Shoulder injections for osteoarthritis and other disorders

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Shoulder region injection procedures can be beneficial in patients with osteoarthritis and other musculoskeletal disorders. These procedures can yield important diagnostic information, especially when identification of the pain generator via physical examination is limited due to pain-related guarding. Injections also can provide good therapeutic benefit directly and indirectly by allowing the patient to participate more meaningfully in physical therapy. As discussed in detail later in this article, some injection procedures can be performed in the examination room as part of a routine office visit, whereas others may require fluoroscopic guidance.

From the perspective of injection procedures, the shoulder-girdle region can be conceptualized as being divided into anterior, lateral, and posterior regions (Table 1 and Fig. 1). The important structures that can be injected anteriorly are the acromioclavicular (AC) joint, the glenohumeral (GH) joint, the bicipital tendon sheaths, the subacromial bursa, the sternoclavicular (SC) joint, and the subcoracoid bursa. The subacromial space also can be injected using a lateral or posterior approach. Although some sources make the distinction between the subacromial and the subdeltoid bursae, others consider these two bursae to represent one distinct bursal complex, referred to as the \textit{subacromial-subdeltoid bursae complex} or simply the \textit{subacromial bursa} \cite{1}. For simplification, this article collectively refers to these two structures as the \textit{subacromial bursa}. The GH joint; the tendon insertions of the supraspinatus, infraspinatus, and subscapularis muscles; and the suprascapular nerve region can be injected using a posterior approach.
Table 1 shows that the GH joint and the subacromial space are distinct structures. There often is confusion, however, between a subacromial injection and a GH joint injection. Some texts do not make the distinction clearly between these two separate structures [2]. In a patient with an intact rotator cuff, the subacromial space and the GH joint are anatomically distinct from one another. An injection can be performed into either structure, and the injectate remains only within one of those structures. In contrast, in a rotator cuff tear, the two spaces no longer are anatomically separated. Appearance of the injected contrast solution within the subacromial space after it has been injected into the GH joint is the basis behind shoulder arthrography when it is used to diagnose a rotator cuff tear [1]. Arthrography was the primary imaging modality for diagnosing rotator cuff tears before the advent of MRI.

Specific shoulder region injection procedures are discussed in the subsequent sections. For each procedure, general comments first are made with an emphasis on indications. These comments are followed by a review of the literature, a discussion of the authors’ collective experience with the procedure, and a discussion of the most commonly described technique for performing the injection.

**Specific injections**

**Subacromial region**

**General comments**

It has been the authors’ overwhelming collective experience that injections into the subacromial region constitute most shoulder region injection procedures in an outpatient physiatric practice. As noted earlier, subacromial injections should not be confused with true GH joint injections. The subacromial space is a distinct structure from the GH joint. Subacromial injections are performed for diagnostic and therapeutic reasons.
Diagnostic subacromial injections can help differentiate impingement from a rotator cuff tear. A typical scenario is a patient who is unable to abduct the shoulder fully. The patient’s pain may be interfering with the physical examination such that it is difficult to determine if the inability to abduct the shoulder is due to pain or to true weakness from a rotator cuff tear. In this setting, a diagnostic subacromial local anesthetic injection can

Fig. 1. (A) Anterior injection sites. (B) Lateral/posterolateral injection sites. (C) Posterior injection sites. AC, acromioclavicular.

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help to make the distinction immediately by eliminating pain. Specifically, if the patient is able essentially to abduct the arm fully after the injection, a large rotator cuff tear is excluded.

In addition to their use as diagnostic tools, subacromial injections can be used therapeutically as follow-up treatment in patients with positive diagnostic injections and in patients in whom the diagnosis of subacromial (also known as subdeltoid) bursitis or rotator cuff tendinitis is evident just from physical examination. A therapeutic subacromial corticosteroid injection can be extremely effective in diminishing shoulder pain relatively quickly. It can be particularly helpful in patients who otherwise might have difficulty participating in any meaningful way in physical therapy due to pain. Ideally the injection should be combined with other aspects of treatment, including avoidance of the inciting activity, oral nonsteroidal anti-inflammatory drugs (NSAIDs), and physical therapy.

In contrast to their diagnostic and therapeutic benefits, excessively repeated subacromial corticosteroid injections are potentially deleterious to the rotator cuff tendons, as suggested by a study in rats in which repeat subacromial corticosteroid injections led to fragmentation of collagen bundles and inflammatory cell infiltration [3]. It is unclear, however, if the findings of this study translate to humans and what the safe number of subacromial corticosteroid injections is for a given patient. In contrast to this study, which looked at subacromial injections, previous studies have cautioned against direct intratendinous corticosteroid injections in general because they have been associated with complete collagenic disorganization.
and sometimes with persistent tendinous necrosis several weeks after the injection [4,5].

Adhesive capsulitis is another disorder for which subacromial injections sometimes are performed. This disorder does not seem to be a major indication for subacromial injection because most of the literature on corticosteroid injections for adhesive capsulitis pertains to GH joint injections (see later).

**Literature review**

A 2003 Cochrane Database Systematic Review was conducted on corticosteroid injections for shoulder pain [6]. Part of the review compared subacromial corticosteroid injections with other interventions (Table 2). The review concluded that for rotator cuff disease, subacromial steroid injections probably have a small benefit over placebo with respect to pain and active range of abduction. No benefit of subacromial steroid injections over NSAIDs

