

Ultrasound Guided Multisite Injection Technique in the Treatment of Frozen Shoulder



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Abstract: Frozen shoulder (FS) is an elusive condition that affects patients' mental and emotional quality of their lives. Corticosteroid injection technique is one of the first-line treatment methods in the treatment of FS. Ultrasound (USG) guidance allows visualization of the shoulder anatomy and improves the accuracy of the injection site. This study describes an USG-guided injection technique for FS treatment. The aim of this technique was to affect glenohumeral joint and capsule, subacromial space, the long head of biceps tendon sheath, and the coracohumeral ligament. For this purpose, four different sites were injected by USG guidance. Patients with FS can be effectively treated through this technique that is detailed in this article.

Introduction

Frozen shoulder (FS) is a common shoulder disorder that has been the subject of uncertainty with its controversial treatment in the literature.¹ Although some studies report spontaneous resolution of symptoms, others state that the vast majority of patients may not achieve full recovery.² With this ambiguity, many treatment methods have emerged for FS.²

Nonsurgical management, such as oral medications, physical therapy, intra-articular injection, and joint distension, are forming the first preferential treatment method.³ However, surgical interventions, including manipulation under general anesthesia and arthroscopic capsular release, are preferred in patients with refractory symptoms.³

Because of its anti-inflammatory effect, the use of corticosteroid injections to treat FS is one of the most common procedures, and it is also effective for pain relief, improving function and increasing range of motion (ROM).^{3,4} Traditionally, corticosteroid is administered to the glenohumeral joint; however, some studies have shown that pathological changes in FS are not limited to the glenohumeral joint.³ According to the pathophysiology of FS, it affects various sites, including glenohumeral joint, subacromial (SA) space, rotator interval (RI), and the long head of biceps tendon sheath.³ These results suggest that injection sites need to be investigated further.³

In the present study, we aim to demonstrate an injection technique in the treatment of the patients with FS. The purpose of the multisite injection technique is to affect the glenohumeral joint, postero-inferior capsule, postero-superior capsule, subacromial space, the long head of biceps tendon sheath, and coracohumeral ligament.

Injection Technique (With Video Illustration)

The goal of this technique is to affect pathologic sites in FS by using ultrasound (USG) guidance. The patient sits in an upright position with their hands positioned on their thighs. Bony landmarks, including clavicle, spina scapulae, acromion, and coracoid process, are identified and marked. At first, ultrasonographic examination (SonoScape S40, 5-12 MHz linear probe, Shenzhen, China) is performed. In the multisite injection technique, a total of 40-ml drug solution, consisting of 2 mL of triamcinolone acetone (40 mg/mL),

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4 mL bupivacaine (0.5%), and 34 mL saline solution is prepared. All injections are performed USG guidance.

After cleaning the skin with povidone-iodine, the injections are performed in a sterile manner. A 23-gauge needle is inserted parallel to the transducer in a semi-oblique plane from the posterior side of the shoulder. The needle is advanced under real-time USG guidance until the needle tip enters the glenohumeral joint. At this point, 5 mL of the solution is injected into the glenohumeral joint, and 5 mL is injected into the outer surface of the postero-inferior capsule (Figs 1 and 2). Ten milliliters of drug combination is applied to the postero-superior capsule from 2 cm cephalous to the midpoint of the spina scapulae by directing the tip of the syringe from the supraspinatus fossa to the under surface of the acromion, while the joint capsule is screening posteriorly by the transducer. The expansion of the joint capsule is checked while the solution is being injected (Figs 2 and 3). For the SA injection, lateral approach is used in which the long axis of the supraspinatus is the parallel to the probe, and the needle is inserted parallel or oblique in relation to the probe. Ten milliliters of the drug combination is injected to the SA space, while visualizing it on the screen (Figs 4 and 5). Finally, the long head of biceps (LHB) tendon sheath and coracohumeral ligament are identified in the transverse plane by USG; perpendicular to the long axis, the needle is inserted in-plane with the probe into the lateral and inferior aspect of the LHB tendon sheath and coracohumeral ligament.



Fig 1. Demonstration of glenohumeral joint and postero-inferior capsule injection (patient in upright position -left shoulder). Injection is administered 2-3 cm distal and medial to the tip of the acromion. The needle is inserted parallel to the ultrasound probe in a semi-oblique plane. Five milliliters of drug solution is applied to each of the glenohumeral joint and postero-inferior capsule (red arrows).

