticosteroid injections (CSI) and manual physical therapy (MPT) for subacromial impingement syndrome (SIS) management.

Methods: This study was a randomized, single-blind, comparative-effectiveness, parallel-group trial. The primary outcome measure was the Shoulder Pain and Disability Index (SPADI) which was assessed at baseline, 1 month, 3 months, 6 months, and 1 year. Subjects either received manual physical therapy (1-6 treatments) or at least 1 subacromial corticosteroid injection. Subjects had a follow-up visit after 1 year.

Results: Both groups reported at least a 50% improvement on the SPADI after 1 year, but neither method showed significantly superior results to the other. However, the subjects in the MPT group made fewer visits to their primary care provider than the CSI group (37% MPT, 60% CSI), and those in the MPT group received fewer corticosteroid injections overall in the long term.

Critique: This study has limitations which include a small sample size of subject who were only present or prior military. Patients and clinicians were not blind to the treatment, and the accuracy of the corticosteroid injection is unknown. Findings of this study indicated that subacromial corticosteroid injections and manual physical therapy for the management of SIS have similar outcomes at 1 year follow-up after treatment, and patients who received the physical therapy had fewer PCP appointments overall. Both groups improved by at least 50% on the SPADI,

indicating that one technique is not superior to the other. Invasive techniques may not always be more effective, and more research is needed in this area looking more specifically at long-term outcomes, as most corticosteroid injection research only looks at short-term outcomes.

Reference #9 (reference #20 in reference list):
Santamato, A., Solfrizzi, V., Panza, F., Tondi, G., Frisardi, V., Leggin, B. G., . . . Fiore, P. (2009). Short-term Effects of High-Intensity Laser Therapy Versus Ultrasound Therapy in the Treatment of People With Subacromial Impingement Syndrome: A Randomized Clinical Trial. *Physical Therapy, 89*(7), 643-652.

Level of Evidence

- **Oxford:** 1b
- **PEDro:** 8/10

Purpose: The aim of this study was to evaluate the short-term effectiveness of 2 different physical therapy modalities in the treatment of subacromial impingement syndrome (SIS): high intensity laser therapy (HILT) and ultrasound (US) therapy.

Methods: This study was a randomized clinical trial. 2 groups of 35 subjects received either ultrasound therapy or high intensity laser therapy for 10 treatments over the course of 2 weeks. Participants were notified not to take any anti-inflammatories or analgesics during the time of the trial. All subjects completed the entirety of the trial and were evaluated using the Visual Analogue Scale (VAS), the Constant-Murley Scale (CMS), and the Simple Shoulder Test (SST).

Results: The subjects treated with HILT showed a greater reduction in pain and more improvement in articular movement, functionality, and muscle strength of the affected shoulder than the subjects treated with US therapy (as measured with the VAS, CMS, and SST). It has been reported that US treatment is not successful for SIS alone, but this study shows that HILT can be effective on its own.

Critique: Limitations of this study include the lack of a control group receiving no treatment; this limitation constrains the ability to claim cause and effect. Participants in both groups may have improved simply because of the passage of time and the avoidance of strenuous activity for the treatment period. There was also lack of long term follow-up in this study. However, in the short-term, this study found that HILT can cause significant improvements in patients with SIS

compared to US therapies when it comes to pain, movement, and strength in the shoulder. There is little literature on this subject and much more is needed specifically looking at HILT for the treatment of SIS.

Discussion

According to the literature reviewed on physical therapy vs corticosteroid injections in the treatment of subacromial impingement syndrome, there are inconsistent results on which treatment provides better outcomes. In general, physical therapy provides better outcomes long-term, and corticosteroids provide adequate short-term, or 'quick fix' treatments, but the long term efficacy and safety of corticosteroid use is controversial. Of the studies reviewed, those which used a placebo or control group found that the factor of time played a role as well, and subjects showed some degree of long-term improvement in their symptoms over time.

Bedsides the baseline improvements in symptoms with time, many studies show that SIS symptoms are relieved more effectively when managed with some sort of modality or therapy. Specifically in physical therapy, multiple studies show that standard treatments (including strengthening, range of motion, and postural correction) are effective long-term, and subjects also showed positive outcomes when treatments were combined or substituted with therapeutic modalities. Subjects treated with acupuncture showed significant improvements over time (Johansson, 2011), and subjects treated with laser acupuncture showed statistically significant improvements in pain and functional status compared to a control group within 3 weeks (Kibar, 2016). Treatments including the use of high intensity laser therapy (HILT) demonstrated better outcomes in pain, articular movement, functionality, and muscle strength over control or ultrasound therapy groups (Santamato, 2011), and surpassed the accepted minimally clinically significant difference (MCID) for that tool. Subjects treated with local microwave diathermy showed equally positive short-term outcomes as corticosteroid injections (Rabini, 2012), as well as patients treated with Kinesio Taping (Goksu, 2016), which further demonstrates that some

non-invasive techniques can be equally as effective as corticosteroid injections in the relief of SIS symptoms.

Overall, subjects treated with non-invasive physical therapy techniques including more generalized mobilizations, exercises, and movement therapies demonstrated improvements in symptoms of subacromial impingement syndrome (Abdulla, 2015), as well as significant improvements in the Shoulder Pain and Disability Index (SPADI) (Guimarães, 2016). Many studies further examined exercises, mobilizations, and manual therapy specifically in the treatment of SIS, and aimed to identify which treatments were most effective. Multiple studies emphasize scapular dyskinesia and deficits in the scapula-humeral rhythm as a possible cause of SIS, and excessive scapular internal rotation and anterior tilt, as well as decreased activation of scapular rotators were found to be present in subjects with SIS (Chen, 2015). Subjects provided with scapular mobilizations demonstrated significant increases in shoulder motion and function, and a significant decrease in pain over time (Aytar, 2015). Subjects treated with scapular stabilization exercises also showed significant positive differences in abduction and external rotation range, improvement of forward shoulder translation and increases in the flexibility of the involved shoulder, as well as improvements in pain, posture, thoracic curvature, and scapular symmetry (Moezy, 2014). Subjects managed specifically with eccentric strength training of the rotator cuff musculature improved significantly in pain intensity and function of the shoulder (Bernhardsson, 2010), and daily stretching of the pectoralis major significantly decreased pain and improved function in subjects with shoulder pain (Rosa, 2016).

The review of the literature for conservative physical therapy-based treatment shows that there are multiple effective non-invasive options in the treatment of SIS, and more research is needed to identify the specific therapies that are most successful. The other conservative therapy

that is most utilized in the management of SIS are subacromial corticosteroid injections. These injections are controversial due to the invasiveness, risk of infection and side-effects, and detrimental risks of repetitive long-term use. Overall, corticosteroids show statistically significant short-term improvements compared with placebo for pain and function, but no statistically significant differences were found in the long-term when compared with placebo, control, or physical therapy (Coombes, 2010). Other studies have examined differences in the specific category of corticosteroid versus non-steroid anti-inflammatory drugs (NSAIDs), and revealed that the localization and type of steroid did not play a role, and all were significantly effective in the short-term for SIS symptoms (Coombes, 2010). However, steroid injections were not significantly better than NSAID injections in the short-term (Min, 2013), and no long-term benefit was shown (Gaujoux-Viala, 2008). When NSAIDs and corticosteroid injections were used in conjunction with each other in the acute or subacute phase of SIS, they provided additional short-term benefit without any additional complications (Akgun, 2004). In a direct comparison of 1-year outcomes of subjects treated with corticosteroid injections or physical therapy with corticosteroid injections, it was identified that both groups showed improvements in the Global Rating of Change scale and pain scores. However, the group receiving only corticosteroids had more visits to their primary care provider, and required more injections than the group that also received physical therapy (Rhon, 2014).

Although corticosteroids are a frequent first-line treatment for SIS, they come with a host of possible side-effects. Pain, itching, and burning are common adverse effects at the injection site (Coombes, 2010), as well as skin discoloration, facial flushing, insomnia, and high blood sugar (Mayo Clinic, 2015). Additionally, accuracy of the injection location can vary based on method and experience of the provider, and results may vary across treatments (Johansson,

2011). There is a statistically significant greater risk in developing muscle atrophy in using corticosteroid injections (Coombes, 2010), and trends in long-term use of corticosteroid injections have shown damaging side effects including tendon rupture, weakness, and collagen necrosis (Akgun, 2004). Injections for the treatment of SIS have not shown to be significantly effective long-term, and it is not recommended to use corticosteroid injections longer than 3-4 years (Mayo Clinic, 2015). More research is necessary to investigate long-term effects of corticosteroid injections, but it is clear in the literature that long-term use is currently not supported, and patients suffering from subacromial impingement syndrome who use corticosteroid injections will need to find alternatives in the long-term management of their symptoms.

Conclusion

The reviewed literature supports a multitude of options for both physical therapy and corticosteroid injections in the treatment of SIS, but effectiveness varies significantly based on long-term and short-term outcomes. The wide variance in physical therapy treatments poses difficulty in recommendations for a specific treatment, although it reveals that a multitude of treatments can all be equally effective, giving clinicians the ability to choose what is best for their patients.

Subacromial impingement syndrome is a complex condition that involves many different structures and functions, and examination and treatment of this condition is multifocal. The cause of this condition can differ from patient to patient, and close investigation of the kinematics of the shoulder joint is essential for proper management, and the spine, musculature, and overall posture should also be analyzed in each patient.

When executed correctly, physical exercises and manual therapy have very low risks. Exercise programs and progressions can be personalized to individual patients, and they can safely be used long-term. Although effective in short-term, corticosteroid injections cannot be individualized dynamically, and pose potential risks and harmful side-effects with long-term or repeated use. Based on the research presented, it can be deduced that physical therapy is the superior treatment for overall long-term safety and management of SIS. Secondly, research demonstrates that some of the most effective forms of physical therapy for decreasing pain and increasing function in patients with SIS involves eccentric training of the rotator cuff musculature, stretching of the pectoralis major muscle, and scapular stability exercises.

It is important that patients be well informed of their options for conservative treatment in SIS, and understand that many different treatment options are available to them. Pros and cons of each treatment should be personally considered for each patient, especially in terms of short-term and long-term outcomes, safety, cost, and availability. Further research for the development of specific parameters, dosages, and progressions is needed for both physical therapy and corticosteroid injections in the treatment of subacromial impingement syndrome.

