A manual physical therapy approach versus subacromial corticosteroid injection for treatment of shoulder impingement syndrome: a randomized clinical trial.

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Boyles, Robert; University of Puget Sound, School of Physical Therapy  
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| **Subject Heading:** | Rehabilitation medicine |
| **Keywords:** | shoulder impingement, family medicine, manual therapy, physical therapy, PRIMARY CARE, corticosteroid |
ARTICLE SUMMARY

Article focus

- Shoulder pain is a common symptom in patients seeking healthcare for musculoskeletal complaints.
- Corticosteroid injections are a common first line intervention for shoulder pain in primary care settings, but their long-term efficacy has not been established.
- There may be other non-invasive interventions that provide longer relief of symptoms.

Key messages

- Manual therapy has been shown to provide improvements in pain and function in patients with shoulder impingement, but has not been directly compared with corticosteroid injections.
- If significantly better changes in pain and function can be maintained out to 1 year with one intervention over the other, then this may help improve clinical practice guidelines for the management of shoulder impingement syndrome.

Strengths and limitations of this study

- This randomised controlled study will evaluate the effectiveness of manual physical therapy compared to corticosteroid injection in patients with shoulder impingement.
• This is a pragmatic study evaluating two interventions that are standard of practice, with corticosteroid injections being used more often in a primary care setting.

• As a blinded randomized clinical trial, this allows for cause and effect analysis

• Due to the pragmatic nature of the study, it is not always easy to replicate the intervention exactly in each patient. The manual therapy approach gives the clinician some latitude with treatment to focus on individual impairments.

Disclaimer: The views expressed are those of the authors and do not reflect the official policy of the Department of the Army, the Department of Defense or the U.S. Government.
INTRODUCTION

Shoulder impingement is among the most common and self-limiting disorders of the musculoskeletal system.[1, 2] The point prevalence of shoulder symptoms has been reported to range from 20-33%[3] and the incidence of shoulder complaints in the general population is increasing.[4] Furthermore, several authors have reported low rates of perceived recovery (patient reports of “being cured”) for patients with a new episode of shoulder or neck pain.[4-7] Less than 25% of patients with a first episode of shoulder pain may recover, without report of any symptoms, after 3 months.[5] Recovery rates at 18 months have been reported only between 49% and 59%[5-7] and 25% of patients with shoulder or neck pain experience at least one episode of recurrence within 12 months.[9] These findings suggest that shoulder pain can be recurrent and frequently progresses to the chronic stage.

A comprehensive manual physical therapy (MPT) approach, including both thrust and non-thrust techniques, has been shown to be effective for patients presenting with a primary report of shoulder pain.[8-18] This is a comprehensive approach that has shown improvement in shoulder symptoms with mobilization and manipulation techniques targeted to the thoracic spine, cervicothoracic spine, rib cage, and acromioclavicular joints [9,14] in addition to the glenohumeral joint. In a trial by Bergman et al.[9] patients with a primary report of shoulder pain were randomly assigned to receive usual medical care (UMC) for their shoulder symptoms from their primary care physicians or usual care plus manipulative therapy (UMC+MT) directed at the cervicothoracic spine and rib cage for a maximum of 6 treatment sessions. The group with the addition of manipulative therapy demonstrated superior rates of patients reporting “full recovery”, as well as more improvement in the severity of main complaints and disability out to 52 weeks.[9] In a trial by Bang and Deyle[8], greater improvements in function and pain were noted at 2 months in patients receiving a manual physical therapy approach, consisting of
manual techniques and reinforcing exercises, versus exercise alone (18% and 40% greater, respectively). Sensbursa et al[18] compared the effectiveness of joint and soft tissue mobilization techniques in addition to ice application and a supervised exercise program consisting of stretching, strengthening, and range of motion exercises to a self-training program performed by the patient at home that was focused on strengthening the depressors of the humeral head. Pain and range of motion improvements were significantly better in the manual therapy group. Conroy and Hayes[10] in a study involving 14 subjects with subacromial impingement, reported that glenohumeral joint mobilization combined with a comprehensive treatment (hot packs, active range of motion, physiologic stretching, muscle strengthening, soft tissue mobilization, and patient education) resulted in a significant decrease in 24-hour pain and symptoms with subacromial compression tests compared with comprehensive treatment alone. Despite the evidence supporting the use of manual therapy, a recent systematic review by Ho et al[19] for shoulder impingement stated there was no clear evidence to suggest additional benefits of manual therapy to other interventions, indicating the need for further high quality research. That systematic review was through January of 2007, excluding some more recent trials that have been discussed here. Several other studies have looked at a less pragmatic approach to manual therapy by breaking down the manual therapy approach into several sub-components.[20, 21] No evidence for harm with using this intervention has been reported.

Corticosteroids injections are a common intervention for symptoms from shoulder impingement. They are one of the most common procedures for the management of shoulder pain used by orthopedists, rheumatologists, and general practitioners.[22] with 96% of clinicians in a recent survey stating that CSI is an efficacious treatment option for rotator cuff pathology.[23] Conflicting evidence in the literature suggests their efficacy in the management of shoulder impingement is not well established.[24-29] A recent meta-analysis by Arroll et. al[25] evaluating the
efficacy of corticosteroid injections for painful shoulder conditions (including rotator cuff tendonitis and adhesive capsulitis) concluded that subacromial injections are probably effective for improvement of rotator cuff tendonitis when compared to placebo or non-steroidal anti-inflammatory drugs (NSAID), but there is still insufficient evidence to determine the extent of their effectiveness. Eight studies were found in the meta-analysis through 2004 that met the inclusion criteria requiring a comparison of corticosteroids against NSAIDs or placebo, and of those, five compared subacromial injection to placebo. Two of those same studies, and one additional study compared injection to NSAIDs, and only one of these studies showed a statistically significant difference between the two although both interventions were significantly better than placebo.[30] That study followed subjects only out to four weeks.[37] Only three of the eight studies were considered high-quality by the reviewers, and only two of the eight studies showing a significant difference between interventions. Those studies were specifically for shoulder impingement. The determination of effectiveness was based on dichotomizing results into success and non-success based on the terms that included ‘responder’, ‘decreased pain’, and ‘remission’. The numbers needed to treat (NNT) in order to obtain a positive result compared to placebo was 3.3 and to NSAIDs was 2.5. However, the NSAID NNT analysis was only based on 1 study. The only two studies showing significant differences between interventions had 4 and 33-week follow-ups. A recent Cochrane review[26] and a meta-analysis by Gaujoux-Viala et al[28] indicated that steroid injections were not more effective than NSAIDs in the treatment of shoulder and elbow tendonitis. The effects of corticosteroid injections should be compared to therapies that have been shown to be successful in the management of this population as NSAIDs and placebo do not necessarily represent best evidence practice for management of rotator cuff tendonitis or shoulder impingement. A recent systematic review by Koester et al[29] found nine randomized clinical trials comparing subacromial corticosteroid injection with placebo in patients with rotator cuff tendonitis.
cuff disease. Whereas the latest Cochrane Review[26] states that there is little
evidence to support or refute their use, the Koseter[29] review concluded, with the
addition of more recent studies, that subacromial corticosteroid injection is not
effective in the treatment of rotator cuff disease. It has been reported that the
variable success with subacromial corticosteroid injections may be due to inaccuracy
of the clinician in terms of approach (posterior or anterolateral)[31], tendon
penetration[32], and/or inconsistencies in dose[25].

Shoulder injections may have a higher correlation with follow-on surgery. A
reported predictor of patients with shoulder pain that eventually have surgery is the
number of subacromial steroid/lidocaine injections they receive as well as their
response to the initial injection.[27] Two recent systematic reviews [33-34] comparing
conservative interventions, including physical therapy, to surgical interventions failed
to find a difference in long-term pain and function between the two interventions. We
should continue to explore the effectiveness of low risk interventions that can provide
significant long-term benefits for patients with shoulder impingement.

Specific aim
To determine if there is a clinically significant difference in outcomes of pain and
disability between subjects with shoulder impingement syndrome that receive MPT
versus CSI at 1 year.

