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Glenohumeral corticosteroid injections in adhesive capsulitis: a systematic search and review

Amos Song, MA^{2,5}, Laurence D. Higgins, MD^{2,3}, Joel Newman, MD⁴, and Nitin B. Jain, MD, MSPH^{1,2,3}

¹Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital and Harvard Medical School, Boston, MA

²Department of Orthopaedic Surgery, Brigham and Women's Hospital and Harvard Medical School, Boston, MA

³Harvard Shoulder Service, Harvard Medical School, Boston, MA

⁴Department of Radiology, New England Baptist Hospital, Boston, MA

⁵Tulane University School of Medicine, New Orleans, LA

Abstract

OBJECTIVES—To assess the literature on outcomes of corticosteroid injections for adhesive capsulitis, and in particular, image-guided corticosteroid injections.

TYPE—Systematic search and review

LITERATURE SURVEY—The databases used were PubMed (1966-present), Embase (1947-present), Web of Science (1900–present), and the Cochrane Central Register of Controlled Trials. Upon reviewing full text articles of these studies, a total of 25 studies were identified for inclusion. The final yield included 7 prospective studies, 16 randomized trials, and 2 retrospective studies.

METHODOLOGY—This systematic review was formatted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Study criteria were limited to clinical trials, prospective studies, and retrospective studies that specifically evaluated intra-articular corticosteroid injections, both alone and in combination with other treatment modalities, for shoulder adhesive capsulitis. We included studies that were not randomized control trials because our review was not a meta-analysis. Data items extracted from each study included: study design, study population, mean patient age, duration of study, duration of symptoms, intervention, single or multiple injections, location of injections, control population, follow up duration, and outcome measurements. A percent change in outcome measures was calculated when

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Corresponding Author: Nitin B. Jain, MD, MSPH, Orthopedic and Arthritis Center for Outcomes Research, Brigham and Women's Hospital, 75 Francis Street, BC-4-016, Boston, MA 02115, Phone: (617) 525-8349; Fax: (617) 525-7900, njain1@partners.org.

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corresponding data was available. Risk of bias in individual studies was assessed when appropriate.

SYNTHESIS—All studies involved at least one corticosteroid injection intended for placement in the glenohumeral joint but only eight studies used image-guidance for all injections. Seven of these studies reported statistically significant improvements in ROM at 12 weeks of follow-up or earlier. Ninety-two percent of all studies documented a greater improvement in either visual analog pain scores or range of motion after corticosteroid injections in the first 1–6 weeks as compared with the control or comparison group.

CONCLUSIONS—Corticosteroid injections offer rapid pain relief in the short-term (particularly in the first 6 weeks) for adhesive capsulitis. Long-term outcomes seem to be similar to other treatments including placebo. The added benefit of image-guided corticosteroid injections in improving shoulder outcomes needs further assessment.

INTRODUCTION

Adhesive capsulitis is a long lasting, painful shoulder condition commonly known as “frozen shoulder.” Patients also experience severe loss of range of motion (ROM) at the glenohumeral joint. The condition results from progressive fibrosis and eventual contracture of the capsule of the glenohumeral joint, which causes pain and stiffness^{1–3}. The specific pathophysiology of adhesive capsulitis is unknown and altering its natural history and shortening recovery time remains challenging.

Adhesive capsulitis is prevalent in about 2% of the general population¹. Most patients are between the ages of 40–60 years and more female patients are affected than male patients^{1,4,5}. Type I diabetics have a 40% chance of developing adhesive capsulitis in their lifetimes¹. Up to 29% of type II diabetics may present with this condition⁶. Hyperthyroidism⁷, hypothyroidism⁸, Parkinson’s disease⁹, cardiac disease^{4,10}, and autoimmune disorders¹¹ are also associated with adhesive capsulitis.

Adhesive capsulitis is a clinical diagnosis made on patient history and physical examination⁵. The key clinical feature is the restriction of passive shoulder range of motion, particularly in forward flexion, abduction, external rotation, and internal rotation^{5,12}. The natural history of adhesive capsulitis is described in three consecutive stages^{1,13,14}. The first stage, the “freezing” stage, is marked by progressive pain and loss of motion lasting up to nine months. The second stage, the “frozen” stage, lasts from four to twenty months. In this stage, pain improves but stiffness persists and continues to impact patients’ ability to perform activities of daily living. The third and final “thawing” stage is a period of recovery marked by gradual improvement in range of motion that can take up to five to twenty-six months.