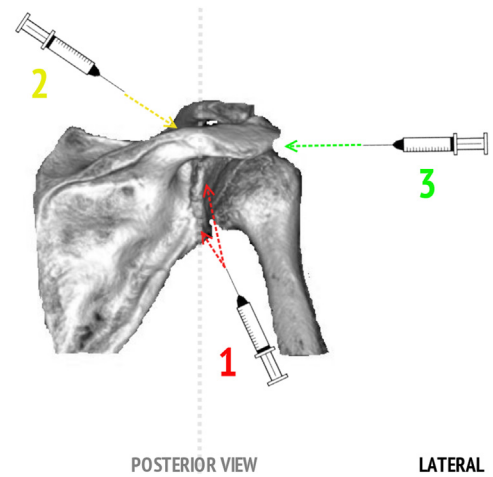


Fig 2. Illustrations of injection sites (right shoulder -posterior view). The first injection is administered into the glenohumeral joint and postero-inferior capsule. The second one targets the postero-superior capsule.

The needle tip position can be checked with a small amount of injected solution and 10-mL drug combination is applied to the LHB tendon sheath and around the coracohumeral ligament (Figs 4 and 6).

Pearls and pitfalls should be reviewed while applying this injection technique (Table 1).

Postinjection Protocol

Patients are observed for 30 minutes for any possible side effects, including local bleeding, weakness, anaphylaxis, motor deficiencies, and/or vasovagal reactions. Each participants should be checked for late side effects. Patients are participated in a standard



Fig 3. Ten milliliters of drug solution is injected into the postero-superior capsule (yellow arrow) from 2 cm proximal to the midpoint of the spina scapula, while joint capsule is screening posteriorly (patient in upright position -left shoulder).

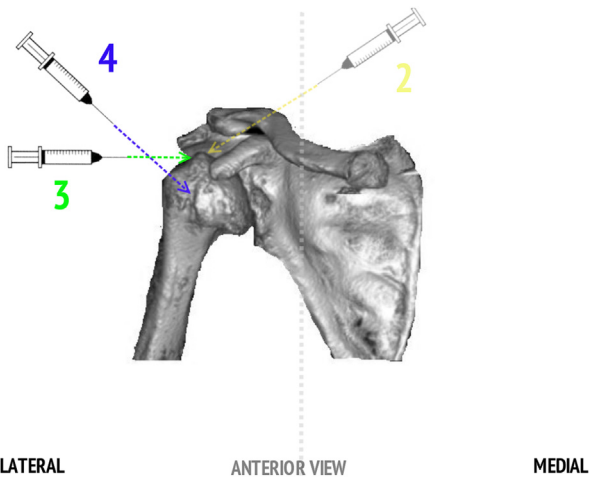


Fig 4. Illustrations of injection sites (right shoulder—anterior view). The subacromial space is visualized, and the third injection is applied to this area. Then, the final injection is administered around the long head of biceps tendon sheath and coracohumeral ligament.

physiotherapy program within the first 2 hours after injection. Physiotherapy is performed in every other days for 6 sessions in total. During the physiotherapy program, glenohumeral joint, scapulothoracic joint, acromioclavicular joint mobilization; capsule stretching exercises; and soft tissue mobilization were performed. Patients are provided a home exercise program consisting of stretching exercises and movements to preserve their ROM. The patients are evaluated in the outpatient clinic visits with daily home exercise program checklists.

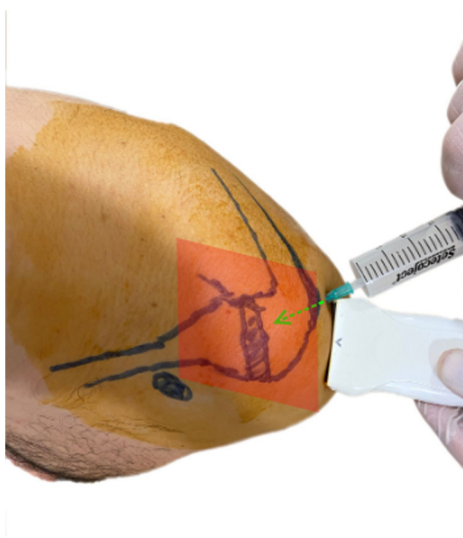


Fig 5. The needle is directed into the subacromial space (green arrow) laterally in a parallel or oblique position to the probe and 10 mL of solution is injected into the subacromial space (patient in upright position -left shoulder).



Fig 6. Ten milliliters of drug solution is applied to the long head of biceps tendon sheath and coracohumeral ligament (blue arrow) when the patient's elbow is flexed at 90° and the forearm in the supine position (patient in upright position -left shoulder). At that moment, intertubercular sulcus is visualized when the probe is in a perpendicular position to the long axis.

Discussion

Treatment of FS includes several different nonoperative modalities, such as physical therapy, oral anti-inflammatory drugs, shoulder injections, or any combination of these.^{5,6} Although shoulder injection has been widely accepted option to be an effective treatment for FS, there is a debate in the literature in terms of the proper location of the injection site.⁶

In recent studies, it has been demonstrated that not only glenohumeral joint capsule but also rotator cuff tendons, subacromial space, rotator interval, and the long head of biceps tendon sheath are affected in pathologic process of FS.^{3,4} Besides, these results indicated that the pathophysiology of the FS varies in different sites of the shoulder.⁴

Table 1. Pearls and Pitfalls

Pearls

- It is important to identify anatomical landmarks.
- It is recommended to use triamcinolone acetonide as well-known long-acting glucocorticoid.
- Patients should be observed for 30 minutes for any possible side effects.
- Patients should be participated the first session of the physiotherapy program within 2 hours after injection.