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Appendix A

Systematic Literature Review Process

Included Studies

Inclusion and Exclusion Criteria

Table 1: Systematic Literature Review Process

Search Terms	Number of Articles	Included/Excluded
PubMed Search		
subacromial impingement syndrome	2,016	Too many.
Physical therapy	247,694	Too many.
subacromial impingement syndrome AND physical therapy AND steroid	31	5 selected due to title relevance to PICO.
CINAHL		
(steroid) AND (physical therapy) AND (shoulder impingement)	7	3 duplicates, 1 selected, 3 excluded due to title irrelevance.
subacromial impingement syndrome AND physical therapy	94	2 selected, 5 duplicates, 87 excluded due to title irrelevance.
PEDro		
Shoulder impingement physical therapy	38	1 selected, 4 duplicates, 33 excluded due to title irrelevance.

Table 2: Included studies

#	Author(s)	Oxford Level	Pedro Score	Purpose	Outcome Measures	Results	Relevant to PICO?
1	Abdulla, S. Y., et al. (2015)	1a	N/A	To evaluate the effectiveness of exercise therapy compared to other interventions, placebo or sham interventions, or no intervention for improving self-rated recovery, functional recovery, pain intensity, health-related quality of life, or psychological outcomes in adults or children with soft tissue injuries of the shoulder	Studies in this SR had to include one of the following: self-rated recovery, function recovery, pain intensity, health-related quality of life, psychological outcomes, or adverse events.	For variable duration subacromial impingement syndrome: 1) supervised strengthening leads to greater short-term improvement in pain and disability over wait listing; and 2) supervised and home-based strengthening and stretching leads to greater short-term improvement in pain and disability compared to no treatment. For persistent subacromial impingement syndrome: 1) supervised and home-based strengthening leads to similar successful outcomes as surgery; and 2) home-based heavy load eccentric training does not add benefits to home-based rotator cuff strengthening and physiotherapy.	Yes
2	Akgun, K., et al. (2004)	1b	8/10	To clarify whether or not corticosteroid injections provide additional benefit when used with NSAIDs and isometric/isotonic strengthening in a group of patients with stage 2 subacromial impingement syndrome.	VAS, functional status of the shoulder by use of the total Constant scale.	Subacromial corticosteroid injections significantly reduced pain and allowed for more functional use (p <.05) within the 1st month of receiving the injection, however there were no lasting effects when assessments were made at month 3.	Yes
3	Aytar, A., et al. (2015)	1b	7/10	to determine the immediate and lasting effects of scapular mobilization in patients with subacromial impingement syndrome.	Shoulder function, pain intensity, ROM, participant satisfaction, DASH, VAS, 7-point Likert scale.	Results revealed that there was a main effect for time in all variables studied, indicating that over the course of treatment, regardless of the treatment group, patients improved, and there were no significant differences found between groups.	Yes

4	Gaujoux-Viala, C., et al. (2008)	1a	N/A	To assess the efficacy on pain and functional disability, and to assess the safety of steroid injections for patients with tendonitis of the shoulder and elbow in published randomized controlled trials (RCTs).	Pain, VAS, limitation of function, total Constant score.	The evidence of this SR concluded that subacromial corticosteroid injections show reduction of pain and increase in function for short-term results, and the long term effect is unknown.	Yes
5	Gebremariam, L., et al. (2014)	1a	N/A	This paper concentrated on the effectiveness of physiotherapy and manual therapy as treatment for patients with subacromial impingement syndrome (SIS). To help physicians select the most appropriate non-surgical intervention and to identify gaps in scientific knowledge, this paper explored the effectiveness of these interventions	VAS, DASH, functional status, Constant score, University of California—Los Angeles Shoulder Rating Scale, the Adolfsson-Lysholm Shoulder Score.	Various levels of evidence were found for different treatment methods, including exercise vs laser placebo (moderate evidence in favor of exercise), exercise vs controls (moderate evidence in favor of exercise), exercise vs hyperthermia (moderate evidence in short-term for hyperthermia), exercise vs shoulder brace (no evidence), exercise vs ultrasound (no evidence), mobilization as an add on to therapeutic exercise (conflicting evidence), manual therapy plus self-training vs self-training (limited evidence in favor of manual therapy plus self-training), physiotherapy vs self-training (no evidence), ultrasound vs placebo (no evidence), ultrasound vs hyperthermia (moderate evidence in short-term favoring hyperthermia), ultrasound plus iontophoresis (no evidence), ultrasound vs corticosteroid injection (no evidence), ultrasound vs acupuncture (no evidence), laser vs placebo (conflicting evidence), and laser vs ultrasound (limited evidence favoring laser therapy).	Yes

6	Johansson, K., et al. (2011)	1b	7/10	to compare the efficacy of two standardized interventions for patients with SIS performed by different primary care professionals: subacromial injection of corticosteroids (by a physician) and a series of manual acupunctures (by a physical therapist) combined with home exercises.	The main outcomes were pain and shoulder function (Adolfsson–Lysholm shoulder assessment score). Secondary outcomes were health-related quality of life (HRQL) (EuroQol-five dimension self-report questionnaire) and the patients' global assessment of change.	There were no significant differences in the primary outcome, pain and shoulder function measured by AL-score (Adolfsson–Lysholm shoulder assessment score). Neither was there a difference in the secondary outcome, HRQL (Health Related Quality of Life), between the treatment groups. However, both treatment groups reported a significant improvement over time regarding pain and shoulder function ($P < 0.001$). HRQL improved significantly within the respective treatment groups ($P < 0.001$) compared with baseline both for the EQ-5D (The EuroQol-five dimension self-report questionnaire) descriptive system and for the EQ-VAS (EuroQol Visual Analogue Scale).	Yes
7	Moezy, A., et al. (2014)	1b	6/10	To compare the effectiveness of two treatment approaches for impingement syndrome of the shoulder: (1) a 6-week scapular stabilization based exercises (named exercise therapy or ET), and (2) a ROM exercise program combined with physical modalities on pain, posture, flexibility and mobility of SIS patients	VAS, ROM, posture and thoracic curvature, forward shoulder translation, flexibility, mobility.	There was significantly more improvement of shoulder abduction and external rotation ranges, postural parameters (forward shoulder translation, forward head posture, mid-thoracic curve and pectoralis minor length) in ET group than the PT group. There was no statistical significance between groups for pain, although both groups reported improved pain over time. Results also showed no benefit to ultrasound therapy alone for patients with SIS.	Yes

8	Rhon, D.I., et al. (2014)	1b	8/10	To compare the 1-year effectiveness of corticosteroid injections (CSI) and manual physical therapy (MPT) for subacromial impingement syndrome (SIS) management.	SPADI, Gobal Rating of Change scores, Numeric Pain Rating Scale, 1-year health care use.	Both groups reported at least a 50% improvement on the SPADI after 1 year, but neither method showed significantly superior results to the other. However, the subjects in the MPT group made fewer visits to their primary care provider than the CSI group (37% MPT, 60% CSI), and those in the MPT group received fewer corticosteroid injections overall in the long term.	Yes
9	Santamato , A., et al. (2009)	1b	8/10	to evaluate the short-term effectiveness of 2 different physical therapy modalities in the treatment of subacromial impingement syndrome (SIS): high intensity laser therapy (HILT) and ultrasound (US) therapy.	Constant-Murley Scale (CMS), visual analog scale (VAS), and the Simple Shoulder Test (SST).	The subjects treated with HILT showed a greater reduction in pain and more improvement in articular movement, functionality, and muscle strength of the affected shoulder than the subjects treated with US therapy (as measured with the VAS, CMS, and SST). It has been reported that US treatment is not effective for SIS alone, but this study shows the HILT can be on its own.	Yes

Table 3: Inclusion & Exclusion Criteria

#	Author(s)	Inclusion Criteria	Exclusion Criteria
1	Abdulla, S. Y., et al. (2015)	English language, published between January 1, 1990 – January 23, 2015, RCTs, and included an inception cohort.	Letters, editorials, commentaries, unpublished manuscripts, dissertations, government reports, books and book chapters, conference proceedings, meeting abstracts, lectures, consensus development statements, or guidelines. Study designs including pilot studies, cross-sectional studies, case reports, case series, qualitative studies, narrative reviews, SRs, clinical practice guidelines, biomechanical studies, or laboratory studies, or cadaveric or animal studies.
2	Akgun, K., et al. (2004)	Patients with positive impingement tests (Neer, Hawkins, painful arc) and only patients with stage 2 impingement.	Patients who had other concomitant shoulder pathologies such as adhesive capsulitis, calcific tendinitis, dislocations, etc., cervical pain or other painful conditions such as fibromyalgia conflicting the clinical picture, any local or systemic contraindication for corticosteroid use such as infection, diabetes, hypertension, etc., history of gastritis or peptic ulcer that may cause complications with NSAID use, prior applications of any treatment modality such as physiotherapy, corticosteroid injections and NSAID during the preceding 3 months were excluded from the study.
3	Aytar, A., et al. (2015)	Study participants were referred from a physician with the diagnosis of SIS. To confirm this evaluation, potential participants demonstrated at least 3 of the following findings: a positive Neer impingement test, a positive Hawkins impingement test, a positive painful arc sign (60–120° of elevation), pain with palpation of the rotator-cuff tendons, pain with isometric resisted abduction, and pain at the shoulder region. On confirmation of these findings, participants were further screened for participation in this study by meeting the following criteria: score of the	Participants were excluded from this study if they demonstrated any of the following symptoms: signs of a rotator-cuff tear or rupture (a positive lag sign such as a drop-arm or lift-off sign); positive shoulder anterior, posterior, and inferior instability tests (a positive anterior and posterior apprehension test, relocation and sulcus sign, drawer test, load and shift test); cervical neurologic symptoms (symptom reproduction from a Spurling test, light touch deficits in a particular dermatome); current trauma such as fractures or dislocations; or previous history of surgery in the affected shoulder.