Trial Design and Methods
The study will be a randomized clinical trial. The independent variables are
treatment (MPT and CSI) and time with 5 levels from baseline out to one year. The
primary dependent variable (DV) is the Shoulder Pain and Disability Index (SPADI).
The secondary DVs are the Global Rating of Change (GRC) and the Numeric Pain
Rating Scale (NPRS). Figure 1 demonstrates the flow of subjects through the trial.
This will be a trial assessing pragmatic delivery of two common interventions, and will
report results following CONSORT guidelines for pragmatic trials.[33] The current SPIRIT guidelines for creating protocols for randomized clinical trials were followed.[34]

Participants

We will recruit 104 subjects, male and female between the ages of 18-65 years with a primary complaint of shoulder pain through the Physical Therapy departments at Madigan Army Medical Center (MAMC) as well as the outlying primary care clinics on the military installation. They will be recruited through the referral source to Physical Therapy from outlying clinics (Family Practice, Orthopaedics, and Primary Care clinics). If recruitment targets are not being met, flyers with information about the study may be distributed for potential subjects to inquire about as patients in this setting have direct access to physical therapy care and do not necessarily need a referral source.

Inclusion criteria:

1. Age 18 and older
2. Read, write, and speak English
3. Eligible for healthcare at a military Medical Treatment Facility (MTF)
4. Primary complaint of shoulder pain
5. Meets diagnostic criteria for shoulder impingement (mentioned below)

Exclusion criteria:

1. History of a shoulder injection in last 3 months
2. History of shoulder dislocation, subluxation, fracture, adhesive capsulitis of the glenohumeral joint, or cervical/shoulder/upper back surgery
3. Isolated acromioclavicular joint (ACJ) pathology. The only location of symptoms is localized specifically with one finger directly over the ACJ and nowhere else, and reproduced only with ACJ palpation by the examiner.

4. Full-thickness rotator cuff tears (evidenced by MRI and/or positive lag signs)

5. Presence of cervical radiculopathy, radiculitis, or referral from cervical spine

6. Total baseline SPADI score not less than 20% (to prevent a ceiling effect with treatment)


8. Prior OMPT treatment to the involved limb for the current episode of pain

9. Military service members pending a medical evaluation board, physical evaluation board, or equivalent discharge process, or in medical hold to determine long term disposition. For non-military personnel, anyone that is pending or undergoing any litigation for their injury.

10. Contraindications or precautions to receiving a corticosteroid injection (history of allergies, adverse reactions, history of multiple injections in that area even if not within last 30 days, uncontrolled diabetes mellitus, pregnancy, etc).

11. Unable to give informed consent to participate in the study.

12. Unable to come into the clinic for regular treatment over the course of the following month.

Diagnostic criteria for entry:

To be included in the study participants are required to have:

(1) pain* with one of the 2 tests in category I, and

(2) pain* with one test from either category II or category III.

* “pain” is defined as reproduction of the usual pain that the subject experiences that makes up the nature of their complaint.

Category I: Impingement signs
1. Passive overpressure at full shoulder flexion with the scapula stabilized.

2. Passive internal rotation at 90 degrees of shoulder flexion in the scapular plane and in progressive degrees of horizontal adduction.

Category II: Active shoulder abduction

Active shoulder abduction

Category III: resisted break tests

1. Abduction

2. Internal rotation

3. External rotation

This criteria has been used in previous clinical trials to classify patients with shoulder impingement syndrome.[17,23]

Randomization

Once the baseline examination is completed, a second investigator blind to the baseline examination will open the randomization envelope indicating the patient’s treatment group assignment that corresponds to the patient's unique identification number. A random number generator will be used to establish randomization lists prior to the initiation of the study. Separate randomization lists will be generated for each participating site to insure that equal numbers of subjects are randomized to each group at each site. Individual randomization assignments will be concealed according to the following procedure. The group assignment will be recorded on a label that is affixed to a 3.5 X 5 inch index card. This card will be folded in half such that the label with the patient's group assignment will be on the inside of the fold. The folded index card will then be placed inside the envelope, and the envelope will be sealed. This will prevent the possibility of the therapist holding the envelope up to the light and visualizing the patient’s treatment group assignment through a sealed yet transparent envelope.
Blinding

Due to the nature of this study, it is not possible to blind the patient or the clinician providing the intervention to the treatment received. The clinician performing the screening, baseline and follow-up measurements, and outcome assessments will be blinded to the patient’s treatment group assignment. Patients will be instructed not to discuss the intervention received with the clinician when reporting for their follow-up appointments unless medically necessary. Incidence of unmasking will be recorded.

Interventions

Both treatment options are standard of care interventions. Their allocation and dosage is described in Table 1.

Table 1. Treatment allocation and dosage.

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Manual Physical Therapy

At the first session, the examiner will perform a standard clinical examination in order to determine the appropriate application and delivery of MPT (Appendix 1) to the entire shoulder, spine, and adjacent joints. The goal of MPT is to improve the quality of motion and decrease the pain associated with motion at the target joint and soft tissue. For our purposes, we define our manual physical therapy as the combination of manual techniques to include joint mobilizations (both thrust and non-thrust
techniques), soft tissue mobilizations, manual stretches and contract-relax
techniques, along with the exercises that help reinforce those techniques. We feel
this is consistent not only with other shoulder trials, but also with other MPT trials[35-
38]. The application of techniques will not be based on a regimented protocol that is
identical for each patient, but rather tailored specifically to the impairments identified
during the clinical examination. We feel this approach is pragmatic and consistent
with the actual delivery of MPT in the clinical setting.

The examiner will provide an initial intervention of MPT that is targeted to
impairments found during the initial clinical examination (the patient will return for a
maximum total of 6 treatment sessions over the following 3 weeks). Each session
will last approximately 30 minutes. The subjects will receive some of the protocol
exercises (Appendix 2) to augment the joint mobilizations, which will collectively
make up the MPT intervention.

The clinicians providing the MPT are 2 fellowship trained orthopaedic manual
physical therapists, that both received training in the same 18-month program, to
ensure consistency with delivery of this intervention approach.

Corticosteroid Injection

The examiner will perform a standardized clinical examination and health screening
in order to confirm the absence of contraindications to steroid injection. The subject
will then receive an injection in the subacromial space of the symptomatic shoulder
by a senior Sports Medicine Fellowship Trained Family Physician (Appendix 3). The
subject will also receive a handout explaining the effects of the steroid injection, how
to manage any potential flare-ups or ensuing pain, and a handout describing
pendulum exercises for the subject to perform. The physician will spend
approximately 30 minutes with each subject explaining the rationale for the injection,
relevant anatomy, performing the procedure, and reviewing the pendulum exercises.
The subject can receive up to a total of 2 shoulder injections with a minimum of 1 month between injections if they are not getting relief of symptoms with the initial injection. This will be dictated by patient preference and the approval/recommendation of the physician performing the injection procedure, as this would represent a pragmatic approach commensurate with standard practice.

**Outcome measures**

The primary dependent variable will be the SPADI and the secondary dependent variables will be the GRC and the NPRS.

**Shoulder Pain and Disability Index (SPADI):**

The SPADI is a 100-point, 13 item self–administered questionnaire. It is divided into two subscales: a five item pain subscale and an eight-item disability subscale. Williams et al have shown that the SPADI is responsive to change and accurately discriminates between patients who are improving or worsening.[39] Authors have reported a high test-retest reliability and internal consistency for this instrument.[40] A recent systematic review identified a minimal detectable change (MDC) of 18 points and a minimally clinically important difference (MCID) of between 8-13 points.[41] The validity and responsiveness to change of SPADI have been described in physical therapy, as well as primary and secondary care settings.[42]

Because disability will be used as an outcome of interest, it is important to insure a moderate level of disability will be present at the inception of the treatment. Thus, patients will be required to have at least a baseline SPADI score of 20 points (average of pain and disability subscales). A score of 0 indicates no pain or functional limitation with the described activities.

**Global Rating of Change Questionnaire (GRC):**
The GRC questionnaire is an instrument that measures overall changes in the quality of life of the subject.[43] The use of a GRC is a common, feasible, and useful method for assessing outcome,[44] and has been shown to be a valid measurement of change in patient status in other pain populations.[45] A change in score of three rating points (+3) has been established as a clinically significant in the patients perception of quality of life.[44] The GRC has 15 possible choices, with 0 being equal to no change and -1 to -7 indicating a negative change and +1 to +7 indicating a positive change.

