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ORIGINAL ARTICLE

Comparative functional outcomes of patients with adhesive capsulitis receiving intra-articular versus sub-acromial steroid injections: case–control study

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Abstract

Purpose This is a prospective case–control study comparing short- and medium-term outcomes between sub-acromial and gleno-humeral corticosteroid injections in adhesive capsulitis.

Methods The study population consisted of 105 patients (33 males, 72 females; mean age, 56.1 years). They were divided into three groups: (1) patients receiving 40 mg of methylprednisolone acetate as intra-articular injection ($n=35$) followed by physical therapy; (2) patients receiving 40 mg of methylprednisolone acetate as sub-acromial injection ($n=35$) followed by physical therapy; (3) patients receiving only physical therapy (heat, passive stretching exercises and wall climbing) and no injections ($n=35$). Functional outcome scores (Constant shoulder score and Shoulder Pain and Disability Index), visual analogue scale for pain and range of motion of shoulder joint were noted at 3, 6 and 12 weeks and 6 months.

Results There was a statistically significant improvement in VAS scores in group 1 and 2 at 3, 6, 12 weeks and 6 months compared to that before the injections. There was no statistically significant improvement in the group 3 at 3 and 6 weeks, but improvement was noticed at 12 weeks and 6 months. There was no statistically significant difference in VAS, CS score, SPADI and ROM between groups 1 and 2 at 3, 6, 12 weeks and 6 months. These scores were significantly better in group 1 and 2 compared to group 3 at 3, 6, 12, weeks and 6 months.

Conclusions Corticosteroid injections into the sub-acromial space and into the gleno-humeral joint produce similar results in terms of pain relief and improvement in function in patients with adhesive capsulitis.

Keywords Adhesive capsulitis · Frozen shoulder · Intra-articular injections · Sub-acromial

Introduction

Adhesive capsulitis is a common condition affecting shoulder joint. Prevalence of adhesive capsulitis in general population is estimated to be approximately 2–5% [1]. It is characterised by painful, global restriction of both active and passive movements of the shoulder, particularly external rotation. It is considered to be a self-limited disease of unknown aetiology. Majority of patients are relieved of pain and regain their movements within 1–2 years after the onset of illness, though some residual stiffness may remain.

Pathological structures in adhesive capsulitis are the joint capsule and surrounding ligamentous structures such as coraco-humeral ligament. They frequently develop fibrosis and thickening. Two most commonly used treatments for adhesive capsulitis are physical therapy and local steroid injections. Local injection of corticosteroids has shown to improve pain and function in short term, though effect on long-term outcomes and duration of disease is uncertain [2, 3].

Gleno-humeral (GH) injections are most commonly used to manage these patients. Classically, sub-acromial space (SA) injections were used for impingement syndrome. Gleno-humeral injections are technically more

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demanding as compared to SA injections as blind injections may frequently fail to reach the joint [4, 5]. They may be accurate in only about 10 to 42% of the patients when administered without imaging or ultrasonography [5]. The pathology of adhesive capsulitis affects not only the synovium of the joint, but also the rotator cuff, rotator interval and the coraco-humeral ligament. Injection into the SA space can reach up to the latter structures involved in adhesive capsulitis. There is limited literature available on use of SA injections in adhesive capsulitis. Only three studies have compared these two techniques which have limitations of small sample size and a high attrition rate [6–8]. There was no significant difference in the shoulder function following those two techniques. Thus, we aim to conduct a prospective case–control study comparing short- and medium-term outcomes between SA and GH corticosteroid injections in patients with adhesive capsulitis.

Methods

The study was approved by the institutional ethics committee. The study population consisted of 105 patients who were divided into three groups:

1. Patients receiving 40 mg of methylprednisolone acetate as intra-articular injection ($n=35$) followed by physical therapy.
2. Patients receiving 40 mg of methylprednisolone acetate as sub-acromial injection ($n=35$) followed by physical therapy.
3. Patients receiving only physical therapy (heat, passive stretching exercises and wall climbing) and no injections ($n=35$).

Inclusion and exclusion criteria are tabulated in Table 1.