		Disabilities of the Arm, Shoulder and Hand Questionnaire (Quick DASH) >20, pain for ≥ 6 months, and pain with activity between 2 and 8 on a 10-cm visual analog scale.	
4	Gaujoux-Viala, C., et al. (2008)	All RCTs reporting the efficacy on pain and/or function, and/or the safety of steroid injections versus placebo, ‘‘wait and see’’, NSAIDs or physiotherapy in patients with epicondylitis, rotator cuff tendonitis or subacromial impingement.	Articles reporting no interpretable results (data required included mean (SD)) for any of the three outcome measures (pain, function and safety) were not analyzed.
5	Gebremariam, L., et al. (2014)	Systematic reviews and randomized clinical trials (RCTs) were included if they fulfilled all of the following criteria: (A) SIS, not caused by an acute trauma or any systemic disease as described in the definition of CANS, was studied (B) an intervention for treating SIS was evaluated, (C) results on pain, function or recovery were reported and (D) a follow-up period of ≥2 weeks was reported.	SIS caused by trauma, any other kind of study besides a RCT or SR, subjects already receiving treatment, results other than pain or function, and studies with no follow-up.
6	Johansson, K., et al. (2011)	30-65 years old, typical history; pain located in the proximal lateral aspect of the upper arm (C5 dermatome), especially during arm elevation. A positive Neer impingement test (subacromial injection of anesthetic), at least 2-month duration of the current episode. Three of the following four inclusion criteria must be positive: Hawkins–Kennedy impingement sign, Jobe supraspinatus test (in 90 degrees of abduction in the scapular plane), Neer impingement sign, Painful arc between 60 and 120 degrees during active Abduction.	Radiological findings: malignancy, osteoarthritis of the glenohumeral joint, skeletal abnormalities decreasing the subacromial space (bony spurs and osteophytes). Known or suspected polyarthritis, rheumatoid arthritis or diagnosed fibromyalgia. Previous fractures of any bone in the shoulder complex and/or shoulder surgery on the affected side. Dislocation of the glenohumeral or the clavicular joints on the affected side. History of instability or current clinical findings of hyperlaxity in any joint of the shoulder complex (negative apprehension sign—relocation test, for exclusion of ventral hyperlaxity of the glenohumeral joint). Suspicion of the diagnosis frozen shoulder: characterized by time-dependent decreased range of movements following the capsular pattern (external rotation—abduction—internal rotation). Pain (and

			hypomobility) during intra-articular mobilization. Problems from the cervical spine. Shoulder symptoms reproduced with neck movements and/or a positive test for the foramina intervertebralia (pain and/or neurological symptoms during manual extension combined with manual lateral flexion and rotation towards the tested side). Having received acupuncture for the current shoulder problem. Having received similar exercises for the current shoulder problem. Having received a corticosteroid injection during the last 2 months for the current shoulder problem. A clinical picture of ruptured rotator cuff (trauma, pronounced weakness and atrophy). Acute subacromial bursitis, making a clinical examination impossible due to pain. Difficulty participating in data collection due to communication problem.
7	Moezy, A., et al. (2014)	Male and female mentally fitted between the ages of 18 to 75 years, unilateral shoulder pain of more than one month localized (anterior and/or anterolateral) to the acromion, tenderness to palpation of the rotator cuff tendons, positive impingement tests, or a painful arc of movement (60°–120°), pain produced or increased during flexion and/or abduction of the symptomatic shoulder.	Cervical or shoulder symptoms reproduced by a cervical screening exam, abnormal results with reflex or thoracic outlet tests, symptoms of numbness or tingling in the upper extremity, pregnancy, a history of the followings: onset of symptoms due to traumatic injury, glenohumeral joint dislocation, acromioclavicular joint separation, shoulder fracture, surgery on the shoulder, fibromyalgia, use of any treatment within three months.
8	Rhon, D.I., et al. (2014)	Patients aged 18 to 65 years with a primary symptom of unilateral shoulder pain referred from family practice and orthopedic clinics to the physical therapy department at Madigan Army Medical Center. Patients were included if they did not have any of the exclusion criteria.	history of shoulder dislocation, fracture, or adhesive capsulitis; history of CSI or physical therapy for the shoulder pain in the past 3 months; baseline SPADI score less than 20%; reproduction of shoulder symptoms with cervical spine examination; history of systemic or neurologic disease affecting the shoulder; positive rotator cuff lag sign or history of full-thickness rotator cuff tear; pending litigation; or inability to attend physical therapy for 3 consecutive weeks.

9	Santamato, A., et al. (2009)	Patients had experienced shoulder pain for at least 4 weeks before the study, the presence of shoulder pain, pain on abduction of the shoulder with a painful arch, a positive impingement sign (Hawkins sign), and a positive impingement test (relief of pain within 15 minutes after the injection of a local anesthetic [bupivacaine, 5 mL]) into the subacromial space).	Anesthetic or corticosteroid injections within 4 weeks of study enrollment, surgery or previous fractures of the humeral head of the affected shoulder, impaired rotation in the glenohumeral joint (as measured with goniometry), a history of acute trauma, known osteoarthritis in the acromioclavicular or glenohumeral joint, calcifications exceeding 2 cm in the rotator cuff tendons, signs of a rupture of the cuff, cervical myofascial pain syndrome, radicular pain, inflammatory rheumatic disease, systemic lupus erythematosus, diabetes mellitus type I or II, thyroid dysfunctions, pacemaker, neurological pathologies, or anxiety-depression syndromes.

Appendix B

Evidence Appraisal Worksheets

Systematic Review – Evidence Appraisal Worksheet #1

Citation: Abdulla, S. Y., Southerst, D., Côté, P., Shearer, H. M., Sutton, D., Randhawa, K., . . . Taylor-Vaisey, A. (2015). Is exercise effective for the management of subacromial impingement syndrome and other soft tissue injuries of the shoulder? A systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) Collaboration. *Manual Therapy, 20*(5), 646-656.

Level of Evidence

- **Oxford Scale:** 1a
- **PEDro Scale:** N/A

Does the design follow the Cochrane method?	
Appraisal Criterion	***Reader's Comments***
Step 1 – formulating the question • Do the authors identify the focus of the review • A clearly defined question should specify the types of: • people (participants), • interventions or exposures, • outcomes that are of interest • studies that are relevant to answering the question	The purpose of this systematic review was to evaluate the effectiveness of exercise therapy (e.g. stretching, strengthening, aerobic exercises) compared to other interventions, placebo or sham interventions, or no intervention for improving self-rated recovery, functional recovery, pain intensity, health-related quality of life, or psychological outcomes in adults or children with soft tissue injuries of the shoulder (e.g. grade I-II sprain/strains, tendinopathy, subacromial impingement). This review targeted studies of adults and/or children with subacromial impingement syndrome and other soft tissue injuries of the shoulder.
Step 2 – locating studies • Should identify ALL relevant literature • Did they include multiple databases? • Was the search strategy defined and include: - Bibliographic databases used as well as hand searching - Terms (key words and index terms) - Citation searching: reference lists - Contact with 'experts' to identify 'grey' literature (body of materials that cannot be found easily through conventional channels such as publishers) - Sources for 'grey literature'	To be eligible, studies had to include one of the following outcomes: self-rated recovery, functional recovery (e.g. disability, return to activities, work, or school), pain intensity, health-related quality of life, psychological outcomes such as depression or fear, or adverse events. The following electronic databases were used: MEDLINE, EMBASE, CINAHL, PsychINFO, Database of Abstracts of Reviews of Effects (DARE), Cochrane Central Register of Controlled Trials, and Index to Chiropractic Literature. 11 RCTs were selected for review from an original pool of 4853 articles.
Step 3 – Critical Appraisal/Criteria for Inclusion • Were criteria for selection specified? • Did more than one author assess the	This SR restricted review to studies that tested the effectiveness of exercise. Exercise was defined as any series of movements with the

relevance of each report • Were decisions concerning relevance described; completed by non-experts, or both? • Did the people assessing the relevance of studies know the names of the authors, institutions, journal of publication and results when they apply the inclusion • criteria? Or is it blind?	aim of training or developing the body or as physical training to promote good physical health. Studies were excluded that listed exercise as one component of a multimodal intervention, because the effectiveness of exercise could not be isolated. The search strategy was developed with a health sciences librarian. A second librarian reviewed the search strategy for completeness and accuracy using the Peer Review of Electronic Search Strategies (PRESS) Checklist. A two-phase screening process to select eligible studies was used. In phase one, random pairs of independent reviewers screened citation titles and abstracts to determine eligibility. Phase I screening resulted in studies being classified as relevant, possibly relevant, and irrelevant. In phase II, the same pairs of reviewers independently screened possibly relevant articles to determine eligibility. Reviewers met to resolve disagreements and reach consensus on the eligibility of studies. A third reviewer was used if consensus could not be reached. Additionally, random pairs of independent reviewers critically appraised the internal validity of eligible studies using the Scottish Intercollegiate Guidelines Network (SIGN) criteria.
Step 3 – Critically appraise for bias: Selection – • Were the groups in the study selected differently? • Random? Concealed? Performance- • Did the groups in the study receive different treatment? • Was there blinding? Attrition – • Were the groups similar at the end of the study? • Account for drop-outs? Detection – • Did the study selectively report the results? • Is there missing data?	This SR specifically screened for bias, and 5 of the 11 articles chosen for review had very low risk of bias. These 5 used appropriate blinding, randomization, and intention-to-treat analysis. The other 6 lower quality studies lacked detailed explanation of randomization, blinding, allocation, and account for drop-outs.

Step 4 – Collection of the data • Was a collection data form used and is it included? • Are the studies coded and is the data coding easy to follow? • Were studies identified that were excluded & did they give reasons why (i.e., which criteria they failed).	RCTs were appraised on the following criteria, but it was not mentioned if a specific form was used. Detailed criteria of included/excluded studies was listed in the appendix of this SR. RCTs were reviewed for: 1) clarity of the research question; 2) randomization method; 3) concealment of treatment allocation; 4) blinding of treatment and outcomes; 5) similarity of baseline characteristics between/among treatment arms; 6) co-intervention contamination; 7) validity and reliability of outcome measures; 8) follow-up rates; 9) analysis according to intention to treat principles; and 10) comparability of results across study sites (where applicable). For cohort and case-control studies, additional aspects (where applicable) included: 1) participation rate; 2) presence of outcome at time of enrollment; 3) assessment of differences in attrition between participants and groups; 4) clearly defined outcomes; 5) similarity in study processes between groups when blinding is not possible; 6) reliable assessment of exposure or prognostic factors; 7) time-varying exposure; 8) main potential confounders are accounted for in the study design and analysis; and 9) confidence intervals are provided to measure precision of results.