Numeric Pain Rating Scale (NPRS):

An 11-point pain rating scale ranging from 0 (no pain) to 10 (worst imaginable pain) will be used to assess pain intensity in the shoulder.[46] This scale has been demonstrated to be reliable, generalizable, and have internal consistency in measures of clinical and experimental pain sensation intensity.[47, 48] A change of at least 3 points has been suggested as the MCID for the NPRS in patients with shoulder pain.[49]

**Justification of sample size:**

The calculations were based on detecting a 12-point (or 9.2% change - based on reported MCID range of 8-13 points)[41] difference in the SPADI with a standard deviation of 10 points, a two-tailed test, and an alpha level equal to 0.05. This generates a sample size of 43 subjects per group. Allowing for a conservative dropout or loss to follow-up rate of approximately 20%, we will recruit 104 subjects into the study. Planning for a larger loss to follow-up rate is deemed necessary in this military population where follow-up at 1 year can be challenging with multiple deployments and changes in duty station around the world. This sample size will
yield greater than 80% power to detect both statistically significant and clinically meaningful changes in the other outcome variables. Sample size estimation was performed with G*Power software, version 3.1.2.[50]

Data analysis

Descriptive statistics will be run on the demographic data (age, gender, race, etc.) and health characteristics of the study population to include measures of central tendency (means, medians, other percentiles) and dispersion (standard deviations, ranges) which will be computed for continuous data for summary. Frequency distributions will be estimated for categorical data. Graphical displays including histograms and box plots will be produced. Transformations will be sought for variables to be included in further analyses to insure distributional assumptions are met.

Inferential analysis of the data for this study will be conducted using a mixed model 2 x 5 repeated measures analysis of variance (ANOVA) with treatment x 2 levels (MPT and CSI) and time with 5 levels (baseline, 1, 3, 6, 12 months) as the independent variables, the SPADI questionnaire as the primary dependant variable, and the GRC and NPRS as the secondary dependent variables. If one treatment is shown to be superior to the other, supplemental analyses will be performed by dichotomizing groups based on minimal clinically important differences (MCIDs) of 13% for the SPADI.[45] This will allow computation of absolute risk reduction, relative risk reduction, and number needed to treat (with associated 95% confidence intervals) using failure to obtain clinically meaningful benefit as the event of interest. The level of significance for all analyses will be a priori established at 0.05 using a two-tailed test.

In the event of subjects dropping out or lost to follow-up, intention-to-treat analyses will be performed by testing different intention to treat assumptions (i.e., last
observation carried forward, completers only, etc.) using multivariate normal multiple
imputation methods. Because of potential crossover between groups data will be
analyzed using both per-protocol and intention to treat principles. The per-protocol
analyses will only include patients who completed the study in the group to which
they were randomly assigned. The intention to treat analyses will include all patients
who were randomized at baseline regardless if they crossed over.

Data analysis will be conducted using SPSS for Windows version 16 (SPSS Inc.,
Chicago, Illinois).

**Trial Organization and Monitoring:**

The investigative team consists of the authors listed in this protocol, in addition to
three other licensed physical therapists that will assist with subject screening, data
collection, subject follow-up, and data entry. The principal investigator will manage
data flow and perform audits of the procedures, enrollment, and treatment throughout
the entire process of the study. The associate investigators will monitor data
collection process and data integrity with periodic evaluation performed continually
during the course of the data collection phase.

**Discussion**

This randomized clinical trial will be the first study that directly compares the short
and long term effects of an impairment-based manual physical therapy approach and
corticosteroid injections for patients with shoulder impingement syndrome. The
results of this study may aid in establishing best clinical practice guidelines for this
patient population.

**Ethical Considerations and Dissemination**
All interventions provided in this study are considered standard of care could be given to a patient as part of their treatment plan even if the were not a part of this study. Ethics review will be conducted by Madigan Army Medical Center and monitored by the U.S. Army Medical Department Clinical Investigation Regulatory Office (CIRO) to ensure compliance with federal regulations for protection of human medical research subjects. This clinical trial was registered with ClinicalTrials.gov with a registration number of NCT01190891.

Publication Policy:

The results of the trial will be published in an appropriate journal regardless of outcome. We will report the results following the CONSORT statement with the recommended extension for pragmatic trials.[33]

Projected Timetable for Trial:

March 2010 – Protocol approved by the Western Regional Medical Command Institutional Review Board.

June 2010 – Subject enrollment begins

June 2011 – First subject completes 1-year follow-up

July 2011 – Subject enrollment complete

July 2012 – Last subject completes 1-year follow-up

December 2012 – Data entry and analysis complete

June 2013 – Publication with study results submitted for publication.

Competing interests

There are no competing interests to disclose involving this study, either financial or otherwise.


**Authors' contributions**

DIR conceived the idea for the project and is the PI. All authors contributed to writing and reviewing the protocol, as well as reviewing and submitting the protocol for publication. JAC provided advice with statistical and methods design. DIR and REB provided all the direct interventions for the MPT group. DLB performed all the injections for the CSI group.

**Acknowledgements**

This study is funded in part by the Orthopaedic Physical Therapy Products Grant through the American Academy of Orthopaedic Manual Physical Therapists. This body has no influence in determining the study design; the collection, analysis, and interpretation of data; the writing of the protocol; or the decision to submit the protocol for publication.

**Tables and Figures**

**Figure 1. Proposed recruitment flow of the study.**

OMPT= Orthopaedic Manual Physical Therapy; SPADI= Shoulder Pain and Disability Index; GROC= Global Rating of Change; NPRS= Numeric Pain Rating Scale.

**Table 1. Treatment allocation and dosage.**

**Appendices**

**Appendix 1: Manual physical therapy manual techniques.**

Represents the majority of the techniques used, but is not inclusive or representative of all of them.

**Appendix 2: Home exercise program handout for OMPT group**

**Appendix 3: Corticosteroid injection procedures**
References


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Treatment Allocation and Dosage
Referral for shoulder pain → Adequate Inclusion/Exclusion Criteria → Informed Consent

Physical Examination and outcome measure assessment

Patient Education on Shoulder Impingement Handout

Randomization into treatment group

Group 1: CSI
  Up to 3 sessions

Group 2: MPT
  6 sessions

Blinded outcomes taken (SPADI, GRC, NPRS) at 1, 3, 6, & 12 month follow-ups

Trial conclusion at 1 year

Study Flow
A manual physical therapy approach versus subacromial corticosteroid injection for treatment of shoulder impingement syndrome: a protocol for a randomized clinical trial.

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ARTICLE SUMMARY

Article focus

- Shoulder pain is a common symptom in patients seeking healthcare for musculoskeletal complaints.
- Corticosteroid injections are a common first line intervention for shoulder pain in primary care settings, but their long-term efficacy has not been established.
- The long-term efficacy of manual physical therapy and corticosteroid injections will be evaluated and compared out to 1 year.

Key messages

- Manual therapy has been shown to provide improvements in pain and function in patients with shoulder impingement, but has not been directly compared with corticosteroid injections.
- Understanding which interventions have better long term outcomes may be instrumental in helping improve clinical practice guidelines for the management of shoulder impingement syndrome.

Strengths and limitations of this study

- This randomised controlled study will compare the effectiveness of a manual physical therapy approach to a corticosteroid injection in patients with shoulder impingement.
- This is a pragmatic study evaluating two interventions that are standard of practice, and have been shown to be effective for shoulder impingement.
• Even as a single blinded randomized clinical trial we do not have a true control group and cannot state if true cause and effect relationship exists.

• Due to the pragmatic nature of the study the intervention will not be standardized which could make it difficult for clinicians to replicate.

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INTRODUCTION

Shoulder impingement is among the most common function-limiting disorders of the musculoskeletal system.[1, 2] The point prevalence of shoulder symptoms has been reported to range from 20-33%[3] and the incidence of shoulder complaints in the general population is increasing.[4] Furthermore, several authors have reported low rates of perceived recovery (patient reports of “being cured”) for patients with a new episode of shoulder or neck pain.[4-7] Less than 25% of patients with a first episode of shoulder pain may recover and be symptom-free after 3 months.[5] Recovery rates at 18 months have been reported only between 49% and 59%[5-7] and 25% of patients with shoulder or neck pain experience at least one episode of recurrence within 12 months.[9] These findings suggest that shoulder pain can be recurrent and frequently progresses to the chronic stage.

A comprehensive manual physical therapy (MPT) approach, including both thrust and non-thrust techniques, has been shown to be effective for patients presenting with a primary report of shoulder pain.[8-18] This is a comprehensive approach that has shown improvement in shoulder symptoms with mobilization and manipulation techniques targeted to the thoracic spine, cervicothoracic spine, rib cage, and acromioclavicular joints [9,14] in addition to the glenohumeral joint. A recent systematic review by Ho et al[19] stated there was no clear evidence to suggest additional benefits of manual therapy to other interventions for shoulder impingement, indicating the need for further high quality research. That systematic review was conducted through January of 2007, excluding some more recent trials discussed below.