<table>
<thead>
<tr>
<th>Type of trial</th>
<th>Effect on pain</th>
<th>Author, year</th>
<th>Main conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versus placebo</td>
<td>Corticosteroid superior</td>
<td>Adebajo, 1990 [9]</td>
<td>Pooled results of these two studies (n = 45) suggest a small benefit over placebo at 4 wk for pain and active abduction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Petri, 1987 [8]</td>
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<td></td>
<td></td>
<td>Blair, 1996 [13]</td>
<td>Some benefit over placebo for pain but no difference in ADLs</td>
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<td></td>
<td></td>
<td>Plafki, 2000 [14]</td>
<td>Some benefit over placebo</td>
</tr>
<tr>
<td>No difference</td>
<td></td>
<td>Kirkley, 1999 [15]</td>
<td>No difference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vecchiod, 1993 [16]</td>
<td>No difference</td>
</tr>
<tr>
<td>Placebo superior</td>
<td></td>
<td>Strobel, 1996 [17]</td>
<td>Placebo more beneficial for pain, but return to work better for corticosteroid</td>
</tr>
<tr>
<td>Versus NSAIDs</td>
<td></td>
<td>Adebajo, 1990 [9]</td>
<td>Pooled results of these 3 trials (n = 120) suggest no benefit with respect to pain, function, and range of abduction at 4 or 6 wk</td>
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<tr>
<td></td>
<td></td>
<td>Petri, 1987 [8]</td>
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<tr>
<td></td>
<td></td>
<td>White, 1986 [10]</td>
<td></td>
</tr>
<tr>
<td>(+) NSAIDs versus</td>
<td></td>
<td>Petri, 1987 [8]</td>
<td>No benefit over NSAIDs alone for pain, function, range of abduction, and remission at 4 wk</td>
</tr>
<tr>
<td>NSAIDs alone</td>
<td></td>
<td></td>
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<tr>
<td>Crystalline versus</td>
<td></td>
<td>Plafki, 2000 [14]</td>
<td>No significant difference between the two corticosteroid preparations</td>
</tr>
<tr>
<td>lipoid corticosteroid</td>
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</tbody>
</table>

**Abbreviations:** ADLs, activities of daily living; NSAIDs, nonsteroidal anti-inflammatory drugs.
was shown, however, based on the pooled results of three trials. A previous literature review of 13 controlled studies of subacromial corticosteroid injections for rotator cuff tendinitis published between 1955 and 1993 also suggested that corticosteroid injections are more effective than placebo [7]. In contrast to the Cochrane review, this earlier review suggested superiority of corticosteroid injections over oral NSAIDs, especially for pain associated with rotator cuff tendinitis. This earlier review had referenced only two of the three double-blind, placebo-controlled studies that were analyzed in a Cochrane review [8,9]. The Cochrane review reached a different conclusion when it had pooled the results of one additional study [10]. Calcific tendinitis was not included specifically as part of either review because it was believed to represent an entity that is distinct from simple rotator cuff tendinitis.

The earlier review and the Cochrane review agreed that many unanswered questions remain, including the optimal injection technique (see later), optimal number of injections, long-term efficacy, and potential deleterious effects. In addition, the question as to whether benefit depends on accurate placement of corticosteroid into the subacromial space has yet to be studied specifically because no trials to date have compared blind injection with radiographically guided injection with respect to outcome. The question of efficacy as it relates to injection placement was examined in two studies. One study involved a group of general shoulder pain patients (n = 43) who received an anatomically guided (ie, the injection was performed into the subacromial space) steroid injection versus a trigger or tender point injection [11]. This double-blinded study found via an intention-to-treat analysis that the anatomically placed injection group did better than the tender or trigger point group with respect to pain after 1 week. Another study found an 87% injection accuracy using an anterolateral approach as determined by the inclusion of contrast material in the injection solution followed by postimaging radiography in 48 patients [12]. Injection accuracy correlated in a statistically significant way with continued pain relief at 2 weeks after the corticosteroid injection. In contrast, pain relief 0.5 hour after the injection probably is not a reliable indicator of injection accuracy because the accurately injected patient group and the nonaccurately injected patient group reported nonstatistically significant differences in pain (P < 0.05).

Authors’ experience

During a prospective study over a 2-year period, the authors personally supervised 90 subacromial injections that were performed by resident physicians as part of a clinical study on teaching injection procedures [18]. In addition to this structured teaching experience, the authors personally have performed and supervised numerous previous and subsequent subacromial injections during their collective 21 years of postresidency experience. It is the consensus among the authors from their teaching study and clinical experience that subacromial corticosteroid injections often provide quick, dramatic pain relief that is, however, sometimes of temporary
benefit. The results seem to be most impressive in terms of the degree of pain relief and long-term duration for patients with severe acute shoulder pain due to exacerbations of chronic calcific tendinitis/bursitis. For other conditions, such as chronic impingement syndrome and partial rotator cuff tears, pain relief often is good but less dramatic and more likely to be transient. The injection seems to be superior to NSAIDs alone, however, because they often provide pain relief in patients who otherwise have failed previous NSAIDs. Subacromial corticosteroid injections are unlikely to result in cure per se, unless they are combined with other treatment, particularly instruction in proper biomechanics to avoid precipitating activities and shoulder positions.

The authors occasionally have performed a subacromial corticosteroid injection in patients with adhesive capsulitis in whom they believed that concomitant subacromial bursitis was present and was interfering with patient progress. The authors’ collective impression is that the injection can provide some temporary symptomatic relief, which might help a patient to perform physical therapy better.

**Technique**

The subacromial bursa can be injected using an anterior, lateral, or posterolateral approach. Unless there is a large palpable subacromial bursa effusion, in which case it is easiest to direct the needle into the region where the effusion is felt best, the authors prefer a posterolateral approach (Fig. 2). This approach provides several advantages over the lateral and anterior approaches (Fig. 3).

![Fig. 2. Subacromial injection—posterolateral approach. (A) Use of Physicians’ Desk Reference to open up subacromial space. (B) Palpation of scapular spine angle. (C) Needle insertion site. (D) Anatomic model showing proper needle entry.](image-url)
Advantages over the lateral approach. Advantages of the posterolateral approach over the lateral approach include the following:

The subacromial space is perhaps widest when approached posterolaterally. During the procedure, the natural reaction of the patient is to shrug his or her arm upward, especially narrowing the space when
approached from a lateral direction because the humeral head rides just under the lateral aspect of the scapula.

The posterolateral approach provides a reproducible palpable landmark—the lateral corner of the scapula. This landmark is especially useful for injections performed on obese or muscular individuals.

Fig. 3. Subacromial injection—alternative approaches. (A and B) Lateral approach. (C and D) Anterior approach.
There is potentially a lot of tissue in between the skin surface and the subacromial space in obese or muscular individuals when using a lateral approach.