Sample size

Sample size calculations were done considering the differences in VAS scores and Shoulder Pain and Disability Index (SPADI) using "a priori" power analysis. The power of study ($1-\beta$) was set at 80% and α at 0.05. Minimum clinically significant difference in VAS score was 2 points with a standard deviation of 2 points between subjects [7]. Minimum clinically significant difference in SPADI is 15 points, and standard difference was assumed to be 15 points. The minimum sample size for VAS score was 28 in each group, and for SPADI was 21. Assuming 25% dropout rate, minimum sample size was calculated to be 35 in each group.

Technique of GH injection

Posterior approach was used with patient in sitting position. Under sterile conditions, 22-gauge needle was inserted into two fingerbreadths inferior and medial to the postero-lateral corner of the acromion and directed antero-medially towards the coracoid process. Allergy to lignocaine is tested before administering the injection. Forty milligrams (1 ml) of methylprednisolone acetate was injected into the gleno-humeral joint.

Technique of SA injection

Lateral approach was used with patient in sitting position. Spine of scapula was palpated and followed laterally where it forms the acromion process. Lateral edge of acromion was palpated and followed inferiorly into the soft spot that can be felt like a depression. The needle is advanced in this space with slight superior angulation.

Outcome scores

Outcome scores were noted in follow-up at 3, 6 and 12 weeks and 6 months after first injection

Table 1 Inclusion and exclusion criteria for patients included in the study

Inclusion criteria	Exclusion criteria
Age 40–60 years, either sex	Previous shoulder capsular surgery
Clinical diagnosis of adhesive capsulitis based on global restriction of range of motion (ROM) to at least < 50% of normal	History of steroid injection(s) into affected shoulder
Symptoms not explained by rotator cuff lesion, biceps tendinitis or cervical spine pathology	Osteoarthritis changes in GH joint on plain radiographs
Stage I and II disease with duration of symptoms more than 3 weeks and < 6 months	History of shoulder trauma or prolonged shoulder immobilisation
	Skin changes suggestive of Sudeck's dystrophy in the affected extremity
	Uncontrolled blood sugars in Diabetes mellitus
	Cardiac surgery, history of angina or myocardial infarction in last 6 months
	Inability to provide informed consent
	Allergy to local anaesthetic agents

- Constant shoulder score and Shoulder Pain and Disability Index (SPADI).
- Visual analogue scale for pain.
- Range of movement (ROM).

  - Flexion abduction: Supine with thorax stabilised.
  - Internal rotation/external rotation—Supine with the shoulder and elbow abducted 90°. The forearm is midway between pronation/supination with the entire humerus supported by the table.
  - ROM assessment for internal rotation was made in sitting position with trunk stabilised. Results were classified as

    - 0—Hand reaches behind trunk to opposite scapula or 5 cm beneath it in full internal rotation. Wrist is not laterally deviated.
    - 1—Hand almost reaches opposite scapula, 6–15 cm beneath it.
    - 2—Hand reaches opposite iliac crest.
    - 3—Hand reaches buttock.
    - 4—Subject cannot move hand behind trunk.

If symptoms recur or not improve, injection will be repeated once more, at least 6 weeks after the first injection.

Statistical analysis

Paired *t* test was applied to within-group comparisons of treatment efficacy. One-way ANOVA was used to compare the three groups. Chi-square test was used for categorical variables. Significance was accepted for $P < 0.05$. Analysis was performed using the software SPSS 16 (SPSS Inc, Chicago, IL, USA).

Results

All 105 patients were available for follow-up for at least 6 months. Demographic profiles of patients in each group are summarised in Table 2. There was no statistically significant difference in mean age, sex distribution, body mass index (BMI), diabetes status and mean duration of symptoms between the three groups. There was no statistically significant difference in VAS, CS score, SPADI and ROM between the three groups before the procedure.

VAS scores, CS score and SPADI for the three groups during follow-up are summarised in Table 3. Range of motion before the injection and at follow-up is also summarised in Table 3. There was a statistically significant improvement in VAS scores in group 1 and 2 at 3, 6, 12 weeks and 6 months compared to that before the injections. There was no statistically significant improvement in the group 3 at 3 and 6 weeks, but improvement was noticed at 12 weeks and 6 months.