Treatment options include non-steroidal anti-inflammatory drugs (NSAIDs) or other analgesics, physical therapy, manipulation under anesthesia (MUA), dilation or distension of the capsule, arthroscopic or open capsular release, and injections of sodium hyaluronate or corticosteroids^{15–18}. Intra-articular corticosteroid injections target the inflammatory process

at the site of pathology, the glenohumeral joint^{2,19}. To improve the accuracy of injections, image guidance with fluoroscopy or ultrasound may be used.

In the existing literature, three reviews found short-term benefits in pain and range of motion from corticosteroid injections specifically for the treatment of adhesive capsulitis^{14,20,21}. However, no reviews have focused their analysis on image-guided injections to assess any added benefit of image-guided injections on shoulder outcomes. There is still debate as to the efficacy of image-guided corticosteroid injections in the treatment of adhesive capsulitis. While the complete pathophysiology of adhesive capsulitis is still unclear, the anatomical location of the pathology lies in the glenohumeral joint². The accuracy of blind corticosteroid injections into the glenohumeral joint is debatable^{22–24}. Utilizing the additional measure of ultrasound or another image modality to guide injections improves accuracy^{25,26} but their ability to improve clinical outcomes compared to that of palpation guided injections remains unclear.

Therefore, we conducted a systematic literature review to assess outcomes of intra-articular corticosteroid injections on adhesive capsulitis. We also specifically assessed the outcomes of image-guided corticosteroid injections.

METHODS

The systematic literature review was formatted and based upon guidelines suggested by “The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration”, which seeks to provide a method of producing more standardized and complete systematic reviews²⁷. Study criteria were limited to clinical trials, prospective studies, and retrospective studies that specifically evaluated intra-articular corticosteroid injections, both alone and in combination with other treatment modalities, for shoulder adhesive capsulitis. We included studies that were not randomized control trials because our review was not a meta-analysis. We excluded case reports but included prospective, retrospective, and randomized trial studies. Studies investigating injections for subacromial bursitis, shoulder impingement, or for generalized shoulder stiffness or pain were excluded. Studies investigating subacromial injections or injections of sodium hyaluronate and other non-corticosteroids were also excluded. Other limits included papers written in the English language and those involving human subjects.

The databases used in our literature search were PubMed (1966-present), Embase (1947-present), Web of Science (1900–present), and the Cochrane Central Register of Controlled Trials. Two authors (A.S., N.J.) collaboratively conducted the search in September 2012 with the assistance of a trained librarian with expertise in medical literature search. The two authors then screened and discussed study titles and abstracts returned from the searches to determine inclusion eligibility. The bibliography of review articles and articles selected for final inclusion was also manually searched for any relevant articles but did not reveal any additional articles.

Our search terms are included in Appendix A (in the Supplementary Material). Data was extracted by one author (A.S.) using a standardized table of relevant data items. The second author (N.J.) then checked the extracted data items. Data items extracted from each study included: study design, study population, diagnosis, mean patient age, duration of study, duration of symptoms before treatment, intervention, single or multiple injections, location of injections, control population (if any), follow up period, and outcome measurements.

The included studies defined adhesive capsulitis as the progressive limitation in shoulder motion. There was wide variability in the outcome measures for pain and range of motion (ROM) used across studies. Outcome measures included passive and active range of motion measures, visual analog scale (VAS), shoulder disability questionnaire (SDQ), shoulder pain and disability index (SPADI), SF-36 (Short Form 36 Health Survey), and Constant-Murley score. In order to facilitate comparisons across studies, we calculated a percent change in outcome measures when these data were presented in the manuscript. We did not statistically combine data or conduct a meta-analysis because outcome measures among studies were too heterogeneous. In addition to outcome measure, studies varied widely in interventions, study design, and comparison group. Risk of bias was assessed within randomized controlled studies. Concealment of randomization and blinding of study participants was determined for each study. Prospective and retrospective studies were not applicable for risk of bias analysis. We determined if concealment of randomization, blinding of patients, health care providers, data collectors, and outcome assessors had been reported for randomized trials. However, not all of the included studies were randomized trials and thus certain risk of bias assessments did not apply to all studies.

RESULTS

Our search strategy is depicted in Figure 1. The initial search returned 859 studies, of which 630 studies were excluded after filtering for studies with human subjects in the English language. After screening for titles and abstracts simultaneously and then adjusting for duplicates, 35 unique articles were retrieved. Upon reviewing full text articles of these studies, a total of 25 studies were identified for inclusion. The final yield included 7 prospective studies, 16 randomized trials, and 2 retrospective studies. The mean duration of symptoms in selected studies ranged from 3.5 to 11 months, including 7 studies with patients who had greater than 18 months of symptom duration. Not all studies reported the range of symptom duration (n=5). The total duration of follow-up in these studies ranged from 4 weeks to 3 years.