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symptoms from their primary care physicians or usual care plus manipulative therapy (UMC+MT) directed at the cervicothoracic spine and rib cage for a maximum of 6 treatment sessions. The group that received manipulative therapy reported demonstrated superior increased rates of patients reporting reported “full recovery”, and more improvement in the severity of main complaints and disability out to 52 weeks. In a trial by Bang, significant greater improvements in function and pain with the use of a manual physical therapy approach, consisting of manual techniques and reinforcing exercises was shown out at two months. Two other studies compared the use of manual mobilization techniques in addition to a comprehensive offering of various therapeutic modalities and exercise, and showed improved outcomes in the groups that received mobilizations in addition to their comprehensive program. Sensbursa et al compared the effectiveness of joint and soft tissue mobilization techniques in addition to ice application and a supervised exercise program consisting of stretching, strengthening, and range of motion exercises to a self-training program performed by the patient at home that was focused on strengthening the depressors of the humeral head. Pain and range of motion improvements were significantly better in the manual therapy group. Conroy and Hayes in a study involving 14 subjects with subacromial impingement, reported that glenohumeral joint mobilization combined with a comprehensive treatment (hot packs, active range of motion, physiologic stretching, muscle strengthening, soft tissue mobilization, and patient education) resulted in a significant, but very short-term decrease in 24-hour pain and symptoms with subacromial compression tests compared with comprehensive treatment alone. Several other studies have looked at a less pragmatic approach to manual therapy by breaking down the manual therapy approach into several sub-components. No evidence for harm with using this intervention has been reported.

Corticosteroids injections are a common intervention for symptoms from shoulder impingement, and have also been shown to be an effective treatment for
shoulder pain. They are one of the most common procedures for the management of shoulder pain used by orthopedists, rheumatologists, and general practitioners,[22] with 96% of clinicians in a recent survey stating that CSI is an efficacious treatment option for rotator cuff pathology.[23] Conflicting evidence in the literature suggests their efficacy in the management of shoulder impingement is not well established.[24-29] A recent meta-analysis by Arroll et. al[25] evaluating the efficacy of corticosteroid injections for painful shoulder conditions (including rotator cuff tendonitis and adhesive capsulitis) concluded that subacromial injections are probably effective for improvement of rotator cuff tendonitis when compared to placebo or non-steroidal anti-inflammatory drugs (NSAID), but that there is still insufficient evidence to determine the extent of their effectiveness. Eight studies were found in the meta-analysis through 2004 that met the inclusion criteria requiring a comparison of corticosteroids against NSAIDs or placebo, and of those, five compared subacromial injection to placebo. Two of those same studies, and one additional study compared injection to NSAIDs, and only one of those studies showed a statistically significant difference between the two although Both interventions were significantly better than placebo.[30] That study followed subjects only out to four weeks.[37] Only Three of the eight studies were considered high-quality by the reviewers, and only two of the eight studies showed a significant difference between interventions. Those studies were specifically for shoulder impingement. The determination of effectiveness was based on dichotomizing results into success and non-success based on the terms that included ‘responder’, ‘decreased pain’, and ‘remission’. The numbers needed to treat (NNT) in order to obtain a positive result compared to placebo was 3.3 for injection and 2.5 for NSAIDs was 2.5. However, the NSAID NNT analysis was only based on 1 study. The only two studies showing significant differences between interventions had follow-up at 4 and 33-weeks follow-ups.

A recent Cochrane review[26] and a meta-analysis by Gaujoux-Viala et al[28] indicated that steroid injections were not more effective than NSAIDs in the treatment
of shoulder and elbow tendonitis. The effects of corticosteroid injections should be compared to therapies that have been shown to be successful in the management of this population as NSAIDs and placebo do not necessarily represent best evidence practice for management of rotator cuff tendonitis or shoulder impingement. A recent systematic review by Koester et. al[29] found nine randomized clinical trials comparing subacromial corticosteroid injection with placebo in patients with rotator cuff disease. Whereas the latest Cochrane Review[26] states that there is little evidence to support or refute their use, the Koseter[29] review concluded, with the addition of more recent studies, that subacromial corticosteroid injection is not effective in the treatment of rotator cuff disease. It has been reported that the variable success with subacromial corticosteroid injections may be due to inaccuracy of the clinician in terms of approach (posterior or anterolateral)[31], tendon penetration[32], and/or inconsistencies in dose[25].

Shoulder injections may have a higher correlation with follow-on surgery. A reported predictor of patients with shoulder pain that eventually have surgery is the number of subacromial steroid/lidocaine injections they receive as well as their response to the initial injection.[27] Two recent systematic reviews [33-34] comparing conservative interventions, including physical therapy, to surgical interventions failed to find a difference in long-term pain and function between the two interventions. We should continue to explore the effectiveness of low risk interventions that can provide significant long-term benefits for patients with shoulder impingement.

Specific aim

To determine if there is a clinically significant difference in outcomes of pain and disability between subjects with shoulder impingement syndrome that receive MPT compared to CSI at 1 year.
**Trial Design and Methods**

The study will be a randomized clinical trial. The independent variables are treatment (MPT and CSI) and time with 5 levels from baseline out to one year. The primary dependent variable (DV) is the Shoulder Pain and Disability Index (SPADI). The secondary DVs are the Global Rating of Change (GRC) and the Numeric Pain Rating Scale (NPRS). Figure 1 demonstrates the flow of subjects through the trial.

This will be a trial assessing pragmatic delivery of two common interventions, and will report results following CONSORT guidelines for pragmatic trials.[33] The current SPIRIT guidelines for creating protocols for randomized clinical trials were followed.[34]

**Participants**

We will recruit 104 subjects, male and female between the ages of 18-65 years with a primary complaint of shoulder pain through the Physical Therapy departments at Madigan Army Medical Center (MAMC) as well as the outlying primary care clinics on the military installation. They will be recruited through the referral source to Physical Therapy from outlying clinics (Family Practice, Orthopaedics, and Primary Care clinics). If recruitment targets are not being met, flyers with information about the study may be distributed for potential subjects to inquire about as patients in this setting have direct access to physical therapy care and do not necessarily need a referral source.

Inclusion criteria:

1. Age 18 and older
2. Read, write, and speak English
3. Eligible for healthcare at a military Medical Treatment Facility (MTF)
4. Primary complaint of shoulder pain
5. Meets diagnostic criteria for shoulder impingement (mentioned below)
Exclusion criteria:

1. History of a shoulder injection for the current episode of pain.
2. History of shoulder dislocation, subluxation, fracture, adhesive capsulitis of the glenohumeral joint, or cervical/shoulder/upper back surgery.
3. Isolated acromioclavicular joint (ACJ) pathology. The only location of symptoms is localized specifically with one finger directly over the ACJ and nowhere else, and reproduced only with ACJ palpation by the examiner.
4. Full-thickness rotator cuff tears (evidenced by MRI and/or positive lag signs).
5. Presence of cervical radiculopathy, radiculitis, or referral from cervical spine.
6. Total baseline SPADI score not less than 20% (to prevent a ceiling effect with treatment).
8. Prior MPT treatment to the involved limb for the current episode of pain.
9. Military service members pending a medical evaluation board, physical evaluation board, or equivalent discharge process, or in medical hold to determine long term disposition. For non-military personnel, anyone that is pending or undergoing any litigation for their injury.
10. Contraindications or precautions to receiving a corticosteroid injection (history of allergies, adverse reactions, history of multiple injections in that area even if not within last 30 days, uncontrolled diabetes mellitus, pregnancy, etc).
11. Unable to give informed consent to participate in the study.
12. Unable to come into the clinic for regular treatment over the course of the following month.

Diagnostic criteria for entry:

To be included in the study participants are required to have:
(1) pain* with one of the 2 tests in category I, and
(2) pain* with one test from either category II or category III.

* “pain” is defined as reproduction of the usual pain that the subject experiences that makes up the nature of their complaint.

**Category I:** Impingement signs

1. Passive overpressure at full shoulder flexion with the scapula stabilized.
2. Passive internal rotation at 90 degrees of shoulder flexion in the scapular plane and in progressive degrees of horizontal adduction.

**Category II:** Active shoulder abduction

   Active shoulder abduction

**Category III:** resisted break tests

1. Abduction
2. Internal rotation
3. External rotation

This criteria has been used in previous clinical trials to classify patients with shoulder impingement syndrome.[17,23]

**Randomization**

Once the baseline examination is completed, a second investigator blind to the baseline examination will open the randomization envelope indicating the patient’s treatment group assignment that corresponds to the patient’s unique identification number. A random number generator will be used to establish randomization lists prior to the initiation of the study. Separate randomization lists will be generated for each participating site to insure that equal numbers of subjects are randomized to each group at each site. Individual randomization assignments will be concealed according to the following procedure. The group assignment will be recorded on a label that is affixed to a 3.5 X 5 inch index card. This card will be folded in half such
that the label with the patient’s group assignment will be on the inside of the fold. The folded index card will then be placed inside the envelope, and the envelope will be sealed. This will prevent the possibility of the therapist holding the envelope up to the light and visualizing the patient’s treatment group assignment through a sealed yet transparent envelope.