The needle is being directed from a relatively posterior position to a relatively anterior position. This is an advantage because the subacromial bursa is located in a relatively anterior position within the subacromial space under the anterior-inferior acromion.

Advantages over the anterior approach. Advantages of the posterolateral approach over the anterior approach include the following:

- The posterolateral approach best keeps the needle out of the visual field of the patient.
- The anterior approach does not allow for the patient to dangle an object (see later) passively from the hand to open up the subacromial space.
- The anterior approach does not allow for an assistant to pull actively down on the arm of the patient as another means of opening up the subacromial space.

Procedure for posterolateral approach. A procedure for injecting the subacromial space via a posterolateral approach is as follows:

- Palpate the posterolateral corner of the acromion, and mark the injection site approximately one fingerbreadth below that site, using the plastic cap covering the needle tip.
- To open up the subacromial space, have the patient dangle a relatively heavy object from the hand, such as the Physicians’ Desk Reference (see Fig. 2) [19].
- Alternatively, an assistant can apply gentle steady traction to the arm.
- After preparing the skin, insert the needle through the mark, and angle the needle slightly upward and anteriorly. It is important to use a long enough needle and to direct the needle anteriorly enough because the subacromial bursa lies anteriorly within the subacromial space under the undersurface of the anterior-inferior acromion. The goal is to place the needle within the bursa, rather than in the posterior subcutaneous tissue.
As you advance the needle, you should not encounter any bone resistance. If you do, the needle may be too inferior and contacting the humeral head or too superior and contacting the undersurface of the acromion.

You should be able to push the needle upward and feel that it is riding under the undersurface of the acromion. It is important to position the needle as superiorly as possible to avoid the substance of the rotator cuff, which lies underneath the bursa.

When you feel this, either attempt to aspirate, if it is indicated, or perform the injection. It has been written that in calcific bursitis, it may be possible to aspirate out calcium deposits from the bursa, but none of the authors has ever been able to do this.

If resistance is encountered, try retracting the needle so that it is slightly less medial. If the resistance does not diminish, try advancing the needle in a little further.

**Acromioclavicular joint**

**General comments**

In the authors’ collective experience, the AC joint is the second most frequently injected structure in the shoulder region. Many pathologic processes, most commonly primary and post-traumatic osteoarthritis, traumatic sprains, and osteolysis of the distal clavicle, may affect this joint.

Although this structure is a potential pain generator, particularly in osteoarthritis patients, it can be difficult to make this determination reliably based on history, physical examination, and imaging without performing a diagnostic injection for the following reasons:

Asymptomatic AC joint degeneration is frequent and does not always correlate with the presence of symptoms [20].

AC joint and subacromial region pathology often coexist. AC joint pathology is believed to accompany chronic rotator cuff impingement syndrome frequently [21]. It can be almost impossible to apportion the pain between the two structures without a diagnostic injection.

The AC joint sometimes is overlooked as a site of potential pathology because of its unique radiographic features. To visualize the joint properly, apical lordotic views are ideal. The AC joint also is atypical in that it is one of the few body regions where erosions, rather than osteophytes typically develop in osteoarthritis. Radiographic evidence of “typical” osteoarthritis may be lacking on plain films. Finally, to visualize subtle AC joint separations, weight-bearing stress views are needed. For all of these reasons, routine shoulder x-rays are likely to miss AC joint pathology. The physiatrist sometimes is faced with a patient who has normal routine shoulder films but pain of possible AC joint etiology.
There are several different potential pain referral patterns from the AC joint, as was shown in a saline injection study [22].

From a therapeutic perspective, there are no specific exercise principles that address the AC joint per se. Therapeutic AC joint injections play a potentially large role in the management of AC joint pathology.

**Literature review**

A PubMed literature search of therapeutic AC joint injections uncovered only one study [23]. Jacob and Sallay [23] retrospectively studied 31 patients with isolated AC joint arthropathy who had received therapeutic injections via a standardized, nonfluoroscopically controlled technique and were followed for 2 years. Using an American Shoulder and Elbow Surgeons pain questionnaire and the surgical end point of distal clavicle excision, the study concluded that injecting local corticosteroids into the AC joint may provide short-term pain relief, but does not alter the natural progression of disease.

**Authors’ experience**

The authors have found AC joint injections to be useful in terms of diagnostic information and therapeutic benefit. Specifically the injection procedure has helped significantly in confirming that the AC joint was a pain generator in patients in whom the imaging was negative. The injections also have helped patients who have received only partial benefit from subacromial corticosteroid injections. In retrospect, these patients also apparently had pathology in the AC joint. The authors have found that fluoroscopy is useful in some patients in whom landmark palpation is difficult.

**Technique**

Most texts describe an AC joint injection approach that directs the needle perpendicular to the surface of the top of the shoulder. Although patients can be placed in the supine or seated position with the affected arm resting comfortably at their side, the authors collectively prefer that patients be seated. The authors believe that this position facilitates identification of joint line because gravity tends to depress the acromion slightly relative to the clavicle. The joint line can be identified by palpating the clavicle distally to its termination, at which point a slight depression should be felt at the joint articulation. The needle is inserted from the superior approach into the AC joint and directed inferiorly. Various methods for guiding AC joint injections have been described, as follows:

- No radiographic visualization
- Fluoroscopic guidance
- Ultrasound guidance
- CT guidance [24]

Choice of injection technique is likely to be influenced by several factors. The patient's body habitus directly affects the ability to palpate the joint.
Another factor is the availability of fluoroscopy or other radiographic imaging modalities. Rates of 67% injection accuracy for blind injections have been reported [25]. There is some controversy, however, as to whether it is necessary actually to inject the joint or whether injection into the tissue over the interosseous groove of the joint at the point of maximal tenderness is adequate [26]. Until studies are performed that show equal efficacy of injections in the area of the AC joint rather than into the AC joint, the authors prefer to make every reasonable attempt to inject into the AC joint. In doing so, it should be kept in mind that there seems to be significant variability in the anatomy of the AC joint. Slight variations in the relative angle of entry into the joint can make attempts at blindly entering the joint challenging. This is particularly true in the setting of osteoarthritis because the joint can be extremely narrowed. For this reason, the authors often prefer to perform AC joint injections using fluoroscopic guidance. The following is an injection protocol used by the authors for AC joint injections using fluoroscopy (Fig. 4):

The patient is seated, and the c-arm is angled to provide an anteroposterior, slightly lordotic view at approximately 10° of a cephalad tilt. This
view helps to visualize the joint optimally by minimizing the appearance of overlying structures.