All interventions involved at least one corticosteroid injection. All 25 studies claimed their injections to be intra-articular but only eight studies used image-guidance for all glenohumeral injections. Two studies used image-guidance for some, but not all injections^{28,29}. Several studies used a combined treatment approach in which one or more steroid injections were provided in conjunction with another treatment (such as corticosteroid injection and supervised physical therapy). The type of corticosteroid used, dose, and injection technique varied across studies. We categorized the included studies by the comparison group (Table I).

Risk of bias within each individual randomized trial study was assessed (Table II). Seven randomized trials reported concealment of randomization, four reported blinding patients, three reported blinding health care providers, one reported blinding data collectors, and eight reported blinding outcome assessors.

Appendix B (in the Supplementary material) provides a summary of the studies and data on this topic. By the end of their respective study periods, all intervention groups across all studies, including placebo and no treatment groups, found improvements in range of motion and pain scores.

Intra-articular steroid injection alone or vs. Placebo injection

Two studies examined steroid injection alone or compared to a placebo injection. In one of these studies, there was a mean 58% improvement in abduction, a 100% increase in internal rotation, and a 60% decrease in VAS score ($p = .001$)³⁰. In the other study, there were no statistically significant differences between the corticosteroid injection group and the placebo injection group in SPADI score and range of motion¹⁹.

Intra-articular steroid injection vs. Physical Therapy

The next group of studies compared steroid injection to physical therapy. In one study, the injection group had no statistically significant differences in range of motion and pain improvements to the physical therapy group at the end of the 12 weeks³¹. Another study compared four groups of treatment: corticosteroid injection and physical therapy, corticosteroid injection alone, physical therapy alone, and placebo injection. At the end of the 12 month study, there were no statistically significant differences between the four groups in SPADI score, SF-36 score, active and passive ROM³². Another study also compared corticosteroid injection and physical therapy in combination or alone. They found no significant differences in Shoulder Disability Questionnaire (SDQ), VAS, and passive external rotation at the end of 16 weeks³³.

Intra-articular steroid injection vs. Manipulation

Three studies considered manipulation under anesthesia (MUA) versus injection. One study found no additional advantage to adding corticosteroid injection to a manipulation treatment at 4 months³⁴. Another study found similar regression coefficients of decrease in VAS for a MUA group and a group treated with injection and distension ($\beta = 2.75$ vs. 2.77)³⁵. The third study reported satisfactory changes in both the steroid injection group and the manipulation group at 12 months in passive forward flexion, abduction, internal rotation, and external rotation in neutral abduction¹⁸.

Intra-articular steroid injection vs. Dilation/Distension

Two studies compared a corticosteroid injection with dilation or distension with steroid. One study found no statistically significant difference between hydrodilation and injection in SPADI score and ROM improvements¹⁷. Gam et al. showed that at 7 and 12 weeks, dilation with steroid and anesthetic had favorable improvements to injection in extension ($p = .03$) and external rotation ($p = .01$)³⁶. However, the actual numerical data of these findings were not reported in the study.

Comparison of steroid dosages, location of injection, or types of steroid

Other studies compared steroid dosages, location of injection, or types of steroid. de Jong et al. found a mean VAS improvement of 49.3 for a higher dosage of triamcinolone acetonide (40 mg) compared to a 31.2 VAS improvement for a lower dosage of triamcinolone acetonide (10 mg) ($p = .04$)³⁷. Lorbach et al. compared a corticosteroid injection and an oral corticosteroid taper. No significant differences between the two treatments were found in VAS pain scores. However, abduction in the injection group was significantly more improved after 12 months ($p = .017$)³⁸. Three of the studies compared the location of injection in the shoulder. Oh et al. found a glenohumeral injection did not have a significantly greater decrease in VAS compared with a subacromial injection²⁹. Another study found similar improvements in ROM between intra-articular and bursal injections³⁹.

Image guided intra-articular steroid injections

The final group of studies investigated ultrasound or fluoroscopically guided corticosteroid injections. Lee et al. compared ultrasound-guided injections of triamcinolone with blind injections. At 6 weeks, the ultrasound guided injection group did not have statistically superior improvements than blind injections in flexion, abduction, external rotation or internal rotation, although improvements from baseline were significant within both groups ($p < .001$). The ultrasound guided injection group also did not have significantly better VAS score improvements after 3 weeks⁴⁰. Lorbach et al. prospectively followed patients who had received 3 fluoroscopically-guided injections followed by physical therapy and, after one year follow-up, found improvements of 181% in abduction ($p < .0001$), 52% in flexion ($p < .0001$), 257% in external rotation ($p < .0001$), and 26% in internal rotation ($p < .005$)⁴¹.