**Blinding**

Due to the nature of this study, it is not possible to blind the patient or the clinician providing the intervention to the treatment received. The clinician performing the screening, baseline and follow-up measurements, and outcome assessments will be blinded to the patient’s treatment group assignment. Patients will be instructed not to discuss the intervention received with the clinician when reporting for their follow-up appointments unless medically necessary. Incidence of unmasking will be recorded.

**Interventions**

Both treatment options are standard of care interventions. Their allocation and dosage is described in Table 1.

**Table 1. Treatment allocation and dosage.**

<table>
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**Manual Physical Therapy**

At the first session, the examiner will perform a standard clinical examination in order
to determine the appropriate application and delivery of MPT (Appendix 1) to the entire shoulder, spine, and adjacent joints. The goal of MPT is to improve the quality of motion and decrease the pain associated with motion at the target joint and soft tissue. For our purposes, we define our manual physical therapy as the combination of manual techniques to include joint mobilizations (both thrust and non-thrust techniques), soft tissue mobilizations, manual stretches and contract-relax techniques, along with the exercises that help reinforce those techniques. We feel this is consistent not only with other shoulder trials, but also with other MPT trials [35-38]. The application of techniques will not be based on a regimented protocol that is identical for each patient, but rather tailored specifically to the impairments identified during the clinical examination. We feel this approach is pragmatic and consistent with the actual delivery of MPT in the clinical setting.

The examiner will provide an initial intervention of MPT that is targeted to impairments found during the initial clinical examination (the patient will return for a maximum total of 6 treatment sessions over the following 3 weeks). Each session will last approximately 30 minutes. The subjects will receive some of the protocol exercises (Appendix 2) to augment the joint mobilizations, which will collectively make up the MPT intervention.

The clinicians providing the MPT are 2 fellowship trained orthopaedic manual physical therapists, that both received training in the same 18-month program, to ensure consistency with delivery of this intervention approach.

Corticosteroid Injection

The examiner will perform a standardized clinical examination and health screening in order to confirm the absence of contraindications to steroid injection. The subject will then receive an injection in the subacromial space of the symptomatic shoulder by a senior Sports Medicine Fellowship Trained Family Physician (Appendix 3). The subject will also receive a handout explaining the effects of the steroid injection, how
to manage any potential flare-ups or ensuing pain, and a handout describing pendulum exercises for the subject to perform. The physician will spend approximately 30 minutes with each subject explaining the rationale for the injection, relevant anatomy, performing the procedure, and reviewing the pendulum exercises. The subject can receive up to a total of 2 shoulder injections with a minimum of 1 month between injections if they are not getting relief of symptoms with the initial injection. This will be dictated by patient preference and the approval/recommendation of the physician performing the injection procedure, as this would represent a pragmatic approach commensurate with standard practice.

Outcome measures

The primary dependent variable will be the SPADI and the secondary dependent variables will be the GRC and the NPRS.

Shoulder Pain and Disability Index (SPADI):

The SPADI is a 100-point, 13 item self–administered questionnaire. It is divided into two subscales: a five item pain subscale and an eight-item disability subscale. Williams et al have shown that the SPADI is responsive to change and accurately discriminates between patients who are improving or worsening.[39] Authors have reported a high test-retest reliability and internal consistency for this instrument.[40] A recent systematic review identified a minimal detectable change (MDC) of 18 points and a minimally clinically important difference (MCID) of between 8-13 points.[41] The validity and responsiveness to change of SPADI have been described in physical therapy, as well as primary and secondary care settings.[42] Because disability will be used as an outcome of interest, it is important to insure a moderate level of disability will be present at the inception of the treatment. Thus, patients will be required to have at least a baseline SPADI score of 20 points.
(average of pain and disability subscales). A score of 0 indicates no pain or functional limitation with the described activities.

Global Rating of Change Questionnaire (GRC):

The GRC questionnaire is an instrument that measures overall changes in the quality of life of the subject.[43] The use of a GRC is a common, feasible, and useful method for assessing outcome,[44] and has been shown to be a valid measurement of change in patient status in other pain populations.[45] A change in score of three rating points (+3) has been established as a clinically significant in the patients perception of quality of life.[44] The GRC has 15 possible choices, with 0 being equal to no change and -1 to -7 indicating a negative change and +1 to +7 indicating a positive change.

Numeric Pain Rating Scale (NPRS):

An 11-point pain rating scale ranging from 0 (no pain) to 10 (worst imaginable pain) will be used to assess pain intensity in the shoulder.[46] This scale has been demonstrated to be reliable, generalizable, and have internal consistency in measures of clinical and experimental pain sensation intensity.[47, 48] A change of at least 3 points has been suggested as the MCID for the NPRS in patients with shoulder pain.[49]

Justification of sample size:

The calculations were based on detecting a 12-point (or 9.2% change - based on reported MCID range of 8-13 points)[41] difference in the SPADI with a standard deviation of 10 points, a two-tailed test, and an alpha level equal to 0.05. This generates a sample size of 43 subjects per group. Allowing for a conservative
dropout or loss to follow-up rate of approximately 20%, we will recruit 104 subjects into the study. Planning for a larger loss to follow-up rate is deemed necessary in this military population where follow-up at 1 year can be challenging with multiple deployments and changes in duty station around the world. This sample size will yield greater than 80% power to detect both statistically significant and clinically meaningful changes in the other outcome variables. Sample size estimation was performed with G*Power software, version 3.1.2.[50]

Data analysis

Descriptive statistics will be run on the demographic data (age, gender, race, etc.) and health characteristics of the study population to include measures of central tendency (means, medians, other percentiles) and dispersion (standard deviations, ranges) which will be computed for continuous data for summary. Frequency distributions will be estimated for categorical data. Graphical displays including histograms and box plots will be produced. Transformations will be sought for variables to be included in further analyses to insure distributional assumptions are met.

We will examine the primary aim using a linear mixed model with repeated measures to account for the correlation among repeated observations from the same patient. Time (baseline, 1, 3, 6, and 12 months) and treatment group (MPT and CSI) will be modeled as fixed effects, with the SPADI questionnaire as the primary dependant variable. A separate model will be constructed in a similar fashion with pain (NPRS) and the GRC as the dependent variable. The hypothesis of interest will be the group by time interaction. Treatment effects will be calculated from the between-group differences in change score from baseline to 1, 3, 6, 12 months. No patients will be removed from the analysis for lack of adherence to treatment procedures. Missing data points will be estimated in the mixed model analyses using restricted maximum
likelihood ratio estimation with 100 iterations. Inferential analysis of the data for this study will be conducted using a mixed model 2 x 5 repeated measures analysis of variance (ANOVA) with treatment x 2 levels (MPT and CSI) and time with 5 levels (baseline, 1, 3, 6, 12 months) as the independent variables, the SPADI questionnaire as the primary dependant variable, and the GRC and NPRS as the secondary dependent variables. If one treatment is shown to be superior to the other, supplemental analyses will be performed by dichotomizing groups based on minimal clinically important differences (MCIDs) of 13% for the SPADI.[45] This will allow computation of absolute risk reduction, relative risk reduction, and number needed to treat (with associated 95% confidence intervals) using failure to obtain clinically meaningful benefit as the event of interest. The level of significance for all analyses will be a priori established at 0.05 using a two-tailed test.

Because of potential crossover between groups data will be analyzed using both per-protocol and intention to treat principles. The per-protocol analyses will only include patients who completed the study in the group to which they were randomly assigned. The intention to treat analyses will include all patients who were randomized at baseline regardless if they crossed over. Data analysis will be conducted using SPSS for Windows version 16 (SPSS Inc., Chicago, Illinois).

**Trial Organization and Monitoring:**

The investigative team consists of the authors listed in this protocol, in addition to three other licensed physical therapists that will assist with subject screening, data collection, subject follow-up, and data entry. The principal investigator will manage data flow and perform audits of the procedures, enrolment, and treatment throughout the entire process of the study. The associate investigators will monitor data collection process and data integrity with periodic evaluation performed continually during the course of the data collection phase.
Discussion

This randomized clinical trial will be the first study that directly compares the short and long term effects of an impairment-based manual physical therapy approach and corticosteroid injections for patients with shoulder impingement syndrome. The results of this study may aid in establishing best clinical practice guidelines for this patient population.