The patient’s shoulder preferably should be extended slightly (rather than flexed or in a neutral position) because shoulder extension can help to separate the acromion slightly from the distal clavicle.

Additional separation of the acromion and clavicle can be achieved by passively hanging a weighted object, such as the *Physicians’ Desk Reference* or a sandbag, from the patient’s hand.

A metallic marker, such as a clamp, is placed on the shoulder surface to identify the skin overlying the entry site.

The overlying skin is marked by depressing it with a plastic needle cap. After preparing the skin, the overlying skin and subcutaneous tissue sometimes are anesthetized with a small amount of 1% lidocaine depending on the body habitus and anxiety level of the patient. Specifically, in obese patients in whom there is a significant amount of tissue between the skin surface and the joint, it might be helpful from a patient comfort perspective to use preinjection local anesthesia.

In an extremely anxious patient, it may be of psychological advantage first to anesthetize the overlying tissue. When doing this, the physician can report to the patient in a comforting way that the area first will be numbed before the injection is performed. Distortion of the overlying tissue is much less of an issue for fluoroscopically-guided injections than for blind injections, in which palpation is much more important and may need to be repeated during the procedure.
This view is used to guide needle placement into the AC joint by visualizing the relative mediolateral needle position. This view also permits an assessment of the relative needle depth, which is important, as the authors have found that the tendency is to insert the needle too deeply such that it penetrates through the inferior joint surface.

Optional: When the needle appears to have entered the AC joint as per the AP apical lordotic view, the relative needle position in the coronal plane can be assessed via an axillary view. To shoot this view best, the patient can rest the affected arm on a table with adjustable height and tilt his or her head away from the affected shoulder as much as possible so as to remove the skull from the line of view of the fluoroscope. The resultant image can be difficult to interpret by a physician who is new to this procedure. A useful way of learning how to interpret this image is to instill a small amount of contrast material, which outlines the joint if the needle is placed properly. Through repetition, the physician should become adept at spotting the AC joint line without the need for contrast injection. Because the volume of the joint is small, it probably is preferable to avoid contrast injection unless absolutely necessary.

On entering the AC joint, an attempt can be made to aspirate the joint. The authors generally have not been able to aspirate fluid from this joint. Aspiration of fluid from the AC joint has been described in patients with osteoarthritis [27]. It has been the authors’ experience that it is the rare exception that fluid can be aspirated from the joint, even when fluoroscopic guidance has ensured proper needle placement.

Ultrasound has been proposed as an alternative modality for providing joint visualization during aspiration procedures of small joints in general [28]. There are no published studies on the accuracy of ultrasound-guided AC joint injections, and the authors collectively have performed only one AC joint injection procedure under ultrasound before access to fluoroscopy was available. It was one author’s (T.P.S.) experience that ultrasound-guided injection was more difficult technically to perform compared with fluoroscopic-guided AC joint injection. Difficulties were encountered with visualizing the needle relative to the joint.

A case report of a CT-guided AC joint injection has been published [24]. The authors do not believe that this offers imaging any advantage over fluoroscopy, which is generally much more readily available and easier to perform, especially with respect to speed and the personnel needed to operate the imaging equipment. Although the authors have no personal experience with CT-guided AC joint injection procedures, they have found CT guidance to be inconvenient for the limited number of spinal injection procedures that they have performed under CT guidance.
Glenohumeral joint

General comments

The GH joint is not a common site of primary osteoarthritis. It can develop secondary osteoarthritis on a post-traumatic basis and due to deposition of calcium hydroxyapatite crystals, in which case the resultant shoulder pathology, including rotator cuff degeneration and arthropathy, is known as the Milwaukee shoulder. Because these conditions are not common, injections into the GH joint rarely are performed for either primary or secondary osteoarthritis. In contrast, GH joint injections are performed more frequently as part of treatment for adhesive capsulitis.

Literature review

There is a moderately large body of literature, relative to other types of shoulder injections, on GH joint corticosteroid injections for adhesive capsulitis. This treatment has been compared alone and in various combinations with placebo, no treatment, and other treatments. Studies that were thought to be of enough scientific merit to warrant inclusion in a Cochrane Database of Systematic Reviews are shown in Table 3 [6]. Table 3 categorizes the studies to compare GH joint corticosteroid injections with other interventions. In most of the studies, the patients also were receiving typical additional treatment such as analgesics, NSAIDs, and home exercises, especially range-of-motion exercises. Table 3 illustrates only differences in treatment beyond the above-mentioned usual interventions. This other treatment is labeled as a “major intervention.” Because some of the studies involved several treatment arms, these studies are referenced more than once in the table. Although definite conclusions are difficult to draw from these studies because of problems with and differences in study design, a few tentative conclusions are suggested, as follows:

The addition of GH joint corticosteroid injections, particularly higher doses of corticosteroids administered via an anterior approach, to other treatments probably more quickly improves pain and range of motion in the early stages of the disease process.

Because the natural history of adhesive capsulitis is generally good, there probably are no long-term differences among treatment approaches, including no specific treatment at all.

Many questions about these injections still need to be addressed regarding patient selection characteristics, timing of the injections, number of corticosteroid injections, and optimal adjuvant treatment in addition to an injection. With respect to the last question, it also would be of interest to study whether combining GH joint and subacromial injections is superior to GH joint injections alone. In patients with intact rotator cuffs, these two spaces are distinct and as such might require separate injections if there also seems to be a component of rotator cuff tendinitis/subacromial bursitis in
addition to the adhesive capsulitis. Theoretically, injections into both of these structures should be helpful in this setting, but this question has yet to be addressed.