Pitfalls

- The longer needle may be needed to use for obese patients.
- The glenohumeral joint and postero-inferior capsule should be injected separately in the posterior approach.
- The long head of biceps tendon sheath should be injected, not the long head of biceps tendon itself.

Table 2. Advantages and Disadvantages**Advantages**

- Ultrasound guidance provides the accuracy of injection sites.
- Multisite injection serves better analgesia and compliance with physiotherapy.

Disadvantages

- The use of ultrasound requires a long learning curve
- The blood glucose level may increase because of the amount of glucocorticoid used.

In an anatomical study, it was determined that different parts of the glenohumeral joint capsule were innervated by different nerves.⁷ According to this study, the innervation of joint capsule shows variations between specimens.⁷ Anecdotally, the authors have supported that the innervation of glenohumeral joint capsule should be known exactly for the treatment of chronic shoulder pain.⁷ As a result, depending on the injection site, different treatment strategies should be determined.⁷

With this injection technique, different parts of the capsule with varying innervation, and the parts of the shoulder complex which are involved in the pathologic process of FS may be treated.⁶ Since multisite injection aims directly to a specific nerve, it serves better analgesia; therefore, it facilitates the compliance with physiotherapy.

One of the issues discussed in the treatment of the FS in previous studies is the effectiveness of injections with and without the use of imaging.⁸ Some studies report that shoulder injections with imaging guidance are more accurate than blind injections, and more effective at reducing pain and improving function.⁸ USG-assisted shoulder injections have been reported more accurate than blind injections.⁸ It was suggested that USG guidance is beneficial, especially in applications to the joint with a posterior approach.⁸ In this multisite injection technique, all injections were applied by USG guidance to ensure the accuracies of the regions.

Although corticosteroids used in shoulder injections vary in types and doses, there is a little scientific evidence about their efficacy, safety, and acting duration.^{3,8} Even though some studies show no difference in results between lower and higher doses of corticosteroids, 40 mg/mL triamcinolone is the most commonly used, long-acting glucocorticoid that has

been proven to be effective.^{3,8} Most of the physicians have selected corticosteroid types and doses based on their experience because of the lack of the scientific data.^{3,8} In this report, 40 mg/mL triamcinolone is recommended according to individual experience and literature support.³

Consequently, the multisite injection technique can achieve good outcomes and advantages (Table 2). The multisite injection technique is presented for the nonsurgical treatment of FS, emphasizing correct injection sites. This will provide better analgesia, better ROM, and better functional results in the treatment of patients with FS.⁶

References

1. Abrassart S, Kolo F, Piotton S, et al. 'Frozen shoulder' is ill-defined. How can it be described better? *EFORT Open Rev* 2020;5:273-279.
2. Forsythe B, Lavoie-Gagne O, Patel BH, et al. Efficacy of arthroscopic surgery in the management of adhesive capsulitis: A systematic review and network meta-analysis of randomized controlled trials. *Arthroscopy* 2020;37:2281-2297.
3. Itoi E, Arce G, Bain GI, et al. Shoulder stiffness: Current concepts and concerns. *Arthroscopy* 2016;32:1402-1414.
4. Zhang J, Zhong S, Tan T, et al. Comparative efficacy and patient-specific moderating factors of nonsurgical treatment strategies for frozen shoulder: An updated systematic review and network meta-analysis. *Am J Sports Med* 2021;49:1669-1679.
5. Hasegawa A, Mihata T, Fukunishi K, Neo M. Does the timing of surgical intervention impact the clinical outcomes and overall duration of symptoms in frozen shoulder? *J Shoulder Elbow Surg* 2020;30:836-843.
6. Koraman E, Turkmen I, Uygur E, Poyanli O. A Multisite injection is more effective than a single glenohumeral injection of corticosteroid in the treatment of primary frozen shoulder: A randomized, controlled trial. *Arthroscopy* 2021;37:2031-2040.
7. Laumonerie P, Dalmas Y, Tibbo ME, et al. Sensory innervation of the human shoulder joint: the three bridges to break. *J Shoulder Elbow Surg* 2020;29(12):e499-e507.
8. Lee JH, Choi EJ, Han SC, et al. Therapeutic efficacy of low-dose steroid combined with hyaluronidase in ultrasonography-guided intra-articular injections into the shoulder for adhesive capsulitis. *Ultrasonography* 2021;40:555-564.