Ethical Considerations and Dissemination

All interventions provided in this study are considered standard of care could be given to a patient as part of their treatment plan even if the were not a part of this study. Ethics review will be conducted by Madigan Army Medical Center and monitored by the U.S. Army Medical Department Clinical Investigation Regulatory Office (CIRO) to ensure compliance with federal regulations for protection of human medical research subjects. This clinical trial was registered with ClinicalTrials.gov with a registration number of NCT01190891.

Publication Policy:

The results of the trial will be published in an appropriate journal regardless of outcome. We will report the results following the CONSORT statement with the recommended extension for pragmatic trials.[33]

Projected Timetable for Trial:

March 2010 – Protocol approved by the Western Regional Medical Command Institutional Review Board.

June 2010 – Subject enrollment begins

June 2011 – First subject completes 1-year follow-up
July 2011 – Subject enrollment complete

July 2012 – Last subject completes 1-year follow-up

December 2012 – Data entry and analysis complete

June 2013 – Publication with study results submitted for publication.

Competing interests
There are no competing interests to disclose involving this study, either financial or otherwise.

Authors’ contributions
DIR conceived the idea for the project and is the PI. All authors contributed to writing and reviewing the protocol, as well as reviewing and submitting the protocol for publication. JAC provided advice with statistical and methods design. DIR and REB will provide all the direct interventions for the MPT group. DLB will perform all the injections for the CSI group.

Acknowledgements
This study is funded in part by the Orthopaedic Physical Therapy Products Grant through the American Academy of Orthopaedic Manual Physical Therapists. This body has no influence in determining the study design; the collection, analysis, and interpretation of data; the writing of the protocol; or the decision to submit the protocol for publication.

Tables and Figures

Figure 1. Proposed recruitment flow of the study.
OMPT= Orthopaedic Manual Physical Therapy; SPADI= Shoulder Pain and Disability Index; GROC= Global Rating of Change; NPRS= Numeric Pain Rating Scale.

Table 1. Treatment allocation and dosage.
Appendices

Appendix 1: Manual physical therapy manual techniques.
Represents the majority of the techniques used, but is not inclusive or representative of all of them.

Appendix 2: Home exercise program handout for OMPT group

Appendix 3: Corticosteroid injection procedures

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Referral for shoulder pain ➔ Adequate Inclusion/Exclusion Criteria ➔ Informed Consent

Physical Examination and outcome measure assessment

Patient Education on Shoulder Impingement Handout

Randomization into treatment group

Group 1: CSI ➔ Up to 3 sessions ➔ Blinded outcomes taken (SPADI, GRC, NPRS) at 1, 3, 6, & 12 month follow-ups ➔ Trial conclusion at 1 year

Group 2: MPT ➔ 6 sessions ➔ Blinded outcomes taken (SPADI, GRC, NPRS) at 1, 3, 6, & 12 month follow-ups ➔ Trial conclusion at 1 year

Study Flow
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Treatment Allocation and Dosage
A manual physical therapy approach versus subacromial corticosteroid injection for treatment of shoulder impingement syndrome: a protocol for a randomized clinical trial.

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| **Complete List of Authors:** | Rhon, Daniel; Madigan Army Medical Center, Department of Physical Medicine  
Boyles, Robert; University of Puget Sound, School of Physical Therapy  
Cleland, Joshua; Franklin Pierce University, School of Physical Therapy  
Brown, David; Madigan Army Medical Center, Department of Family Medicine |
| **Subject Heading:** | Rehabilitation medicine |
| **Keywords:** | shoulder impingement, family medicine, manual therapy, physical therapy, PRIMARY CARE, corticosteroid |
ARTICLE SUMMARY

Article focus

- Shoulder pain is a common symptom in patients seeking healthcare for musculoskeletal complaints.

- Corticosteroid injections are a common first line intervention for shoulder pain in primary care settings, but their long-term efficacy has not been established.

- The long-term efficacy of manual physical therapy and corticosteroid injections will be evaluated and compared out to 1 year.

Key messages

- Manual therapy has been shown to provide improvements in pain and function in patients with shoulder impingement, but has not been directly compared with corticosteroid injections.

- Understanding which interventions have better long term outcomes may be instrumental in helping improve clinical practice guidelines for the management of shoulder impingement syndrome.

Strengths and limitations of this study

- This randomised controlled study will compare the effectiveness of a manual physical therapy approach to a corticosteroid injection in patients with shoulder impingement.

- This is a pragmatic study evaluating two interventions that are standard of practice, and have been shown to be effective for shoulder impingement.
• Even as a single blinded randomized clinical trial we do not have a true control group and cannot state if true cause and effect relationship exists.

• Due to the pragmatic nature of the study the intervention will not be standardized which could make it difficult for clinicians to replicate.

• The lack of gold standard with the diagnosis of shoulder impingement makes this population difficult to study.

Disclaimer: The views expressed are those of the authors and do not reflect the official policy of the Department of the Army, the Department of Defense or the U.S. Government.
INTRODUCTION

Shoulder impingement is among the most common function-limiting disorders of the musculoskeletal system.[1, 2] The point prevalence of shoulder symptoms has been reported to range from 20-33%[3] and the incidence of shoulder complaints in the general population is increasing.[4] Furthermore, several authors have reported low rates of perceived recovery (patient reports of “being cured”) for patients with a new episode of shoulder or neck pain.[4-7] Less than 25% of patients with a first episode of shoulder pain may recover and be symptom-free after 3 months.[5] Recovery rates at 18 months have been reported only between 49% and 59%[5-7] and 25% of patients with shoulder or neck pain experience at least one episode of recurrence within 12 months.[9] These findings suggest that shoulder pain can be recurrent and frequently progresses to the chronic stage.

A comprehensive manual physical therapy (MPT) approach, including both thrust and non-thrust techniques and reinforcing mobility exercises, has been shown to be effective as a common intervention for patients presenting with a primary report of shoulder pain.[8-18] This is a comprehensive approach that has shown improvement in shoulder symptoms with mobilization and manipulation techniques targeted to the thoracic spine, cervicothoracic spine, rib cage, and acromioclavicular joints [9,[14] in addition to the glenohumeral joint. A recent systematic review by Ho et al.[19] stated there was no clear evidence to suggest additional benefits of manual therapy to other interventions for shoulder impingement, indicating the need for further high quality research. That systematic review was conducted through January of 2007, excluding some more recent trials discussed below.

In a trial by Bergman et al.[9] patients with a primary report of shoulder pain were randomly assigned to receive usual medical care (UMC) for their shoulder
symptoms from their primary care physicians or usual care plus manipulative therapy (UMC+MT) directed at the cervicothoracic spine and rib cage for a maximum of 6 treatment sessions. The group that received manipulative therapy reported increased rates of “full recovery”, and improved disability out to 52 weeks.[9] In a trial by Bang[8], significant improvements in function and pain with the use of a manual physical therapy approach, consisting of manual techniques and reinforcing exercises was shown out at two months. Two other studies compared the use of manual mobilization techniques in addition to a comprehensive offering of various therapeutic modalities and exercise, and showed improved outcomes in the groups that received mobilizations in addition to their comprehensive program.[18,10] Several other studies have looked at a less pragmatic approach to manual therapy by breaking down the manual therapy approach into several sub-components.[20, 21] No evidence for harm with using this intervention has been reported.

Corticosteroids injections are a common intervention for symptoms from shoulder impingement, and have also been shown to be an effective treatment for shoulder pain. They are one of the most common procedures for the management of shoulder pain used by orthopedists, rheumatologists, and general practitioners,[22] with 96% of clinicians in a recent survey stating that CSI is an efficacious treatment option for rotator cuff pathology.[23] Conflicting evidence in the literature suggests their efficacy in the management of shoulder impingement is not well established.[24-29] A recent meta-analysis by Arroll et. al[25] evaluating the efficacy of corticosteroid injections for painful shoulder conditions (included rotator cuff tendonitis and adhesive capsulitis) concluded that subacromial injections are probably effective for improvement of rotator cuff tendonitis when compared to placebo or non-steroidal anti-inflammatory drugs (NSAID), but that there is still insufficient evidence to
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A recent Cochrane review[26] and a meta-analysis by Gaujoux-Viala et al[28] indicated that steroid injections were not more effective than NSAIDs in the treatment of shoulder and elbow tendonitis. Another review by Koester et. al[29] found nine randomized clinical trials comparing subacromial corticosteroid injection with placebo in patients with rotator cuff disease and concluded . The Koester[29] review concluded, with the addition of more recent studies, that subacromial corticosteroid injection is not effective for the treatment of rotator cuff disease. It has been reported that the variable success with subacromial corticosteroid injections may be due to inaccuracy of the clinician in terms of approach (posterior or anterolateral)[31], tendon penetration[32], and/or inconsistencies in dose[25].