Overall, most studies show an increased improvement in VAS scores and ROM after corticosteroid injections in the first 1–6 weeks as compared with the control or comparison group (Figures 2 and 3). Also, seven of the eight studies that provided image-guided injections showed statistically significant ROM improvements by within 12 weeks of follow-up.

DISCUSSION

The review of the literature indicates that corticosteroid injections in the setting of adhesive capsulitis may offer initial improvements in shoulder pain and function for the first 1–6 weeks. However, beyond 6 to 12 weeks, corticosteroid injections may not offer significantly added benefits in improving pain and ROM compared to physical therapy. Studies comparing corticosteroid injection to manipulation under anesthesia or dilation have mixed results. Image-guided injections also provide improvements in function, pain, and ROM within the first 12 weeks but their added benefit over non-image guided shoulder injections is inconclusive.

The injection groups of the two studies investigating steroid injections alone or along with a placebo injection showed improvement in range of motion and pain at 12 weeks^{19,30}. It can also be hypothesized that a placebo injection can provide therapeutic benefit by distention of the joint capsule. Compared to a physical therapy regimen alone, corticosteroid injections

may offer significantly greater improvements in SPADI score³², Shoulder Disability Questionnaire score³³, and range of motion⁴² by six weeks follow-up. But a combined corticosteroid injection and physical therapy treatment may have greater ROM improvements than either treatment alone³². The results of dilation or distension of the glenohumeral joint compared to injection is mixed^{36,17}. The results for studies comparing MUA to injection are also mixed^{28,34,35}.

Based on the results of studies that compared steroid dosages, location of injection, or types of steroid, injections of intra-articular, 40 mg triamcinolone acetate provide the greatest relief in terms of pain and ROM improvement when compared with extra-articular injections, injections of methylprednisolone, injection of 10 mg of triamcinolone acetate, or oral prednisolone.

Although a clear conclusion on the long-term effectiveness of corticosteroid injections cannot be made due to disparate findings between studies, inadequate study designs and research methodology, and inconsistent outcomes across studies, several studies show that injections provide rapid relief of pain and increase ROM in the first 6 weeks after treatment. The control or comparison groups also show a decrease in VAS, although the improvement occurs at a slower rate than the corticosteroid injection groups. Similarly, abduction improves more rapidly for corticosteroid injection groups relative to the control or comparison groups.

We hypothesize two possible reasons for inconclusive findings between studies. First, only eight studies specifically included patients in the second or third stage of adhesive capsulitis or those with less than 12 months of symptom duration^{18,19,32,33,38,40,41,43}. Studies including patients with greater than 12–18 months of symptom duration may have injected corticosteroids well into the second/third stage of adhesive capsulitis when the painful inflammatory process is reduced. Thus, the efficacy of corticosteroid injections may be reduced in these studies.

Second, the lack of image-guidance may have lead to disparate conclusions in studies. Only eight studies in this review reported an image-guided injection technique that ensured intra-articular placement of all corticosteroid injections - five used fluoroscopy and three used ultrasound^{17,18,32,36,38,40,41,44}. Studies have shown low accuracy of glenohumeral injections performed without image guidance. Only 26.8%–64.7% of injections using an anterior approach without the use of image-guidance were intra-articular^{22–24}. Tobola et al. found the accuracy of an anterior approach glenohumeral injection was 64.7%, regardless of clinician experience²⁴. In comparison to a blind posterior injection technique, ultrasound guided injections had a greater success rate of reaching of the glenohumeral joint (72.5% vs. 92.5%)²⁶. Daley et al. reported glenohumeral joint injections with image guidance had an average accuracy rate of 95% (range: 83–100%) compared to 79% without image guidance (27–100%)²⁵. Kim et al. found a 100% injection accuracy score using ultrasound to guide glenohumeral injections on 12 cadavers⁴⁵. However, there is a paucity of data on the clinical efficacy of image-guided injections for improved shoulder outcomes when performing glenohumeral corticosteroid injections.