Table 2 Summary of demographic profile of patients included in each group

	Group 1	Group 2	Group 3	*p* value
Total number	35	35	35	
Mean age[#]	55.6 ± 5.7	57.9 ± 6.8	54.8 ± 4.8	0.074
Males/females	12/23	10/25	11/24	0.875
Body mass index[#]	23.6 ± 3.4	23.9 ± 3.9	24.0 ± 4.2	0.903
Diabetes mellitus	14	12	15	0.756
Mean duration of symptoms (weeks)[#]	15.6 ± 4.9	14.2 ± 4.4	16.6 ± 5.1	0.116

[#]Results expressed in mean ± standard deviation

There was no statistically significant difference in VAS, CS score, SPADI and ROM between groups 1 and 2 at 3, 6, 12 weeks and 6 months. These scores were significantly better in group 1 and 2 compared to group 3 at 3, 6, 12 weeks and 6 months, but the significance levels declined as the duration advanced.

Discussion

Shin et al. [8] divided 191 patients with adhesive capsulitis into 4 groups: receiving SA, GH, SA + GH and no injections. While they found a significant short-term benefit of corticosteroid injections over only physiotherapy, there was no difference in functional outcomes between patients receiving only GH or SA injections or a combination of the two. Similar findings were shared by Oh et al. [6] and Rizk et al. [7]. Oh et al. [6] compared 37 patients receiving GH injections with 34 patients receiving SA corticosteroid injections for adhesive capsulitis. There was a significant reduction in pain scores in both the groups, though the patients receiving GH injections had lower pain score at 3 weeks following injections. There was no difference in pain scores at 6 and 12 weeks. Rizk et al. [7] had used three injections at 1-week interval in their study of 48 patients receiving GH or SA steroid injections or plain lignocaine. There was no significant difference between the groups in relation to the site of injection.

Equally good improvements with sub-acromial injections and intra-articular injections have got a good bearing on understanding of patho-anatomy of adhesive capsulitis. Sub-acromial bursa covers a large part of antero-superior aspect of shoulder joint. It extends up to the rotator interval and the coraco-humeral ligament anteriorly, where it is located superficial to these structures and deep to the deltoid muscle. Neviaser initially found that the bursal tissues may be spared in adhesive capsulitis and primarily

Table 3 Functional outcome scores and range of motion in each group before and after the injections