Specific aim
To determine if there is a clinically significant difference in outcomes of pain and disability between subjects with shoulder impingement syndrome that receive MPT compared to CSI at 1 year.

**Trial Design and Methods**
The study will be a randomized clinical trial. The independent variables are treatment (MPT and CSI) and time with 5 levels from baseline out to one year. The primary dependent variable (DV) is the Shoulder Pain and Disability Index (SPADI).

The secondary DVs are the Global Rating of Change (GRC) and the Numeric Pain Rating Scale (NPRS). Figure 1 demonstrates the flow of subjects through the trial. This will be a trial assessing pragmatic delivery of two common interventions, and will
report results following CONSORT guidelines for pragmatic trials.[33] The current SPIRIT guidelines for creating protocols for randomized clinical trials were followed.[34]

Participants

We will recruit 104 subjects, male and female between the ages of 18-65 years with a primary complaint of shoulder pain through the Physical Therapy departments at Madigan Army Medical Center (MAMC) as well as the outlying primary care clinics on the military installation. They will be recruited through the referral source to Physical Therapy from outlying clinics (Family Practice, Orthopaedics, and Primary Care clinics). If recruitment targets are not being met, flyers with information about the study may be distributed for potential subjects to inquire about as patients in this setting have direct access to physical therapy care and do not necessarily need a referral source.

Inclusion criteria:

1. Age 18 and older
2. Read, write, and speak English
3. Eligible for healthcare at a military Medical Treatment Facility (MTF)
4. Primary complaint of shoulder pain (glenohumeral region)
5. Meets diagnostic criteria for shoulder impingement (mentioned below)

Exclusion criteria:

1. History of a shoulder injection for the current episode of pain.
2. History of shoulder dislocation, subluxation, fracture, adhesive capsulitis of the glenohumeral joint, or cervical/shoulder/upper back surgery
3. Isolated acromioclavicular joint (ACJ) pathology. The only location of symptoms is localized specifically with one finger directly over the ACJ and nowhere else, and reproduced only with ACJ palpation by the examiner.

4. Full-thickness rotator cuff tears (evidenced by MRI and/or positive lag signs)

5. Presence of cervical radiculopathy, radiculitis, or referral from cervical spine

6. Total baseline SPADI score not less than 20% (to prevent a ceiling effect with treatment)


8. Prior MPT treatment to the involved limb for the current episode of pain

9. Military service members pending a medical evaluation board, physical evaluation board, or equivalent discharge process, or in medical hold to determine long term disposition. For non-military personnel, anyone that is pending or undergoing any litigation for their injury.

10. Contraindications or precautions to receiving a corticosteroid injection (history of allergies, adverse reactions, history of multiple injections in that area even if not within last 30 days, uncontrolled diabetes mellitus, pregnancy, etc).

11. Unable to give informed consent to participate in the study.

12. Unable to come into the clinic for regular treatment over the course of the following month.

Diagnostic criteria for entry:

To be included in the study participants are required to have:

(1) pain* with one of the 2 tests in category I, and

(2) pain* with one test from either category II or category III.

* “pain” is defined as reproduction of the usual pain that the subject experiences that makes up the nature of their complaint.

Category I: Impingement signs
1. Passive overpressure at full shoulder flexion with the scapula stabilized.

2. Passive internal rotation at 90 degrees of shoulder flexion in the scapular plane and in progressive degrees of horizontal adduction.

**Category II: Active shoulder abduction**

Active shoulder abduction

**Category III: resisted break tests**

1. Abduction

2. Internal rotation

3. External rotation

This criteria has been used in previous clinical trials to classify patients with shoulder impingement syndrome.[17,23]

**Randomization**

Once the baseline examination is completed, a second investigator blind to the baseline examination will open the randomization envelope indicating the patient's treatment group assignment that corresponds to the patient's unique identification number. A random number generator will be used to establish randomization lists prior to the initiation of the study. Separate randomization lists will be generated for each participating site to insure that equal numbers of subjects are randomized to each group at each site. Individual randomization assignments will be concealed according to the following procedure. The group assignment will be recorded on a label that is affixed to a 3.5 X 5 inch index card. This card will be folded in half such that the label with the patient's group assignment will be on the inside of the fold. The folded index card will then be placed inside the envelope, and the envelope will be sealed. This will prevent the possibility of the therapist holding the envelope up to the light and visualizing the patient's treatment group assignment through a sealed yet transparent envelope.
Blinding

Due to the nature of this study, it is not possible to blind the patient or the clinician providing the intervention to the treatment received. The clinician performing the screening, baseline and follow-up measurements, and outcome assessments will be blinded to the patient's treatment group assignment. Patients will be instructed not to discuss the intervention received with the clinician when reporting for their follow-up appointments unless medically necessary. Incidence of unmasking will be recorded.

Interventions

Both treatment options are standard of care interventions. Their allocation and dosage is described in Table 1.

Table 1. Treatment allocation and dosage.

<table>
<thead>
<tr>
<th>INTERVENTION</th>
<th>SUBJECTS NEEDED</th>
<th>DOSAGE</th>
<th>Follow-up Time Points (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corticosteroid Injection</td>
<td>N = 52</td>
<td>1 initially. Option for a total of 3 within first 6 months.</td>
<td>1, 3, 6, 12</td>
</tr>
<tr>
<td>Manual Physical Therapy</td>
<td>N = 52</td>
<td>6 sessions</td>
<td>1, 3, 6, 12</td>
</tr>
</tbody>
</table>

Manual Physical Therapy

At the first session, the examiner will perform a standard clinical examination in order to determine the appropriate application and delivery of MPT (Appendix 1) to the entire shoulder, spine, and adjacent joints. The goal of MPT is to improve the quality of motion and decrease the pain associated with motion at the target joint and soft tissue. For our purposes, we define our manual physical therapy as the combination of manual techniques to include joint mobilizations (both thrust and non-thrust
techniques), soft tissue mobilizations, manual stretches and contract-relax
techniques, along with the exercises that help reinforce those techniques. We feel
this is consistent not only with other shoulder trials, but also with other MPT trials[35-
38]. The application of techniques will not be based on a regimented protocol that is
identical for each patient, but rather tailored specifically to the impairments identified
during the clinical examination. We feel this approach is pragmatic and consistent
with the actual delivery of MPT in the clinical setting.

The examiner will provide an initial intervention of MPT that is targeted to
impairments found during the initial clinical examination (the patient will return for a
maximum total of 6 treatment sessions over the following 3 weeks). Each session
will last approximately 30 minutes. The subjects will receive some of the protocol
exercises (Appendix 2) to augment the joint mobilizations, which will collectively
make up the MPT intervention.

The clinicians providing the MPT are 2 fellowship trained orthopaedic manual
physical therapists, that both received training in the same 18-month program, to
ensure consistency with delivery of this intervention approach.

Corticosteroid Injection

The examiner will perform a standardized clinical examination and health screening
in order to confirm the absence of contraindications to steroid injection. The subject
will then receive an injection in the subacromial space of the symptomatic shoulder
by a senior Sports Medicine Fellowship Trained Family Physician (Appendix 3). The
subject will also receive a handout explaining the effects of the steroid injection, how
to manage any potential flare-ups or ensuing pain, and a handout describing
pendulum exercises for the subject to perform. The physician will spend
approximately 30 minutes with each subject explaining the rationale for the injection,
relevant anatomy, performing the procedure, and reviewing the pendulum exercises.
The subject can receive up to a total of 2 shoulder injections with a minimum of 1 month between injections if they are not getting relief of symptoms with the initial injection. This will be dictated by patient preference and the approval/recommendation of the physician performing the injection procedure, as this would represent a pragmatic approach commensurate with standard practice.

### Outcome measures

The primary dependent variable will be the SPADI and the secondary dependent variables will be the GRC and the NPRS.

#### Shoulder Pain and Disability Index (SPADI):

The SPADI is a 100-point, 13 item self-administered questionnaire. It is divided into two subscales: a five item pain subscale and an eight-item disability subscale.

Williams et al have shown that the SPADI is responsive to change and accurately discriminates between patients who are improving or worsening.[39] Authors have reported a high test-retest reliability and internal consistency for this instrument.[40] A recent systematic review identified a minimal detectable change (MDC) of 18 points and a minimally clinically important difference (MCID) of between 8-13 points.[41] The validity and responsiveness to change of SPADI have been described in physical therapy, as well as primary and secondary care settings.[42] Because disability will be used as an outcome of interest, it is important to insure a moderate level of disability will be present at the inception of the treatment. Thus, patients will be required to have at least a baseline SPADI score of 20 points (average of pain and disability subscales). A score of 0 indicates no pain or functional limitation with the described activities.