The studies using image-guided injections were effective for improving range of motion and pain. Seven of these studies reported statistically significant improvements in ROM at 12 weeks of follow-up or earlier for groups receiving an image guided corticosteroid injection^{17,18,32,38,40,41,44}. It is unclear if the accurate placement of corticosteroid into the glenohumeral joint has a positive impact on shoulder outcomes in the treatment of adhesive capsulitis. However, we hypothesize that if corticosteroids are not consistently being placed into the glenohumeral joint without the aid of imaging, the potential benefits of corticosteroids on shoulder pain and function may not be fully realized. Nevertheless, the literature in this area is lacking and we are unable to comment on the added benefit or lack thereof of adding an imaging component to guide corticosteroid injections.

CONCLUSION

Corticosteroid injections offer rapid relief of pain and improved range of motion in the short-term (particularly in the first 6 weeks) although long-term outcomes seem to be similar to other treatments including placebo. This is likely because the natural history of adhesive capsulitis is to spontaneously resolve over time. Hence, corticosteroid injections may offer pain relief in the initial phases of adhesive capsulitis when patients have the most pain. Also, seven of 8 studies using image-guided injections in this review found ROM improvements within 12 weeks. Image-guided corticosteroid injections increase the accuracy of the injection, which may improve shoulder outcomes. However, there is limited data on the clinical efficacy ultrasound or fluoroscopically guided injections to make conclusions on their added benefit over non-image guided injections. The necessity and efficacy of image-guided corticosteroid injections, by ultrasound or otherwise, in the management of adhesive capsulitis warrants further investigation.

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Figure 1.
A flow diagram of study selection.

Figure 2.

VAS improvements over time in corticosteroid injection groups. Image-guided injections are indicated with black lines and circle data points. (US = ultrasound, INJ = injection, PT = physical therapy)

*Visual analog scale adjusted to a 0 to 10 scale where 0 represents “no pain” and 10 represents the “worst possible pain”

Figure 3.

Abduction improvements over time in corticosteroid injection groups. Image-guided injections are indicated with black lines and circle data points. (CS = Corticosteroid injection; DIS = Distension; INJ = injection; MUA = manipulation under anesthesia; PT = physical therapy; US = ultrasound)

Table I
Studies by comparison group

All studies included at least one injection of a corticosteroid to the glenohumeral joint in the treatment of adhesive capsulitis. Only eight studies used image guidance with either fluoroscopy or ultrasound to perform all glenohumeral injections.

	Number of studies	Number of subjects
Steroid Injection Alone or Steroid Injection vs. Placebo Injection	2	124
Steroid Injection vs. Physical Therapy	6	460
Steroid Injection vs. Manipulation Under Anesthesia	3	113
Steroid Injection vs. Dilation/Distension	2	96
Comparison of steroid injection dosages, location of injection, or types of steroid.	6	435
Steroid injections in combination with distension, dilation, or manipulation under anesthesia	4	136
Image-guided steroid injections alone or vs. blind steroid injections *	2	65
Total	25	1429

* Studies that explicitly and specifically investigated the efficacy of image-guided injections

Table II

Risk of bias within randomized controlled studies

The 25 studies included in the review were individually evaluated for risk of bias. Study type, concealment of randomization, blinding of patients, health care providers, data collector, and outcome assessors were evaluated when applicable.

Trials	Concealment of Randomization	Patients Blinded	Health Care Providers Blinded	Data Collectors Blinded	Outcomes Assessors Blinded
Bal ¹⁸ (2008)	Yes	Yes	No	NR	Yes
Arslan ³⁰ (2001)	No	No	No	NR	NR
Carette ³¹ (2003)	Yes	Yes	Yes	NR	Yes
Ryans ³² (2005)	Yes	Yes	Yes	NR	NR
Bulgen ⁴¹ (1984)	No	No	No	NR	Yes
De Carl ¹⁷ (2011)	NR	No	No	NR	Yes
Jacobs ³⁴ (2009)	Yes	No	No	NR	NR
Kivimaki ³³ (2001)	No	No	No	NR	NR
Gam ³⁵ (1998)	Yes	No	No	NR	Yes
Tveita ¹⁶ (2008)	Yes	No	No	NR	No
de Jong ³⁶ (1998)	Yes	Yes	Yes	NR	NR
Lorbach ³⁷ (2010)	No	No	No	NR	NR
Oh ²⁸ (2011)	No	NR	No	Yes	NR
Rizk ³⁸ (1991)	NR	NR	NR	NR	Yes
White ⁴⁴ (1996)	NR	No	No	No	NR
Lee ³⁹ (2009)	NR	No	No	NR	Yes

Prospective and retrospective studies were not applicable for risk of bias analysis;^{27,29,40,42,43,45–48}

(*NR = not reported)