In contrast to the use of GH joint injections in adhesive capsulitis, there are only a few studies on their use in rotator cuff pathology. One study found no difference in benefit from corticosteroid injections compared with placebo, ultrasound, or acupuncture [40].

There have been several published studies involving intra-articular injections as one of the injection procedures for shoulder pain due to “mixed diagnoses” [41,42]. It is difficult to draw conclusions from these studies because of the nonuniformity of diagnoses being treated and the combined injection procedures that were performed.

Authors’ experience

The authors have a moderate degree of experience with GH joint injections. Before the availability of fluoroscopy in the authors’ practices, these injections were performed in a blinded fashion. Although no complications were noted, and the authors believed that this procedure was relatively easy, their collective opinions have changed now that they perform the procedure with fluoroscopic guidance. Specifically the authors have a greater appreciation for how difficult it can be to place the needle into the joint, even using fluoroscopic guidance. This is particularly true in obese individuals.

Technique

GH joint injections at least in theory can be performed without fluoroscopic guidance. Either an anterior or a posterior approach can be used. There are certain advantages and disadvantages to the approaches. A posterior approach completely avoids the subclavian artery, subclavian vein, and brachial plexus and offers the psychological advantage of hiding the needle completely from the patient’s field of view. In contrast, the anterior approach offers the advantage of a more reproducible bone landmark, the coracoid process, to help guide the injection.

Posterior approach. The posterior approach is performed as follows (Fig. 5):

The patient typically is seated with the arm internally rotated and resting in the lap. Internal rotation of the arm helps to open up the posterior joint line to allow easier needle entry into the joint.

The physician chooses and marks a needle entry site that is opposite to the coracoid process anteriorly and is approximately two finger-breadths below the scapular spine.

After the skin is prepared, the physician typically uses a 3.5-inch or longer spinal needle to aim for the coracoid process, which is being palpated with the index finger of the hand other than that being used to drive the needle.
Table 3
Clinical trials of glenohumeral joint corticosteroid injections for adhesive capsulitis*

<table>
<thead>
<tr>
<th>Type of trial</th>
<th>Other intervention being compared</th>
<th>Author, year</th>
<th>Main conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versus another intervention(s)</td>
<td>Versus no treatment</td>
<td>Bulgen, 1984 [29]</td>
<td>Some early benefit in pain and range for injection but little long-term difference (6 mo) between groups</td>
</tr>
<tr>
<td></td>
<td>Versus ice</td>
<td>Bulgen, 1984 [29]</td>
<td>Some early benefit in pain and range for injection but little long-term difference between groups</td>
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<td></td>
<td>Versus analgesics (only)</td>
<td>Lee, 1973 [30]</td>
<td>Injection significantly better for pain, abduction, and overall treatment success</td>
</tr>
<tr>
<td></td>
<td>Versus physical therapy</td>
<td>van der Windt, 1998 [31]</td>
<td>At 7 wk, all outcomes favored the injection group; at 13 wk, only the main complaint remained statistically significant in the injection group; at 26 wk, no outcome differences; at 1 yr, only the main complaint was slightly better for the injection group</td>
</tr>
<tr>
<td></td>
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<td>Bulgen, 1984 [29]</td>
<td>Some early benefit in pain and range for injection but little long-term difference between groups</td>
</tr>
<tr>
<td></td>
<td>Versus physical therapy and NSAIDs</td>
<td>Arslan, 2001 [32]</td>
<td>No difference in pain at 2 and 12 wk</td>
</tr>
<tr>
<td></td>
<td>Versus infrared irradiation</td>
<td>Lee, 1973 [30]</td>
<td>Improvement not significantly different</td>
</tr>
<tr>
<td></td>
<td>Versus bicipital tendon sheath injection</td>
<td>Lee, 1973 [30]</td>
<td>Improvement not significantly different</td>
</tr>
<tr>
<td></td>
<td>Versus subacromial lidocaine injection</td>
<td>Rizk, 1991 [33]</td>
<td>No difference in pain or range of motion at 1 wk–6 mo</td>
</tr>
<tr>
<td></td>
<td>Versus subacromial steroid injection</td>
<td>Rizk, 1991 [33]</td>
<td>No difference in pain or range of motion at 1 wk–6 mo</td>
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<td></td>
<td>Versus glenohumeral joint lidocaine injection</td>
<td>Rizk, 1991 [33]</td>
<td>No difference in pain or range of motion at 1 wk–6 mo</td>
</tr>
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(continued on next page)
If intermittent fluoroscopic guidance is used, the physician can aim for the center of the posterior aspect of the joint. The posterior joint line can be distinguished from the anterior joint line by observing for an increase in width of the joint line as the patient’s arm is passively internally rotated and a decrease in width as the arm is passively externally rotated. Correct placement can be confirmed with contrast dye.

If fluoroscopic guidance is not being used, the physician must rely on feel.
The authors suggest that the spinal needle be aimed slightly laterally so that it makes contact with the humeral head; then the needle is walked off the humeral head medially into the joint. This is preferable to aiming slightly medially because the needle tip would be more likely to contact the bony glenoid, in which case it could be difficult to walk the needle off laterally into the joint due to the concave posterior surface of the glenoid, or the needle tip could pierce into the cartilaginous glenoid causing potential injury. Another advantage of a slightly lateral trajectory is that it avoids

Fig. 5. Glenohumeral joint injection. (A) Internal rotation opening up posterior joint line. (B) Posterior needle entry into joint. (C) Standard anteroposterior approach. (D) Anterosuperior approach.
the spinoglenoid notch and exiting suprascapular artery and nerve. Aiming the needle slightly lateral also probably is preferable to aiming directly for the joint itself because depth of penetration would be potentially more difficult to judge without use of a bone landmark, such as when the humeral head is used.

- Some suggest that if resistance still is encountered, the needle should be angled upward so that it is in the upper recess of the shoulder joint away from the head of the humerus.