#### Global Rating of Change Questionnaire (GRC):

The GRC questionnaire is an instrument that measures overall changes in the quality of life of the subject.[43] The use of a GRC is a common, feasible, and useful method for assessing outcome,[44] and has been shown to be a valid measurement of change in patient status in other pain populations.[45] A change in score of three rating points (+3) has been established as a clinically significant in the patients perception of quality of life.[44] The GRC has 15 possible choices, with 0 being equal to no change and -1 to -7 indicating a negative change and +1 to +7 indicating a positive change.

Numeric Pain Rating Scale (NPRS):

An 11-point pain rating scale ranging from 0 (no pain) to 10 (worst imaginable pain) will be used to assess pain intensity in the shoulder.[46] This scale has been demonstrated to be reliable, generalizable, and have internal consistency in measures of clinical and experimental pain sensation intensity.[47, 48] A change of at least 3 points has been suggested as the MCID for the NPRS in patients with shoulder pain.[49]

**Justification of sample size:**

The calculations were based on detecting a 12-point (or 9.2% change - based on reported MCID range of 8-13 points)[41] difference in the SPADI with a standard deviation of 10 points, a two-tailed test, and an alpha level equal to 0.05. This generates a sample size of 43 subjects per group. Allowing for a conservative dropout or loss to follow-up rate of approximately 20%, we will recruit 104 subjects into the study. Planning for a larger loss to follow-up rate is deemed necessary in this military population where follow-up at 1 year can be challenging with multiple deployments and changes in duty station around the world. This sample size will
yield greater than 80% power to detect both statistically significant and clinically meaningful changes in the other outcome variables. Sample size estimation was performed with G*Power software, version 3.1.2.[50]

**Data analysis**

Descriptive statistics will be run on the demographic data (age, gender, race, etc.) and health characteristics of the study population to include measures of central tendency (means, medians, other percentiles) and dispersion (standard deviations, ranges) which will be computed for continuous data for summary. Frequency distributions will be estimated for categorical data. Graphical displays including histograms and box plots will be produced. Transformations will be sought for variables to be included in further analyses to insure distributional assumptions are met.

We will examine the primary aim using a linear mixed model with repeated measures to account for the correlation among repeated observations from the same patient. Time (baseline, 1, 3, 6, and 12 months) and treatment group (MPT and CSI) will be modeled as fixed effects, with the SPADI questionnaire as the primary dependant variable. A separate model will be constructed in a similar fashion with pain (NPRS) and the GRC as the dependent variable. The hypothesis of interest will be the group by time interaction. Treatment effects will be calculated from the between-group differences in change score from baseline to 1, 3, 6, 12 months. No patients will be removed from the analysis for lack of adherence to treatment procedures. Missing data points will be estimated in the mixed model analyses using restricted maximum likelihood ratio estimation with 100 iterations. Inferential analysis of the data for this study will be conducted using a mixed model 2 x 5 repeated measures analysis of variance (ANOVA) with treatment x 2 levels (MPT and CSI) and time with 5 levels (baseline, 1, 3, 6, 12 months) as the independent variables, the SPADI questionnaire.
as the primary dependent variable, and the GRC and NPRS as the secondary dependent variables. If one treatment is shown to be superior to the other, supplemental analyses will be performed by dichotomizing groups based on minimal clinically important differences (MCIDs) of 13% for the SPADI.[45] This will allow computation of absolute risk reduction, relative risk reduction, and number needed to treat (with associated 95% confidence intervals) using failure to obtain clinically meaningful benefit as the event of interest. The level of significance for all analyses will be a priori established at 0.05 using a two-tailed test.

Because of potential crossover between groups data will be analyzed using both per-protocol and intention to treat principles. The per-protocol analyses will only include patients who completed the study in the group to which they were randomly assigned. The intention to treat analyses will include all patients who were randomized at baseline regardless if they crossed over. Data analysis will be conducted using SPSS for Windows version 16 (SPSS Inc., Chicago, Illinois).

**Trial Organization and Monitoring:**

The investigative team consists of the authors listed in this protocol, in addition to three other licensed physical therapists that will assist with subject screening, data collection, subject follow-up, and data entry. The principal investigator will manage data flow and perform audits of the procedures, enrolment, and treatment throughout the entire process of the study. The associate investigators will monitor data collection process and data integrity with periodic evaluation performed continually during the course of the data collection phase.

**Discussion**

This randomized clinical trial will be the first study that directly compares the short and long term effects of an impairment-based manual physical therapy approach and
corticosteroid injections for patients with shoulder impingement syndrome. The results of this study may aid in establishing best clinical practice guidelines for this patient population.

**Ethical Considerations and Dissemination**

All interventions provided in this study are considered standard of care could be given to a patient as part of their treatment plan even if the were not a part of this study. Ethics review will be conducted by Madigan Army Medical Center and monitored by the U.S. Army Medical Department Clinical Investigation Regulatory Office (CIRO) to ensure compliance with federal regulations for protection of human medical research subjects. This clinical trial was registered with ClinicalTrials.gov with a registration number of NCT01190891.

**Publication Policy:**

The results of the trial will be published in an appropriate journal regardless of outcome. We will report the results following the CONSORT statement with the recommended extension for pragmatic trials.[33]

**Projected Timetable for Trial:**

March 2010 – Protocol approved by the Western Regional Medical Command Institutional Review Board.

June 2010 – Subject enrollment begins

June 2011 – First subject completes 1-year follow-up

July 2011 – Subject enrollment complete

July 2012 – Last subject completes 1-year follow-up

December 2012 – Data entry and analysis complete
June 2013 – Publication with study results submitted for publication.

**Competing interests**
There are no competing interests to disclose involving this study, either financial or otherwise.

**Authors’ contributions**
DIR conceived the idea for the project and is the PI. All authors contributed to writing and reviewing the protocol, as well as reviewing and submitting the protocol for publication. JAC provided advice with statistical and methods design. DIR and REB will provide all the direct interventions for the MPT group. DLB will perform all the injections for the CSI group.

**Acknowledgements**
This study is funded in part by the Orthopaedic Physical Therapy Products Grant through the American Academy of Orthopaedic Manual Physical Therapists. This body has no influence in determining the study design; the collection, analysis, and interpretation of data; the writing of the protocol; or the decision to submit the protocol for publication.

**Tables and Figures**

**Figure 1. Proposed recruitment flow of the study.**
OMPT= Orthopaedic Manual Physical Therapy; SPADI= Shoulder Pain and Disability Index; GROC= Global Rating of Change; NPRS= Numeric Pain Rating Scale.

**Table 1. Treatment allocation and dosage.**
Appendices

Appendix 1: Manual physical therapy manual techniques.
Represents the majority of the techniques used, but is not inclusive or representative of all of them.

Appendix 2: Home exercise program handout for OMPT group

Appendix 3: Corticosteroid injection procedures

References


23. Alvarez CM, Litchfield R, Jackowski D, Griffin S, Kirkley A: A prospective, double-blind, randomized clinical trial comparing subacromial injection of


34. Strengthening the credibility of clinical research. Lancet, 375:1225.


Referral for shoulder pain \rightarrow Adequate Inclusion/Exclusion Criteria \rightarrow Informed Consent

Physical Examination and outcome measure assessment

Patient Education on Shoulder Impingement Handout

Randomization into treatment group

Group 1: CSI \rightarrow Up to 3 sessions

Group 2: MPT \rightarrow 6 sessions

Blinded outcomes taken (SPADI, GRC, NPRS) at 1, 3, 6, & 12 month follow-ups

Trial conclusion at 1 year

Study Flow
87x93mm (300 x 300 DPI)
CONSORT 2010 Flow Diagram

Enrollment

Assessed for eligibility (n= )

- Excluded (n= )
  - Not meeting inclusion criteria (n= )
  - Declined to participate (n= )
  - Other reasons (n= )

Randomized (n= )

Allocation

- Allocated to intervention (n= )
  - Received allocated intervention (n= )
  - Did not receive allocated intervention (give reasons) (n= )

- Allocated to intervention (n= )
  - Received allocated intervention (n= )
  - Did not receive allocated intervention (give reasons) (n= )

Follow-Up

- Lost to follow-up (give reasons) (n= )
- Discontinued intervention (give reasons) (n= )

- Lost to follow-up (give reasons) (n= )
- Discontinued intervention (give reasons) (n= )

Analysis

- Analysed (n= )
  - Excluded from analysis (give reasons) (n= )

- Analysed (n= )
  - Excluded from analysis (give reasons) (n= )