Are the results of this SR valid?	
Appraisal Criterion	***Reader's Comments***
1. Is this a SR of randomized trials? Did they limit this to high quality studies at the top of the hierarchies a) If not, what types of studies were included? b) What are the potential consequences of including these studies for this review's results?	All 11 studies reviewed in this SR were RCTs. 5 of high quality with low risk of bias, and 6 of lower quality.
2. Did this study follow the Cochrane methods selection process and did it identify all relevant trials? If not, what are the consequences for this review's results?	Yes.
3. Do the methods describe the processes and tools used to assess the quality of individual studies?	Yes, the RCTs were reviewed with 10 different specific criteria (see above) to assess the

If not, what are the consequences for this review's results?	quality of the study.
4. What was the quality of the individual studies included? Were the results consistent from study to study? Did the investigators provide details about the research validity or quality of the studies included in review?	This SR included 5 high quality RCTs with low risk for bias, and 6 RCTs of lower quality with higher risk for bias. Details were provided for each study regarding the quality and short-comings of the research.
5. Did the investigators address publication bias?	No.
Are the valid results of this SR important?	
Appraisal Criterion	***Reader's Comments***
6. Were the results homogenous from study to study? If not, what are the consequences for this review's results?	The 11 studies were reviewed looked at different variables, making many of the studies heterogeneous. However, similar studies were compared to each other making smaller homogenous groups. This can add error due to smaller samples of studies. Four RCTs assessed the effectiveness of exercise for the management of shoulder impingement syndrome (two targeting persistent duration and two targeting variable duration). One RCT studied exercise for the management of nonspecific shoulder pain lasting more than one-month. The median pain intensity at baseline was lower than 3/10 cm on the VAS; therefore, this study was categorized as population with low-grade nonspecific shoulder pain.
7. If the paper is a meta-analysis did they report the statistical results? Did they include a forest plat? What other statistics do they include? Are there CIs?	Agreements were computed between reviewers for the screening of articles and reported the kappa statistic (k) and 95% confidence interval (CI). When available, data provided in the admissible articles to measure the association between the tested interventions and the outcomes by computing the relative risk (RR) and its 95% CI. Similarly, computed differences in mean changes between groups and 95% CI to quantify the effectiveness of interventions. The computation of 95% CIs was based on the assumption that baseline and follow-up outcomes were highly correlated (r= 0.80).
8. From the findings, is it apparent what the cumulative weight of the evidence is?	This SR found that for variable duration subacromial impingement syndrome: 1) supervised strengthening leads to greater short-term improvement in pain and disability over wait listing; and 2) supervised and home-based

	strengthening and stretching leads to greater short-term improvement in pain and disability compared to no treatment. For persistent subacromial impingement syndrome: 1) supervised and home-based strengthening leads to similar successful outcomes as surgery; and 2) home-based heavy load eccentric training does not add benefits to home-based rotator cuff strengthening and physiotherapy. For variable duration low-grade nonspecific shoulder pain, supervised strengthening and stretching leads to similar successful short-term outcomes as corticosteroid injections or multimodal care.
Can you apply this valid, important evidence from this SR in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
9. Is your patient different from those in this SR?	No, the patient is similar to those included in this SR, as this SR emphasized exercises as a treatment for SIS.
10. Is the treatment feasible in your setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	Yes, exercise is a crucial part of physical therapy and is readily implemented in the outpatient orthopedic setting.
11. Does the intervention fit within your patient/client's stated values or expectations? If not, what will you do now?	Yes, the patient prefers exercise treatments for her condition.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
Summarize your findings and relate this back to clinical significance.	Overall, the evidence of this SR suggests that supervised progressive shoulder exercises alone or combined with home-based shoulder exercises (strengthening with or without stretching) are effective over the short-term for the management of subacromial impingement syndrome of variable duration, and have similar results as decompression surgery in the long-term for SIS. These kinds of exercises can easily be implemented into clinical practice and show to have successful outcomes, although much more detailed research is needed in this area.

Intervention – Evidence Appraisal Worksheet #2

Citation: Akgün, K., Birtane, M., & Akarırmak, Ü. (2004). Is local subacromial corticosteroid injection beneficial in subacromial impingement syndrome? *Clinical Rheumatology, 23*(6), 496-500.

Level of Evidence

- **Oxford Scale:** 1b
- **PEDro Scale:** 8/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	The purpose of this study was to clarify whether corticosteroid injections provide additional benefit when used with other conservative treatment modalities in a group of patients with stage 2 SIS.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study.	Yes, relevant background was provided on the condition of subacromial impingement syndrome, different therapeutic methods for treatment, and the contradicting research of those methods. This study is necessary to further clarify the effectiveness of corticosteroid injections in patients with subacromial impingement syndrome.

Does the research design have strong internal validity?	
Appraisal Criterion	***Reader's Comments***
Discuss possible threats to internal validity in the research design. Include: ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	Subjects with history of other shoulder/thoracic injuries or treatments were excluded. Investigators failed to use goniometry and relied on other methods to assess ROM, which may have left smaller changes unnoticed. VAS and Constant Scale were used for pain and function. This study was not double-blind, as the physician performing injections was aware of the corticosteroid, however, the assessors were unaware.

	History: No control group. Instrumentation: Accuracy of injection placement may not be consistent. Compensatory Equalization: Investigators not blinded, effects of this unknown.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
1. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, Patients were randomly divided into three equal groups of 16 patients in a simple systematic manner according to the therapeutic injections applied.
2. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	The physician performing the injections was aware of which steroids were injected, however, the physician performing post-testing was blinded to what kind of injection each subject received.
3. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?** **b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?**	Yes, this study reported no significant differences between groups (p <.05) Age, gender, and symptom duration were all taken into account for groups.
4. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	No. The subjects all knew they were receiving a local anesthetic agent, but were unaware if it contained an additional corticosteroid.
5. Did the investigators know to which treatment group subjects were assigned ? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	The assessors were blinded.
6. Were the groups managed equally, apart from the actual experimental treatment?	Yes, all groups received the same evaluations (prior, 1 month, and 2 months following

a. If not, what are the potential consequences of this knowledge for the study's results?	injection) and process of injection.
7. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Each subject received a 3-month follow-up assessment. This was sufficient as the investigators were looking at short-term results.
8. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	Yes, subjects were not lost during the study.
9. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***
10. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI** **f. Other stats should be included here**	The changes in pain and function parameters within and between the groups in the 1st and 3rd months after therapy onset were evaluated by nonparametric analysis of variance (ANOVA), Mann-Whitney U and Wilcoxon's tests. Pain assessed using VAS, function assessed using Constant scale. When compared with the baseline values, significant improvements in terms of all pain parameters measured by VAS, and function by Constant scale were observed at the first (1 month later) and second (3 months later) evaluation after therapy onset in all of the groups ($p < 0.05$). The group comparisons revealed more favorably improved values in pain causing sleep disturbance measured by VAS ($p < 0.001$) and daily living activity (p

	<0.001) parameters in group 1 patients than the patients in groups 2 and 3 only in the 1st month after therapy onset. No significant difference of any parameter was observed among the groups at the second evaluation 3 months after therapy onset (p >0.05).
11. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	Corticosteroid injection provided additional pain relief only after the 1st month of receiving it, and had no lasting effect. The findings suggest that other means of therapy (i.e. PT) may be more effective for the long-term in SIS.
12. Do these findings exceed a minimally important difference? Was this brought up or discussed? **a. If the MCID was not met, will you still use this evidence?**	N/A
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
13. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	The corticosteroid injection would need to be completed by a physician, but it could be done in the outpatient setting. However, the isometric/isotonic exercises that were performed along with this treatment could be completed in the outpatient PT setting with little cost and equipment.
14. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	Yes, the study subjects fit within the same age and activity groups as my patient, and had the same complaints of pain and discomfort.
15. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	No. There are many risks to repeated corticosteroid injections, and studies show that there is little to no benefit of the steroid compared to a placebo.
16. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	No, this patient would like to improve in her symptoms without the use of corticosteroid injections.
17. Are there any threats to external validity in this study?	Small sample size.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
PEDRO score	8/10. There was no blinding of the administrator of the corticosteroid injection. It was unknown if allocation was concealed.
Summarize your findings and relate this back to clinical significance	The authors found that short-term use of subacromial corticosteroid injections were effective in pain relief when used alongside NSAIDs and exercise, but it needs to be noted that these effects were only noted within the 1st month of receiving the injection. The authors made it clear that there are long-term risks to repeated corticosteroid injections, and were only looking at short term effects. The authors also cited other studies revealing that corticosteroid injections showed little to no advantage over placebos for pain relief. There is more research needed around this subject for long term therapy, and due to the risks of steroid use, physical therapy may be an advantage for long term relief.

Intervention – Evidence Appraisal Worksheet #3

Citation: Aytar, A., Baltaci, G., Uhl, T., Tuzun, H., Oztop, P., & Karatas, M. (2015). The Effects of Scapular Mobilization in Patients with Subacromial Impingement Syndrome: A Randomized, Double-Blind, Placebo-Controlled Clinical Trial. *Journal of Sport Rehabilitation, 24*(2), 116-129.

Level of Evidence

- **Oxford Scale:** 1b
- **PEDro Scale:** 7/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	The purpose of this study was to determine the immediate and lasting effects of scapular mobilization in patients with subacromial impingement syndrome.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study.	Yes, this study provided a well-rounded review of past studies and gaps in the literature when it came to GHJ vs scapulothoracic mobilizations in patients with subacromial impingement syndrome. This study is necessary to further evaluate manual therapy emphasizing scapular movement and its lasting effects.

Does the research design have strong internal validity?	
Appraisal Criterion	***Reader's Comments***
Discuss possible threats to internal validity in the research design. Include: ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	Assignment: This study originally included 15 male and 51 female, possibly skewing results. History: No control group. Attrition: this study lost 51% of participants after 11 weeks. Statistical analyses were completed considering this dropout. Compensatory Equalization: Investigators not blinded, effects of this unknown.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
1. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, using randomizing computer software, 3 groups of 22 participants were split up.
2. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	It was not specifically stated whether or not investigators were aware of allocation of groups. This could potential skew results by putting specific subjects in each group.
3. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?** **b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?**	Yes, although there was a significantly higher number of females in each group than males (but there were no statistically significant demographic differences between groups, as tested with ANOVA).
4. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	No, this study was double-blind.
5. Did the investigators know to which treatment group subjects were assigned ? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	No, this study was double-blind.
6. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, all managed the same. Each group received a hot pack, TENS, a HEP brochure, and education on sleeping position, load carrying, and ADLs.
7. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, the authors were looking at more long-term effects of scapular mobility, and there was 8 weeks of follow-up after the 3 weeks of treatment.

8. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No. All 66 completed the 3 weeks of treatment, but only 31 completed all follow-up visits.
9. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, all participants were analyzed in the group to which they were originally assigned, but it is unknown whether there was an intention to treat analysis completed.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***
10. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI** **f. Other stats should be included here**	All stats with alpha level $p<.05$. Group comparisons completed with ANOVA; no significant differences. The comparison of 3 groups across 5 specific time points for outcome measures of function, pain at rest, pain at night, pain with activity and shoulder flexion, and internal and external range of motion revealed the exact same responses of no group-by-time interaction. There was a main effect for time in all variables studied, indicating that over the course of treatment, regardless of the treatment group, patients improved, and there were no significant differences found between groups. Post hoc analysis with a Bonferroni correction for multiple comparisons was used to determine differences between specific factors; no significant differences were found.
11. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	This study found no significant difference in long-term outcomes between groups receiving scapular mobilizations, sham treatment, or supervised exercise. All groups got better during treatment, and plateaued at follow-up. This means that purely time and additionally many different treatments are showing improvements in long-term outcomes of SIS, making many options of value.

12. Do these findings exceed a minimally important difference? Was this brought up or discussed? **a. If the MCID was not met, will you still use this evidence?**	N/A
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
13. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	Yes, this study used scapular mobilization and supervised exercise, and based outcomes on pain, ROM, and functional mobility, which is very similar to the outpatient PT clinical setting.
14. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	Yes.
15. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Yes. Risks were very minimal in this study and the benefits were all the same regardless of the group allocation.
16. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient is looking for physical therapy techniques to help her SIS, versus other treatment methods.
17. Are there any threats to external validity in this study?	This study may be biased to females based on a high ratio of female:male, and the sample sizes were quite small.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
PEDRO score	7/10. Unknown if intention to treat analyses were performed, allocation not concealed, therapists were not blinded.
Summarize your findings and relate this back to clinical significance	This study had limitations including short treatment period and lack of a control group, which should be taken into consideration. This study revealed that purely time can improve symptoms of SIS in a small sample size, and additionally scapular mobilization and exercise can show improvements as well. This study demonstrated that much more research is needed to pinpoint the best treatment for patients with SIS, but a multimodal approach shows to be somewhat effective.

Systematic Review – Evidence Appraisal Worksheet #4

Citation: Gaujoux-Viala, C., Dougados, M., & Gossec, L. (2008). Efficacy and safety of steroid injections for shoulder and elbow tendonitis: a meta-analysis of randomised controlled trials. *Annals of the Rheumatic Diseases, 68*(12), 1843-1849.

Level of Evidence

- **Oxford Scale:** 1a
- **PEDro Scale:** N/A

Does the design follow the Cochrane method?	
Appraisal Criterion	***Reader's Comments***
Step 1 – formulating the question • Do the authors identify the focus of the review • A clearly defined question should specify the types of: • people (participants) • interventions or exposures • outcomes that are of interest • studies that are relevant to answering the question	The objective of this study was to assess the efficacy on pain and functional disability, and to assess the safety of, steroid injections for patients with tendonitis of the shoulder and elbow in published randomized controlled trials (RCTs). The clinical question considered was whether or not steroid injections are effective compared with other commonly used treatments (''wait and see'', NSAIDs, physiotherapy) or placebo in terms of improvement of pain and functional ability in tendinosis (ie, epicondylitis, rotator cuff tendonitis or subacromial impingement).
Step 2 – locating studies • Should identify ALL relevant literature • Did they include multiple databases? • Was the search strategy defined and include: - Bibliographic databases used as well as hand searching - Terms (key words and index terms) - Citation searching: reference lists - Contact with 'experts' to identify 'grey' literature (body of materials that cannot be found easily through conventional channels such as publishers) - Sources for 'grey literature'	This study reported that they reviewed all RCTs pertaining to efficacy on pain or functional disability, and/or the safety of steroid injections, versus placebo, non-steroidal anti-inflammatory drugs (NSAIDs) or physiotherapy in patients with tendonitis. Databases included PubMed, EMBASE, the Cochrane library and manual searches. Pooled effect size (ES) was calculated by meta-analysis using the Mantel–Haenszel method. The search strategy was defined and all search terms and citations were included.
Step 3 – Critical Appraisal/Criteria for Inclusion • Were criteria for selection specified? • Did more than one author assess the relevance of each report • Were decisions concerning relevance described; completed by non-experts, or both? • Did the people assessing the relevance of	The trials were initially selected on the basis of their titles and abstract, then on the full texts. The inclusion criteria were all RCTs reporting the efficacy on pain and/or function, and/or the safety of steroid injections versus placebo, ''wait and see'', NSAIDs or physiotherapy in patients with epicondylitis, rotator cuff tendonitis or subacromial impingement.

studies know the names of the authors, institutions, journal of publication and results when they apply the inclusion • criteria? Or is it blind?	Articles reporting no interpretable results (data required included mean (SD)) for any of the three outcome measures (pain, function and safety) were not analyzed. One investigator (CGV) selected the articles and collected the data using a predetermined form. The following methodological features were collected: blinding, intention to treat analysis or not, and number of participants who completed follow-up. The Jadad scale was applied.
Step 3 – Critically appraise for bias: Selection- • Were the groups in the study selected differently? • Random? Concealed? Performance- • Did the groups in the study receive different treatment? • Was there blinding? Attrition- • Were the groups similar at the end of the study? • Account for drop-outs? Detection- • Did the study selectively report the results? • Is there missing data?	All 20 studies in the SR were RCTs, and all participants were randomly allocated to groups. 14 of the studies included concealed allocation. The groups in the studies received different treatments based on the objective of that study, but the outcomes measured were the same including pain, function, and safety of injections. Unknown if every study included blinding of subjects and administrators. This SR did not discuss whether or not groups were similar at the end of the study or whether or not the studies accounted for drop-outs. 9 studies included precise patient outcomes, and it was not emphasized in this SR if there was missing data.
Step 4 – Collection of the data • Was a collection data form used and is it included? • Are the studies coded and is the data coding easy to follow? • Were studies identified that were excluded & did they give reasons why (i.e., which criteria they failed).	The SR states that data was collected using a predetermined form, however it was not attached. The literature was further assessed using the Jadad Scale. Initially 218 trials were reviewed, and 119 were excluded. Articles reporting no interpretable results (data required included mean (SD)) for any of the three outcome measures (pain, function and safety) were not analyzed.

Are the results of this SR valid?	
Appraisal Criterion	***Reader's Comments***
1. Is this a SR of randomized trials? Did they limit this to high quality studies at the top of the hierarchies c) If not, what types of studies were included? d) What are the potential consequences of including these studies for this review's results?	Yes, all RCTs.

2. Did this study follow the Cochrane methods selection process and did it identify all relevant trials? If not, what are the consequences for this review's results?	Yes.
3. Do the methods describe the processes and tools used to assess the quality of individual studies? If not, what are the consequences for this review's results?	In each trial the effect size (ES) or the standardized response mean (SRM) were determined to assess the magnitude of treatment effect. However, if no measure of variability was given the ES could not be extrapolated and we calculated the SRM (mean change divided by SD of the change) when available. By convention, an ES, 0.2 is usually considered as trivial; 0.2–0.5 as small; 0.5–0.8 as moderate; 0.8–1.2 as important and .1.2 as very important. 19 SRM values .0.8 are considered as large. Pooled ES and pooled SRM were calculated by meta-analysis, using the Mantel–Haenszel method.
4. What was the quality of the individual studies included? Were the results consistent from study to study? Did the investigators provide details about the research validity or quality of the studies included in review?	Many of the RCTs in this study were heterogeneous and had varying results, but this was due to a wide range of conditions included, and additionally could be due to low quality of study, and different outcome measures used. This SR included diagnostic considerations and attempted to differentiate studies based upon the nature of the populations being studied, steroid injections were compared to placebo but also to other commonly used treatments, effect sizes were calculated for the different reported outcome measures in different trials, and time since injections was taken into account, as efficacy was assessed by the change in overall pain intensity and/or physical functional status between baseline and week 1 to 3, week 4 to 8, week 12 to 24 and week 48.
5. Did the investigators address publication bias?	Yes.
Are the valid results of this SR important?	
Appraisal Criterion	***Reader's Comments***
6. Were the results homogenous from study to study? If not, what are the consequences for this review's results?	No, but of the 20 RCTs selected, 16 were specifically selected for efficacy, and 19 selected for safety. The lack of homogeneity can add error to the results due to the lack of standardization.
7. If the paper is a meta-analysis did they report the statistical results? Did they include a forest plot?	This paper was a meta-analysis, but did not

What other statistics do they include? Are there CIs?	include a forest plot. This paper reported CIs, EF, NNT, NNH, SRM, and SDs.
8. From the findings, is it apparent what the cumulative weight of the evidence is?	Yes, it is apparent that subacromial corticosteroid injections show reduction of pain and increase in function for short-term results, and long term is unknown.
Can you apply this valid, important evidence from this SR in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
9. Is your patient different from those in this SR?	No, the patient is similar in criteria, but has not yet received a corticosteroid injection.
10. Is the treatment feasible in your setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	The standard outpatient physical therapy clinic does not provide corticosteroid injections, and is therefore not feasible in this setting, although it would be covered by insurance in a different setting if deemed necessary.
11. Does the intervention fit within your patient/client's stated values or expectations? If not, what will you do now?	No, the patient does not want to receive any invasive procedures. This information will be used to make judgments for long term care, as this SR shows that corticosteroid injections appear to be ineffective after ~9 months. Other conservative methods may be more effective in long term care, including physical therapy.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
Summarize your findings and relate this back to clinical significance.	The findings of this SR report that overall subacromial corticosteroid injections are effective for pain relief and increase in function in the short term (<9-12 months). This SR also found that NSAIDs are as effective as corticosteroid injections for short-term use. This paper demonstrates that corticosteroid use may be beneficial, but only for a short time at the first onset of symptoms, and much more research is needed for long-term effects of repeated corticosteroid use and alternative therapies including physical therapy.