Visual analogue scale for pain				
Before injection	8.8 ± 1.4	9.0 ± 1.8	8.4 ± 2.0	0.348
3 weeks	2.3 ± 1.3	2.1 ± 1.6	8.2 ± 2.2	0.000
6 weeks	1.9 ± 1.4	2.0 ± 1.8	8.0 ± 2.1	0.000
12 weeks	2.8 ± 2.0	3.0 ± 1.6	6.8 ± 2.2	0.000
6 months	3.7 ± 2.3	3.4 ± 2.7	5.7 ± 2.9	0.001
Constant shoulder score				
Before injection	28.8 ± 9.6	30.5 ± 8.8	31.4 ± 9.9	0.507
3 weeks	65.7 ± 20.5	63.8 ± 22.4	34.5 ± 12.6	0.000
6 weeks	68.4 ± 25.7	65.9 ± 25.8	36.8 ± 11.9	0.000
12 weeks	70.4 ± 27.8	69.8 ± 27.9	44.6 ± 15.7	0.000
6 months	64.8 ± 24.4	63.2 ± 22.9	49.7 ± 16.4	0.007
SPADI score				
Before injection	40.4 ± 12.3	44.5 ± 13.5	42.5 ± 14.6	0.411
3 weeks	13.2 ± 4.4	12.8 ± 4.7	40.6 ± 15.4	0.000
6 weeks	12.6 ± 4.9	12.6 ± 4.2	36.8 ± 12.3	0.000
12 weeks	17.6 ± 5.4	18.2 ± 6.0	37.8 ± 11.8	0.000
6 months	21.8 ± 9.5	20.4 ± 8.4	28.7 ± 11.6	0.001
Range of motion				
Before injection				
Flexion	144.6 ± 17.5	148.6 ± 14.4	146 ± 10.9	0.507
Abduction	88.6 ± 13.7	92.2 ± 18.6	86.5 ± 18.8	0.377
External rotation	51.0 ± 14.2	52.7 ± 12.8	49.6 ± 10.8	0.593
Internal rotation	2.9 ± 0.8	2.8 ± 0.8	2.75 ± 0.9	0.747
3 weeks				
Flexion	166.7 ± 20.3	164.0 ± 15.6	148.9 ± 9.6	0.000
Abduction	151.3 ± 21.2	153.4 ± 10.9	90.6 ± 10.5	0.000
External rotation	68.5 ± 19.4	70.4 ± 16.7	46.8 ± 8.8	0.000
Internal rotation	2.3 ± .8	2.25 ± 0.7	2.75 ± 0.9	0.019
6 weeks				
Flexion	168.9 ± 19.5	166 ± 16.7	155.6 ± 8.8	0.000
Abduction	156.8 ± 16.6	157.8 ± 13.9	95.4 ± 12.7	0.000
External rotation	72.3 ± 13.4	74.6 ± 10.3	50.9 ± 7.8	0.000
Internal rotation	2.0 ± 0.7	2.05 ± 0.7	2.6 ± 0.9	0.001
12 weeks				
Flexion	170.4 ± 15.6	166.4 ± 15.6	160 ± 10.1	0.009
Abduction	158.9 ± 12.6	156.8 ± 16.7	105 ± 14.6	0.000
External rotation	72.4 ± 9.9	73.4 ± 9.8	56.7 ± 12.8	0.000
Internal rotation	1.7 ± 0.7	1.6 ± 0.7	2.1 ± 0.8	0.002
6 months				
Flexion	163.6 ± 16.7	162.7 ± 12.3	162.1 ± 18.3	0.933
Abduction	156.7 ± 13.4	159.8 ± 12.2	140.1 ± 19.9	0.000
External rotation	70.6 ± 8.7	72.5 ± 6.8	60.9 ± 11.1	0.000
Internal rotation	1.3 ± 0.5	1.25 ± 0.6	2.0 ± 0.8	0.000

Results expressed in mean ± standard deviation

SPADI Shoulder Pain and Disability Index

the joint capsule is involved [9]. Andrieu et al. found that the sub-acromial space is almost invariably involved in adhesive capsulitis and suggested an adjuvant sub-acromial corticosteroid injection in patients who do not respond to an intra-articular injection. Rotator interval and coraco-humeral ligaments are the chief structures now believed to be involved in adhesive capsulitis [10, 11]. Both these structures are essentially extra-articular. Findings of this study support that synovial inflammation model of pathogenesis of adhesive capsulitis may not be

complete and there may be significant contribution from the bursal side. On the contrary, it may be argued that these results may be explained by a relatively high prevalence of rotator cuff pathologies in this age group and a large number of these stiff shoulders may be adhesive capsulitis secondary to degenerative rotator cuff lesions.

Corticosteroids may provide relief by decreasing synovitis, thereby allowing earlier and greater range of shoulder range of motion and thus reducing development of peri-articular fibrosis. Pathology in adhesive capsulitis affects not only gleno-humeral joint capsular tissues, but there is accompanying contractures of coraco-humeral ligament and rotator interval. Arthroscopic release of the rotator interval is an important surgical procedure in the operative treatment of adhesive capsulitis for achieving more complete restoration of shoulder motion. Injection in the sub-acromial space addresses these important structures involved in adhesive capsulitis. Rotator interval and coraco-humeral ligament can be reached by injection into the sub-acromial space. Therefore, the use of a sub-acromial injection is expected to help in adhesive capsulitis. Administering a sub-acromial injection is technically easier compared to intra-articular injection, when both are given blindly. Strengths of this study include prospective design with an adequate sample size, long follow-up and control groups. One limitation of this study is that we did not use ultrasonography for localisation of the gleno-humeral joint before steroid injections.

Conclusions

Steroid injections provide faster and better pain relief and improvement in shoulder function as compared to physical therapy alone. Corticosteroid injections into the sub-acromial space and into the gleno-humeral joint produce similar results in terms of pain relief and improvement in function.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interests.

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