Anterior approach. Because of the relative proximity of the neurovascular bundle when injecting from an anterior approach, the authors believe that it is best to ensure that the patient is not anticoagulated and has normal platelet function. Patients who are taking warfarin (Coumadin) stop taking the drug in preparation for the injection, or the injection is performed from a posterior approach. In addition, patients stop taking aspirin and aspirin-containing products and are switched from NSAIDs to cyclooxygenase type 2 inhibitors.

The procedure is performed as follows:

The injection is performed with the patient placed in a supine position with the arm straight and slightly externally rotated so as to open up the anterior joint line.

The acromion is palpated, and a skin entry site is marked such that it is approximately 1 inch inferior to the acromion process [43]. After skin preparation, the needle (preferably a 3.5-inch spinal needle) is directed into the joint.

If fluoroscopic guidance is used, the physician can aim for the center of the anterior aspect of the joint. The target anterior joint line can be distinguished reliably from the posterior joint line by noting a widening with passive shoulder external rotation.

Correct placement can be confirmed with contrast dye. If fluoroscopic guidance is not being used, the physician must rely on feel. Similar to the posterior approach, the authors suggest that the spinal needle is aimed slightly laterally so that it makes contact with the humeral head; then the needle is walked off the humeral head medially into the joint. The same advantages to a slight lateral approach are true for the anterior approach as they are for the posterior approach. The major advantage of a slightly lateral entry for the anterior approach is the relative position of the neurovascular bundle, which is situated medial and inferior to the joint.

Anterosuperior approach. Finally, an anterosuperior approach has been described [44]. This approach was developed based on anatomic dissections. It uses the anterior aspect of the AC joint as a landmark and involves inserting a 21G, 1.5-inch needle inferiorly into the GH joint. When resistance
is met, the shoulder is passively internally and then externally rotated. If this rotation is accompanied by movement of the needle tip, the needle is retracted slightly and then should be in the proper position.

**Bicipital tendon sheath**

**General comments**

The long and short biceps tendon heads rarely are involved in isolation (ie, rarely without other concomitant shoulder pathology). Bicipital tendinitis generally is found along with rotator cuff tendinitis/subacromial bursitis as part of a more generalized shoulder impingement syndrome. The biceps tendons usually are impinged beneath the coracoacromial arch [45]. The physician should differentiate between involvement of the long and short heads of the biceps by palpation. The long head of the biceps tendon runs in the bicipital groove after originating on the anterior labrum, whereas the short head originates on the coracoid process. In contrast to palpation, provocative physical examination maneuvers, including Speed’s test and Yergason’s maneuver, cannot distinguish reliably between the two tendons as the primary pain generator. Identification of the tendon most involved in pain production is essential because this knowledge guides the needle placement during the subsequent injection.

**Literature review**

There are no published studies on the efficacy, accuracy, or side effects associated with bicipital tendon sheath injections. A general statement appears throughout the literature that caution should be exercised with tendon sheath injections because inadvertent intratendinous injections have been associated with tendon rupture.

**Authors’ experience**

The authors have some experience in performing bicipital tendon sheath injections. The authors believe that these injections are needed uncommonly in a typical outpatient musculoskeletal practice because bicipital tendinitis most often accompanies subacromial bursitis/rotator cuff tendinitis as a secondary pathologic process rather than as the primary pathology. As such, often an injection is performed more logically into the subacromial space because this directly treats the primary pathology and indirectly treats the secondary pathologic process.

**Technique**

The provocative maneuvers that generally are performed before the diagnostic injection are Speed’s test and Yergason’s maneuver. When these have been assessed, the physician can proceed with the diagnostic injection. The choice as to whether to inject the short or the long head tendon sheath of the biceps tendon depends on the site of maximal tenderness. Specifically,
if the site of maximal tenderness is in the region of the bicipital groove, the long head of the biceps tendon is involved. In contrast, if the area of maximal tenderness is in the vicinity of the coracoid process, the short head of the biceps tendon is involved.

**Long head of biceps tendon.** One technique for performing a diagnostic bicipital tendon sheath injection of the long head of the biceps is as follows (Fig. 6):

Identify the most tender area over the bicipital groove. To help guide palpation, the bone aspect of the bicipital groove can be palpated along the anterior aspect of the humerus. Alternatively the bicipital tendon itself often can be palpated, particularly in nonobese patients, by sliding an examining finger over the anterior aspect of the shoulder, lateral to the coracoid process, and feeling for a discrete ropelike structure.

Insert the 21G or 22G needle at approximately a 30° angle to the skin surface and parallel to the bicipital groove. It is the authors’ opinion that a larger gauge needle is unnecessarily painful, whereas smaller gauge needles are more likely to lead to inadvertent intratendinous injection because they allow for too-easy passage into tendons with the minimal sensation of increased resistance being encountered during needle advancement.

![Fig. 6. (A and B) Bicipital tendon sheath injection.](image-url)
Attempt to contact the bicipital tendon itself with the needle tip but not to penetrate deeply into it. One should try to penetrate at least superficially so as not to end with the needle tip resting outside of the tendon sheath because the goal of the injection is to be between the tendon and its sheath. Increased resistance to needle passage is one clue that the needle has entered the tendon, as is the feeling that the needle is passing through strands of tissue fibers.

When the physician senses that the needle is contacting the bicipital tendon, an attempt should be made to perform the injection gently. Resistance to injection should be encountered.

While still applying pressure to the plunger, the needle should be withdrawn at most a few millimeters at a time. A sudden loss of resistance indicates that the needle is between the tendon and the sheath. The needle should be held in place and the injection completed. A hallmark of a successfully placed injection is the absence of localized tissue fullness after the injection, as would occur if the injection is given into the overlying soft tissue rather than into the tendon sheath.

A hallmark of a successfully placed injection is the absence of localized tissue fullness after the injection, as would occur if the injection is given into the overlying soft tissue rather than into the tendon sheath.