Systematic Review – Evidence Appraisal Worksheet #5

Citation: Gebremariam, L., Hay, E. M., Sande, R. V., Rinkel, W. D., Koes, B. W., & Huisstede, B. M. (2013). Subacromial impingement syndrome—effectiveness of physiotherapy and manual therapy. *British Journal of Sports Medicine, 48*(16), 1202-1208.

Level of Evidence

- **Oxford Scale:** 1a
- **PEDro Scale:** N/A

Does the design follow the Cochrane method?	
Appraisal Criterion	***Reader's Comments***
Step 1 – formulating the question • Do the authors identify the focus of the review • A clearly defined question should specify the types of: • people (participants), • interventions or exposures, • outcomes that are of interest • studies that are relevant to answering the question	This article concentrated on the effectiveness of physiotherapy and manual therapy as treatment for patients with subacromial impingement syndrome (SIS). To help physicians select the most appropriate non-surgical intervention and to identify gaps in scientific knowledge, this paper explored the effectiveness of these interventions.
Step 2 – locating studies • Should identify ALL relevant literature • Did they include multiple databases? • Was the search strategy defined and include: - Bibliographic databases used as well as hand searching - Terms (key words and index terms) - Citation searching: reference lists - Contact with 'experts' to identify 'grey' literature (body of materials that cannot be found easily through conventional channels such as publishers) - Sources for 'grey literature'	This SR included literature searches from the Cochrane Library, PubMed, EMBASE, PEDro and CINAHL. Keywords related to SIS and interventions were included, and the entire search strategy was listed in the appendix of the SR. 2 SRs and 10 RCTs were included in this SR.
Step 3 – Critical Appraisal/Criteria for Inclusion • Were criteria for selection specified? • Did more than one author assess the relevance of each report • Were decisions concerning relevance described; completed by non-experts, or both?	SRs and RCTs were included if they fulfilled all of the following criteria: (A) SIS, not caused by an acute trauma or any systemic disease as described in the definition of CANS, was studied (B) an intervention for treating SIS was evaluated, (C) results on pain, function or recovery were reported and (D) a follow-up

• Did the people assessing the relevance of studies know the names of the authors, institutions, journal of publication and results when they apply the inclusion • criteria? Or is it blind?	period of ≥2 weeks was reported. There were no language restrictions. After the full-text articles were included, the included studies were divided into different treatment groups for which separate reviews could be conducted. One of these groups concerned physiotherapeutic interventions. In this review, only studies were included in which physiotherapeutic interventions were compared to placebo, no treatment or another non surgical treatment. Two reviewers independently applied the inclusion criteria (Furlan's 12 Criteria) to select potentially relevant studies from the title, abstracts and full-text articles, respectively. A consensus method was used to solve any disagreements concerning inclusion of studies, and a third reviewer was consulted if disagreement persisted.
Step 3 – Critically appraise for bias: Selection – • Were the groups in the study selected differently? • Random? Concealed? Performance- • Did the groups in the study receive different treatment? • Was there blinding? Attrition – • Were the groups similar at the end of the study? • Account for drop-outs? Detection – • Did the study selectively report the results? • Is there missing data?	The groups in each study were selected randomly, but there was not blinding of the patients in any study except for 1. Of the 2 SRs that were included, 17 reported that there was incomplete outcome data and dropout was addressed. The most prevalent flaws of the 10 RCTs included in this paper were (1) care provider not blinded and (2) unclear whether allocation was concealed.
Step 4 – Collection of the data • Was a collection data form used and is it included? • Are the studies coded and is the data coding easy to follow? • Were studies identified that were excluded & did they give reasons why (i.e., which criteria they failed).	Yes, this SR include specific characteristics of the included studies and a flowchart of the literature search. Two reviewers independently applied the inclusion criteria (Furlan's 12 Criteria). SRs and RCTs were included if they fulfilled all of the following criteria: (A) SIS, not caused by an acute trauma or any systemic disease as described in the definition of CANS, was studied (B) an intervention for treating SIS was evaluated, (C) results on pain, function or

	recovery were reported and (D) a follow-up period of ≥2 weeks was reported. There were no language restrictions. only studies were included in which physiotherapeutic interventions were compared to placebo, no treatment or another non surgical treatment.

Are the results of this SR valid?	
Appraisal Criterion	***Reader's Comments***
1. Is this a SR of randomized trials? Did they limit this to high quality studies at the top of the hierarchies e) If not, what types of studies were included? f) What are the potential consequences of including these studies for this review's results?	Yes, this paper included 2 other SRs (of RCTs) and 10 RCTs only.
2. Did this study follow the Cochrane methods selection process and did it identify all relevant trials? If not, what are the consequences for this review's results?	Yes.
3. Do the methods describe the processes and tools used to assess the quality of individual studies? If not, what are the consequences for this review's results?	Yes, this SR used Furlan's 12 criteria to address risk of bias and quality.
4. What was the quality of the individual studies included? Were the results consistent from study to study? Did the investigators provide details about the research validity or quality of the studies included in review?	The author stated that the 2 SRs and 5 of the RCTs were of highest quality, and the other 5 RCTs were of slightly lower quality. Tables highlighting each element of the quality of each article were included, and weaknesses of the studies were included in the discussion. There were various levels of conflicting evidence in the different categories that this SR addressed (i.e. laser therapy vs ultrasound).
5. Did the investigators address publication bias?	No.
Are the valid results of this SR important?	
Appraisal Criterion	***Reader's Comments***
6. Were the results homogenous from study to study? If not, what are the consequences for this review's results?	This SR split up the studies into different categories based on the treatment applied against the control, so each study was not compared to each other. Results varied based on the independent variables.
7. If the paper is a meta-analysis did they report the statistical results? Did they include a forest plat? What other	N/A.

statistics do they include? Are there CIs?	
8. From the findings, is it apparent what the cumulative weight of the evidence is?	The following table concluded the evidence of each category.

Table 3 Evidence for the effectiveness of physiotherapy and manual therapy *for subacromial impingement syndrome*

Physiotherapy			
Exercise:		**Ultrasound:**	
► exercise* vs.		► Ultrasound vs.	
laser placebo:		Placebo:	
Mid-term	++	*Short-term*	NE
Long-term	NE	*Mid-term*	NE
► exercise* vs.		*Long-term*	NE
controls		► Ultrasound vs.	
Short-term	++	Hyperthermia*:	
Mid-term	++	*Short-term*	++
► exercise vs.		► Ultrasound plus	
Hyperthermia*:		ionthophoresis:	
Short-term	++	(no FU time given)	NE
► exercise vs.		► Ultrasound vs.	
shoulder brace:		Corticosteroid injection:	
Short-term	NE	*Short-term (4 weeks)*	NE
► exercise vs.		► ultrasound vs.	
ultrasound:		acupuncture	
Short-term	NE	*Short-term*	NE
► WWH* vs.		*Mid-term*	NE
CWH:		*Long-term*	NE
Short-term	+		
		Laser:	
Mobilisation:		► laser vs.	
► mobilisation as		placebo:	
add on therapy to		*Short-term*	±
exercise:		► laser* vs. ultrasound:	
Short-term:	±	*Short-term*	+
Manual therapy:		**PEMF**	
► **manual therapy**		► PEMF vs.	
plus self-training* vs		placebo:	
self-training		*Short-term*	±
Short-term:	+		
Self-training:			
► **self-training vs.**			
physiotherapy:			
Short-term	NE		

*In favour of.
+, limited evidence found; ++, moderate evidence found; +++, strong evidence found; ±, conflicting evidence for effectiveness; CWH, clinic-based work hardening; FU, follow-up; NE, no evidence found for effectiveness of the treatment: RCT(s) available, but no differences between the intervention and control groups were found; SR, systematic review; RCT, randomized clinical trial; WWH, workplace-based work hardening.

Can you apply this valid, important evidence from this SR in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
9. Is your patient different from those in this SR?	No, this patient is similar to those studied in this SR.
10. Is the treatment feasible in your setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	Yes, many of the treatments are. Some of the modalities are less common but feasible and billable in the outpatient clinical setting.
11. Does the intervention fit within your patient/client's stated values or expectations? If not, what will you do now?	Yes, the patient is interested in pursuing manual therapy and exercise techniques, if possible.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
Summarize your findings and relate this back to clinical significance.	Overall, this SR found that some form of exercise and manual therapy is more effective than placebo or modalities such as laser or ultrasound. There is conflicting evidence when comparing exercise to corticosteroid injections, which is the trend in the literature. It is more effective to have patients with SIS participate in some form of manual therapy, exercise, or use an anti-inflammatory, than to simply let the condition get better with time.

Intervention – Evidence Appraisal Worksheet #6

Citation: Johansson, K., Bergstrom, A., Schroder, K., & Foldevi, M. (2011). Subacromial corticosteroid injection or acupuncture with home exercises when treating patients with subacromial impingement in primary care--a randomized clinical trial. *Family Practice, 28*(4), 355-365.

Level of Evidence

- **Oxford Scale:** 1b
- **PEDro Scale:** 7/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	The aim of this study was to compare the efficacy of two standardized interventions for patients with SIS performed by different primary care professionals: subacromial injection of corticosteroids (by a GP) and a series of manual acupunctures (by a PT) combined with home exercises.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study.	Yes. Adequate background for success rates of corticosteroid injections vs PT for patients with SIS were presented and discussed. This study was necessary to gain perspective on alternative methods and adjunct therapies to obtain similar long-term and short-term outcomes that corticosteroids offer for patients with SIS.

Does the research design have strong internal validity?	
Appraisal Criterion	***Reader's Comments***
Discuss possible threats to internal validity in the research design. Include: ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	Attrition: 123 subjects originally started this study, only 91 completed all follow-up. History: No control group. Instrumentation: Accuracy of injection placement may not be consistent. Maturation: unknown whether or not healing took place differently for different subjects. Compensatory Equalization: Investigators not

	blinded, effects of this unknown. Compensatory Rivalry: Subjects not blinded, effects of this unknown.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
1. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, subjects were randomly assigned to a group receiving a corticosteroid injection by a physician, or acupuncture with exercise performed by a physical therapist.
2. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	No, the groups were divided randomly using computer software.
3. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?** **b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?**	Yes, demographics were reported and there were not statistically significant differences between groups.
4. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, since groups received different treatments. This could bias results (positively or negatively) if the patient was particularly interested/disinterested in the treatment they received.
5. Did the investigators know to which treatment group subjects were assigned ? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, since they were performing different treatments. Potential consequences include bias of results by both the investigator and subject.
6. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge**	Yes.

for the study's results?	
7. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	No, there needed to be longer follow-up. Some subjects in the study did not want to complete final follow-ups because they felt they recovered, so it may have been beneficial to follow-up again at a later date to assess regression. Inadequate follow-up may positively skew the results.
8. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No. Originally there were 123 subjects, 7 dropped out due to adhesive capsulitis, and others lost due to lack of follow-up. 91 subjects completed the entirety of the study.
9. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes, and intention to treat analysis was completed.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***
10. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI** **f. Other stats should be included here**	*P*<.05 and 95% CI. To compare demographic data between the two treatments groups, t -test was used for continuous data, a chi-square test for categorical data and a Mann–Whitney U –test for ordinal data. Change over time (in the AL score, EQ-5D and EQ-VAS) within and between treatment groups was analyzed using analysis of variance repeated measures design. The score at all assessments served as the dependent variable. There were no significant differences in the primary outcome, pain and shoulder function measured by AL-score. Neither was there a difference in the secondary outcome, HRQL (Health Related Quality of Life), between the treatment groups. However, both treatment groups reported a significant improvement over time regarding pain and shoulder function (P< 0.001). HRQL

	improved significantly within the respective treatment groups ($P < 0.001$) compared with baseline both for the EQ-5D descriptive system and for the EQ-VAS.
11. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	Although there was no significant advantage to either treatment, all subjects in this study reported improvement over time, meaning that there are multiple options and approaches to treating SIS that seem to be effective.
12. Do these findings exceed a minimally important difference? Was this brought up or discussed? **a. If the MCID was not met, will you still use this evidence?**	N/A
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
13. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	Acupuncture (or similar technique like dry-needling) requires additional training for a PT, but is feasible to be used in an outpatient setting. The exercise intervention is readily available and expected in this setting.
14. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	This study used patients in Sweden, but demographic-wise it was very similar to my patient. The outcomes can be applied to the United States as well.
15. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	There was no control in this study, making it difficult to weigh risks. Risks in both corticosteroid injections and acupuncture are quite low, but both have higher risks than exercise alone. Studies have not shown significantly better outcomes with injections vs manual therapy, making the risks outweigh the benefits in those cases.
16. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	The patient would prefer to avoid injections, but is not completely opposed to dry needling, making this intervention fit similarly within the patients scope of treatment.
17. Are there any threats to external validity in this study?	This study was small and completed in Sweden, which may bias the sample.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
PEDRO score	7/10. Subjects and therapists not blinded, inadequate follow-up.
Summarize your findings and relate this back to clinical significance	This study looked at outcomes for pain and function of the shoulder. Both groups reported statistically significant positive outcomes over time, but neither group was superior to the other. This demonstrates that multiple different treatments can gain similar positive outcomes. The authors noted that progression of strength training was not emphasized, and need for further study of eccentric progression should be studied. There is a need for further study of dose-response of corticosteroids, acupuncture, and strength progression in patients with SIS.

Intervention – Evidence Appraisal Worksheet #7

Citation: Moezy, A., Sepehrifar, S., & Dodaran, M. (2014). The effects of scapular stabilization based exercise therapy on pain, posture, flexibility and shoulder mobility in patients with shoulder impingement syndrome: a controlled randomized clinical trial. *Medical Journal of the Islamic Republic of Iran, 28*(87), 1-15.

Level of Evidence

- **Oxford Scale:** 1b
- **PEDro Scale:** 6/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	The purpose of this study was to compare the effectiveness of two treatment approaches for impingement syndrome of the shoulder: (1) a 6-week scapular stabilization based exercises (exercise therapy or ET), and (2) a ROM exercise program combined with physical modalities on pain, posture, flexibility and mobility of SIS patients (physical therapy or PT).
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study.	Thorough background on mechanics of the shoulder and the effect on SIS was discussed, and multiple studies were addressed in reference to outcomes of SIS compared to cervical, thoracic, scapular, and GH deficits. This study is necessary to further explore the role of scapular stabilization on SIS.

Does the research design have strong internal validity?	
Appraisal Criterion	***Reader's Comments***
Discuss possible threats to internal validity in the research design. Include: ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	Attrition: 6 subjects were lost, and there was no apparent correction made to the data. History: No control group. Instrumentation: Different therapists completed assessments with goniometer, introducing inter-rater reliability error. Maturation: Some subjects were as young as 18 and it is unknown how age could affect

	progress of treatment. Compensatory Equalization: Investigators not blinded, effects of this unknown. Compensatory Rivalry: Subjects not blinded, effects of this unknown.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
1. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, randomization was completed using a random number table and block random sampling.
2. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	No, allocation was random.
3. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?** **b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?**	Yes. Demographics were reported and there was no statistically significant difference between groups.
4. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, they were aware of the treatment. This may introduce bias if a certain treatment was favored or disfavored for any reason.
5. Did the investigators know to which treatment group subjects were assigned ? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, because treatments were different. This may introduce bias to favored treatments.
6. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential**	Yes. All subjects received the same evaluations.

consequences of this knowledge for the study's results?	
7. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	There was no follow-up period in this study, it was looking only at the 6 weeks with intervention. Lack of follow-up may skew positive results making the results look long-lasting.
8. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	No, there were 72 originally, and 66 completed the 6-week trial. There was no intention-to-treat analysis completed.
9. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	No, and it was not specifically noted in the study how the data was analyzed, which may introduce bias in the results.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***
10. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI** **f. Other stats should be included here**	There were significant differences in VAS, abduction, external rotation, forward shoulder translation, pectoralis minor length in the PT group between pre and posttests ($p<0.05$). All variables showed significant differences in ET group except scapular rotation and symmetry between pre and posttests ($p<0.05$). There was no significant difference in pain between groups ($p < .05$), although both groups reported improved pain. The ET group demonstrated significant improvement over the PT group in ROM, forward posture, thoracic curve, and pec minor length.

11. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	There was significantly more improvement of shoulder abduction and external rotation ranges, postural parameters (forward shoulder translation, forward head posture, mid-thoracic curve and Pectoralis minor length) in ET group than the PT group. This demonstrates that scapula specific stabilization exercises and mobility may be more beneficial than a more global physical therapy approach in patients with SIS. This study also showed no benefit to ultrasound therapy alone for patients with SIS.
12. Do these findings exceed a minimally important difference? Was this brought up or discussed? **a. If the MCID was not met, will you still use this evidence?**	N/A
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
13. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	Yes, manual therapy and scapula specific mobilizations would be easily implemented into practice in the outpatient setting.
14. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	This study was conducted in Iran, but the demographics of the subjects match my patient.
15. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Yes. The scapular exercises and mobilizations have low risk and demonstrate significantly better outcomes than other exercises and modalities that do not highlight the scapula.
16. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes.
17. Are there any threats to external validity in this study?	This study was completed with a small sample size in Iran.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
PEDRO score	6/10. No concealed allocation, subjects not blinded, therapists not blinded, no intention-to-treat analysis completed.

Summarize your findings and relate this back to clinical significance	This study lacked scapula specific strength testing and did not include a follow-up period, which leaves question for long-term outcomes. However, this study did show that scapula specific exercises have significantly better effects that less specific physical therapy, and demonstrates the need for further emphasis on scapular mechanics for patients with SIS.

Intervention – Evidence Appraisal Worksheet #8

Citation: Rhon, D. I., Boyles, R. B., & Cleland, J. A. (2014). One-Year Outcome of Subacromial Corticosteroid Injection Compared With Manual Physical Therapy for the Management of the Unilateral Shoulder Impingement Syndrome. *Annals of Internal Medicine, 161*(3), 161-170.

Level of Evidence

- **Oxford Scale:** 1b
- **PEDro Scale:** 8/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	The objective of this study was to compare the 1-year effectiveness of corticosteroid injections (CSI) and manual physical therapy (MPT) for subacromial impingement syndrome (SIS) management.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study.	Relevant background information was provided on previous RCTs and SRs looking at the effects of corticosteroid injections and physical therapy, and the timing and comparison of each. There has been conflicting and inconclusive evidence for both, and there is little research directly comparing CSI and MPT, which this study addresses.

Does the research design have strong internal validity?	
Appraisal Criterion	***Reader's Comments***
Discuss possible threats to internal validity in the research design. Include: ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	Assignment: Twice as many subjects in the MPT group smoked tobacco, and twice as many subjects in the CSI group were veterans, as opposed to active duty military. Attrition: This study lost 6 subjects. They were not included in analysis. History: No control group. Instrumentation: Accuracy of injection placement may not be consistent.