Short head of biceps tendon. A tendon sheath injection of the short head of the biceps tendon is similar to the injection for the long head of the biceps. The only major difference is that palpation is conducted inferior to the coracoid process because the short head of the biceps tendon inserts on the coracoid process. When the most tender spot along this tendon has been identified, the injection is conducted in an essentially identical fashion as for the long head of the biceps tendon.

Not all physicians believe that it is essential to perform a bicipital tendon sheath injection for either the long or the short head tendon sheaths [46]. Nicholas and Lennard [46] wrote that it is sufficient to deposit the steroid in immediate proximity to the point of tenderness, rather than within the tendon sheath itself. Although these authors did not specifically state this, it is likely that their reasoning is based on the fact that corticosteroids are lipid soluble to the degree that the injectate likely diffuses into the tendon sheath as long as it has been placed in the immediate vicinity of the tendon sheath. No published studies compare this peritendinous sheath injection method with a true tendon sheath injection.

Rotator cuff tendon insertion injections

General comments

Depending on the location of pathology, inflammation associated with rotator cuff tendinoses theoretically can be treated with injections into the rotator cuff insertion sites. These procedures at least can be considered in the setting of rotator cuff tendinitis or partial tears. These injections are different from subacromial injections, in which the injections are performed into the subacromial bursa, and inflammation associated with rotator cuff
pathology presumably is treated by relieving the subacromial bursitis that may develop secondarily or by diffusion of the corticosteroid through the undersurface of the bursa and onto the underlying rotator cuff tendons. From the perspective of injection procedures, supraspinatus pathology perhaps should be considered as being unique compared with pathology of the other rotator cuff tendons because the supraspinatus tendon and its insertion site are situated much closer to the subacromial bursa than are the other three rotator cuff tendon insertion sites. It seems logical that a subacromial injection procedure would be more likely to help manage supraspinatus-related inflammation compared with pathology of the other rotator cuff tendons.

The main site of pathology of supraspinatus tendinitis is usually in the rotator cuff critical zone of relative hypovascularity located 1 cm proximal to (rather than exactly at) its insertion site on the greater tuberosity [47]. It is unclear as to whether injections at the insertion site or into the subacromial bursa best treat the inflammation associated with supraspinatus pathology. For supraspinatus tendinitis, although it generally is believed that rotator cuff tendinitis and subacromial bursitis coexist, this injection has the advantage of placing the medication closer to the actual site of primary pathology in patients with rotator cuff tendinitis. This may be only a theoretical advantage because corticosteroid perhaps diffuses out of the subacromial bursa and onto the rotator cuff tendon sheaths anyway; this might explain why patients who seem to have primarily supraspinatus tendinitis seem to respond at least in part to subacromial injections. A supraspinatus tendon insertion injection is more difficult to perform, however, than a subacromial injection. The exact role of this injection procedure compared with the more traditionally used subacromial injection still is unclear.

**Literature review**

These injection procedures have been described, but few studies have examined their efficacy and potential complications.

**Authors’ experience**

The authors collectively have limited experience in performing these procedures because they prefer to treat rotator cuff tendinitis or partial rotator tears with a subacromial corticosteroid injection as part of the treatment armamentarium. It has been the authors’ collective experience, however, that most pathology involves the supraspinatus in its critical zone. It is the consensus among the authors that most rotator cuff pathology usually is associated with a component of subacromial bursitis and is treated adequately at least in part with a subacromial corticosteroid injection. The authors also prefer subacromial injections because they are easy to perform, and there is an extremely limited body of literature on rotator cuff tendon region injections in general compared with subacromial injections. In the rare instances in which there is pathology involving one of the rotator cuff
tendons at a location clearly outside of the subacromial region, a rotator cuff tendon insertion injection at least should be considered.

**Technique**

Rotator cuff tendon insertion injections should be administered under some, but not excessive, resistance. Excessive resistance suggests that the injection was performed inadvertently into the tendon itself. The specific techniques are discussed subsequently (Figs. 7 and 8).

**Supraspinatus injection**

**Literature review**

A PubMed literature search found only one published study on supraspinatus injection [48]. Withrington et al [48] compared supraspinatus tendon region injections with placebo in 25 patients with supraspinatus tendinitis. The study found no difference in pain or analgesic consumption at 2 and 8 weeks of follow-up.

**Technique**

Waldman [43] described a technique whereby the patient is placed in a supine position. The arm is internally rotated by placing it behind the patient’s back. This rotation exposes the supraspinatus insertion site along the anterior aspect of the humeral head. The skin overlying a point just below the anterior edge of the acromion is marked and prepared. The needle is advanced perpendicularly through the skin, subcutaneous tissue, and joint capsule until it impinges on bone. The needle is withdrawn slightly, and the injection is completed under slight resistance. Some authors report that a tender area is discovered by the point of the injecting needle [46].

**Infraspinatus injection**

**General comments**

Isolated infraspinatus pathology is relatively rare compared with supraspinatus tendinitis. Infraspinatus tendinitis has been described in certain individuals, however, such as assembly line workers who perform activities that require repetitive adduction and external shoulder rotation, such as installing brake pads [43].

**Literature review**

A search of the medical literature up until the time of this writing failed to reveal any studies on injections into the infraspinatus insertion site.

**Technique**

With the patient seated, the insertion site of the infraspinatus tendon on the posterolateral aspect of the humeral head is identified by palpation. The overlying skin is marked and prepared in the usual fashion. Then the needle is advanced perpendicularly through the skin, subcutaneous tissue, and
Fig. 7. Rotator cuff tendon insertion injections. (A and B) Teres minor tendon insertion injection. (C and D) Infraspinatus tendon insertion injection.
margins of the deltoid and infraspinatus muscles until it impinges on bone. The needle is withdrawn slightly out of the periosteum of the humerus, and the injection is completed under slight resistance.

**Subscapularis injection**

**General comments**

Isolated subscapularis pathology is relatively rare compared with supraspinatus tendinitis. Subscapularis tendinitis has been described, however, in
individuals such as assembly line workers, who perform activities requiring repetitive adduction and internal shoulder rotation [43].

**Literature review**

A search of the medical literature up until the time of this writing failed to reveal any studies on injections into the subscapularis insertion site.