	Compensatory Equalization: Investigators not blinded, effects of this unknown. Compensatory Rivalry: Subjects not blinded, effects of this unknown.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
1. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes, randomization was computer generated with assignments placed in envelopes by an off-site investigator.
2. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	No, the primary investigators were unaware.
3. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?** **b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?**	Twice as many subjects in the manual physical therapy group smoked tobacco, otherwise all demographics were reported and there were no other statistically significant differences between groups. I do not consider this difference a threat to the validity of this study.
4. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, subjects were not blinded. Knowledge of treatment can skew results if patients have an favor or disfavor with a certain treatment for any reason.
5. Did the investigators know to which treatment group subjects were assigned ? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, because treatments were different. This can introduce bias into the study by the investigators.
6. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge**	No, manual physical therapy treatments were not identical, but they were individualized based on each subjects impairments. This may introduce error.

for the study's results?	
7. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, there was 1 year follow-up, which is what this study was specifically interested in.
8. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	104 subjects originally enrolled, 98 completed. 6 subjects did not receive any treatment and were not included in the study.
9. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***
10. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI** **f. Other stats should be included here**	The sample size estimated to achieve 80% power to detect a 12-point difference (or a 9.2% change) in the SPADI, based on a reported minimal clinically important difference range of 8 to 13 points (32), with an SD of 10 points, a 2-tailed test, and an alpha level of 0.05 was 43 participants per group. Although an improvement greater than 50% was seen in the SPADI from baseline to 1 year in each group neither treatment was superior (between-group difference at 1 year, 1.5% [95% CI, -6.3% to 9.4%]). Self perceived improvement on the GRC (Global Rating of Change) was 3 points [CI, 2 to 4]), and self-reported pain (NPRS – Numeric Pain Rating Scale) improved at 1 year (mean change, 0.8 for CSI and 1.7 for MPT), but neither group was superior (between-group difference in change from baseline to 1 year: GRC, 0 [CI, -2

	to 1]; NPRS, 0.4 [CI, -0.5 to 1.2]).
11. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	Both groups reported at least a 50% improvement on the SPADI after 1 year, but neither method showed significantly superior results to the other. However, the subjects in the MPT group made fewer visits to their PCP than the CSI group (37% MPT, 60% CSI), and those in the MPT group received fewer corticosteroid injections overall in the long term. This could safe a lot of time and money in the long term.
12. Do these findings exceed a minimally important difference? Was this brought up or discussed? **a. If the MCID was not met, will you still use this evidence?**	Yes, it was based on a MCID of 8-13 points on the SPADI.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
13. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	Corticosteroid injections would not be readily available in an outpatient physical therapy clinic, nor can a PT administer them. However, the manual physical therapy is an integral part of practice and would be easily implemented.
14. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	All of these subjects were current or prior military, which my patient was not. However, the symptoms of the condition and age of patients matched up with her well.
15. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	Yes. Manual physical therapy was shown to be as effective as corticosteroid injections with a lower risk.
16. Does the intervention fit within your patient/client's stated values or expectations? **a. If not, what will you do now?**	Yes, the patient would like to avoid invasive injections.
17. Are there any threats to external validity in this study?	This study was completed in the military population only. Small sample size, and subjects came only from physician referral.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
PEDRO score	8/10. No blind subjects, no blind therapists.
Summarize your findings and relate this back to clinical significance	Findings of this study indicate that subacromial corticosteroid injections and manual physical therapy for the management of SIS have similar outcomes at 1 year follow-up after treatment, and patients who received the physical therapy had fewer PCP appointments overall. Both groups improved by at least 50% on the SPADI, indicating that one technique is not superior to the other. Invasive techniques may not be more effective in the long term.

Intervention – Evidence Appraisal Worksheet #9

Citation: Santamato, A., Solfrizzi, V., Panza, F., Tondi, G., Frisardi, V., Leggin, B. G., . . . Fiore, P. (2009). Short-term Effects of High-Intensity Laser Therapy Versus Ultrasound Therapy in the Treatment of People With Subacromial Impingement Syndrome: A Randomized Clinical Trial. *Physical Therapy, 89*(7), 643-652.

Level of Evidence

- **Oxford Scale:** 1b
- **PEDro Scale:** 8/10

Is the purpose and background information sufficient?	
Appraisal Criterion	***Reader's Comments***
Study Purpose Stated clearly? Usually stated briefly in abstract and in greater detail in introduction. May be phrased as a question or hypothesis. A clear statement helps you determine if topic is important, relevant and of interest to you. Consider how the study can be applied to PT and/or your own situation. What is the purpose of this study?	The aim of this study was to evaluate the short-term effectiveness of 2 different physical therapy modalities in the treatment of SIS: high intensity laser therapy (HILT) and ultrasound (US) therapy.
Literature Relevant background presented? A review of the literature should provide background for the study by synthesizing relevant information such as previous research and gaps in current knowledge, along with the clinical importance of the topic. Describe the justification of the need for this study.	This study provided substantial background on prior studies that have been conducted around modalities and SIS. Information about the cellular effects of both high and low intensity laser therapy were also discussed. It was especially noted that there is very little research for high intensity laser therapy and SIS, and that is why this study was completed.

Does the research design have strong internal validity?	
Appraisal Criterion	***Reader's Comments***
Discuss possible threats to internal validity in the research design. Include: ➢ **Assignment** ➢ **Attrition** ➢ **History** ➢ **Instrumentation** ➢ **Maturation** ➢ **Testing** ➢ **Compensatory Equalization of treatments** ➢ **Compensatory rivalry** ➢ **Statistical Regression**	History: No control group. Instrumentation: calibration may not be completely accurate in the different instruments, and practitioners may apply the treatment in different ways. Compensatory Equalization: Investigators not blinded, effects of this unknown. Compensatory Rivalry: Subjects not blinded, effects of this unknown.

Are the results of this therapeutic trial valid?	
Appraisal Criterion	***Reader's Comments***
1. Did the investigators randomly assign subjects to treatment groups? **a. If no, describe what was done** **b. What are the potential consequences of this assignment process for the study's results?**	Yes. Concealed allocation was performed with random computer-based assignment.
2. Did the investigators know who was being assigned to which group prior to the allocation? **a. If they were not blind, what are the potential consequences of this knowledge for the study's results?**	No, investigators were unaware of group allocation.
3. Were the groups similar at the start of the trial? Did they report the demographics of the study groups? **a. If they were not similar – what differences existed?** **b. Do you consider these differences a threat to the research validity? How might the differences between groups affect the results of the study?**	Yes. Demographics were recorded and no statistically significant differences were noted between the 2 groups.
4. Did the subjects know to which treatment group they were assign? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes, because they received different treatments that they participated in. This can skew results if a subject has a bias towards one treatment or the other.
5. Did the investigators know to which treatment group subjects were assigned ? **a. If yes, what are the potential consequences of the subjects' knowledge for this study's results**	Yes. This can skew results by introducing bias to one treatment or the other if the investigator has preference.
6. Were the groups managed equally, apart from the actual experimental treatment? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes, they were managed the same. Each group received 10 treatments within 2 weeks.
7. Was the subject follow-up time sufficiently long to answer the question(s) posed by the research? **a. If not, what are the potential consequences of this knowledge for the study's results?**	Yes.

8. Did all the subjects originally enrolled complete the study? **a. If not how many subjects were lost?** **b. What, if anything, did the authors do about this attrition?** **c. What are the implications of the attrition and the way it was handled with respect to the study's findings?**	Yes, the retention rate was 100%.
9. Were all patients analyzed in the groups to which they were randomized (i.e. was there an intention to treat analysis)? **a. If not, what did the authors do with the data from these subjects?** **b. If the data were excluded, what are the potential consequences for this study's results?**	Yes.
Are the valid results of this RCT important?	
Appraisal Criterion	***Reader's Comments***
10. What were the statistical findings of this study? **a. When appropriate use the calculation forms below to determine these values** **b. Include: tests of differences With p-values and CI** **c. Include effect size with p-values and CI** **d. Include ARR/ABI and RRR/RBI with p-values and CI** **e. Include NNT and CI** **f. Other stats should be included here**	Sample sizes of 35 for the HILT group and 35 for the US therapy group achieved a power of 80% to detect a difference of 50% in the VAS. Alpha level .05. Differences between treatment groups in change scores at the baseline and after 10 treatment sessions over a period of 2 consecutive weeks were analyzed with an independent 2-sample t test. Repeated measurements obtained before and after treatments within groups were analyzed with a paired matched t test. A 2-way repeated measures analysis of variance (ANOVA) was performed to estimate differences between (group effect) and within (time and time x group effects) treatment groups for each studied outcome. A significant change in test performance was observed in both groups after the initiation of treatments (VAS: ANOVA *F* statistic for a time effect = 435.73; *df* =1,68; *P*<.001; CMS: ANOVA *F* statistic for a time effect=800.98; *df*=1,68; *P*<.001; SST: ANOVA *F* statistic for a time effect=366.38; *df*=1,68; *P*<.001). Moreover, we found a significant difference in VAS scores when we compared US therapy with HILT (ANOVA *F* statistic for groups =

	10.863, *P*=.002), but we found no significant differences in CMS and SST scores between treatments. Finally, statistically significant differences in changes from the baseline after 10 treatment sessions by treatment group were observed (VAS: ANOVA *F* statistic for a time x group effect: 34.07; *df*=1,68; *P*<.001; CMS: ANOVA *F* statistic for a time x group effect=22.72; *df*=1,68; *P*<.001; SST: ANOVA *F* statistic for a time x group effect = 7.88; *df* = 1,68; *P*=.007).
11. What is the meaning of these statistical findings for your patient/client's case? What does this mean to your practice?	The subjects treated with HILT showed a greater reduction in pain and more improvement in articular movement, functionality, and muscle strength of the affected shoulder than the subjects treated with US therapy (as measured with the VAS, CMS, and SST). It has been reported that US treatment is not effective for SIS, but this study shows the HILT can be. This may be a beneficial addition to conservative therapies for SIS.
12. Do these findings exceed a minimally important difference? Was this brought up or discussed? **a. If the MCID was not met, will you still use this evidence?**	N/A, no MCID available for these interventions.
Can you apply this valid, important evidence about an intervention in caring for your patient/client? What is the external validity?	
Appraisal Criterion	***Reader's Comments***
13. Does this intervention sound appropriate for use (available, affordable) in your clinical setting? Do you have the facilities, skill set, time, 3rd party coverage to provide this treatment?	HILT is less likely to be available in outpatient settings due to expense, but it is available in some clinics, and may a valuable asset to have, especially for patients with SIS. This treatment is billable and can be conducted by a PT.
14. Are the study subjects similar to your patient/ client? **a. If not, how different? Can you use this intervention in spite of the differences?**	Yes, the subjects in this study were in an outpatient setting of similar age and symptoms.
15. Do the potential benefits outweigh the potential risks using this intervention with your patient/client?	HILT has low risks and the therapy appears to show benefit after follow-up. This therapy is non-invasive and may be a good addition to conservative treatment.
16. Does the intervention fit within your patient/client's stated values or expectations?	Yes, the patient is looking for non-invasive conservative treatment and is willing to try alternative modalities.

a. If not, what will you do now?	
17. Are there any threats to external validity in this study?	Small sample size, all patients came from the same setting.

What is the bottom line?	
Appraisal Criterion	***Reader's Comments***
PEDRO score	8/10. Therapists not blinded, subjects not blinded.
Summarize your findings and relate this back to clinical significance	When compared to US, this study concluded that HILT is effective in improving pain, function, and strength of the shoulder in the short-term. This study lacked a control and long term follow-up, which may skew results, however it demonstrated that there is some kind of effect in treating SIS. This study demonstrated another option for those seeking conservative treatment for their SIS, and further research and implementation of this modality is needed.