**Technique**

With the patient lying supine, the insertion site of the subscapularis tendon on the lesser tuberosity of the humerus is identified by palpation. Palpation of this site is facilitated by passively externally rotating the humerus (ie, internally rotating the shoulder joint) approximately 45°. The overlying skin is marked and prepared in the usual fashion. The needle is advanced through the skin and subcutaneous tissue until it impinges on bone. The needle is withdrawn slightly out of the periosteum of the humerus, and the injection is completed under slight resistance.

**Suprascapular nerve block**

**General comments**

The suprascapular nerve transmits sensation from the GH joint, the shoulder capsule, and the AC joint. A suprascapular nerve block can help to relieve pain from these structures. A tradeoff is that this injection produces weakness of the supraspinatus and infraspinatus muscles because the suprascapular nerve innervates these muscles. In contrast, injections of the GH joint and AC joint do not cause secondary weakness of the supraspinatus and infraspinatus muscles the way a suprascapular nerve block does. Although an algorithm for use of this injection has not been published to the authors’ knowledge, a suprascapular nerve block can be
considered as a second-line injection procedure that is performed if a GH joint or AC joint injection either was not technically possible or was not successful. A suprascapular nerve block also can be performed to help diagnose and subsequently to treat a patient with suprascapular nerve entrapment. Its use in the setting of patients with recurrent pain despite subacromial injections is unclear and does not seem to make as much sense as for failed GH joint or AC joint injections because the suprascapular nerve does not transmit sensation from the subacromial space.

### Literature review

Suprascapular nerve blocks and infusions have been studied alone and in combination with other procedures to varying degrees in the management of shoulder pain from a variety of disorders, in the prevention of referred shoulder pain after surgery, and as a diagnostic tool in hemiplegic shoulder pain. Painful conditions for which the nerve block and infusions have been used include adhesive capsulitis, osteoarthritis, rheumatoid arthritis, rotator cuff tendinitis and tears, acute shoulder dislocation, chronic shoulder pain presumptively from subacromial bursitis, shoulder pain after shoulder surgery, malignancy-associated shoulder pain, and referred shoulder pain. There does not seem to be any consensus in the literature as to the exact indications for this procedure. Suprascapular nerve blocks have shown some promise in limited trials in reducing shoulder pain associated with adhesive capsulitis [49,50]. The use of suprascapular nerve blocks for adhesive capsulitis due to reflex sympathetic dystrophy has been described [51]. Suprascapular nerve blocks also have been studied for adhesive capsulitis in combination with stellate ganglion blocks and electroacupuncture [52]. This study found that the 50 patients who received the combination of a suprascapular nerve and stellate ganglion block along with electroacupuncture did significantly better than the 50 patients who received only electroacupuncture and the 50 patients who underwent only the two nerve block procedures. It was unclear from the aforementioned study if the patients were thought to have adhesive capsulitis in association with reflex sympathetic dystrophy as a reason for including a stellate ganglion block.

Several small studies have been published on the use of suprascapular nerve blocks for patients with rheumatoid arthritis or osteoarthritis [53,54]. There has only been one large randomized, placebo-controlled trial examining the efficacy of suprascapular nerve block for shoulder pain in arthritis or degenerative disease using pain and disability end points [55]. Shanahan et al [55] conducted a randomized, double-blind, placebo-controlled trial of the efficacy of suprascapular nerve block for shoulder pain in rheumatoid arthritis or degenerative disease of the shoulder in 83 patients (108 shoulders). These investigators found clinically and statistically significant improvements in all pain scores, all disability scores, and some range-of-movement scores in the shoulders receiving suprascapular
nerve block compared with the shoulders receiving placebo at weeks 1, 4, and 12. There were no significant adverse effects in either group. The procedure also has been studied in combination with an axillary nerve block to treat pain associated with osteoarthritis and rheumatoid arthritis [56].

Vecchio et al [57] described the use of this block in rotator cuff tendinitis via a randomized controlled trial. These authors concluded that a steroid/bupivacaine mixture was temporarily effective in reducing pain in rotator cuff tendinitis and tears, improving range of movement in tendinitis, and was possible in an outpatient setting with little or no complication risk.

Case reports were published on the successful use of suprascapular nerve blocks in acute shoulder dislocation [58]. When suprascapular nerve blocks subsequently were compared with intra-articular local anesthetic to relieve pain associated with acute shoulder dislocation, however, they were found to be inferior in terms of efficacy and ease of administration [59].

Comments have been published on the use of suprascapular nerve blocks for malignancy-associated shoulder pain [60].

Suprascapular nerve blocks also have been studied on a limited basis in reducing shoulder pain after nonarthroscopic shoulder surgery. It is believed to be a useful adjunct to general anesthesia and interscalene brachial plexus blocks for short-term postoperative analgesia, but reports have been conflicting regarding its benefit at 24 hours after surgery [61].

The procedure also has been studied for referred shoulder pain after nonshoulder surgery but has not been found to be effective. Suprascapular nerve block did not prevent shoulder tip pain after laparoscopic surgery [62]. Another trial found that the procedure did not provide pain relief of referred shoulder pain associated with thoracotomy [63].

Chronic shoulder pain presumptively from the subacromial bursa has been alluded to in the literature as a use for suprascapular nerve block [64]. There have been no published studies, however, on its use in this setting.

In addition to single injection procedures, continuous suprascapular nerve blocks have been studied on a limited basis for chronic nonmalignant shoulder pain. An initial case report was published on the use of suprascapular nerve block infusion for analgesia in a scapular fracture [65]. A case report subsequently was published on the successful use of continuous suprascapular nerve block for a patient with lung cancer and breakthrough shoulder pain due to scapular involvement [66]. A case report was published on the successful use of continuous suprascapular nerve block in a patient with adhesive capsulitis [67].

A modified technique for continuous suprascapular nerve blocks was described [68]. Using a catheter to block the suprascapular nerve continuously, the efficacy was believed to be high and the complication rate low.

In addition to use in treating shoulder pain, suprascapular nerve blocks were used in a study of painful shoulder in hemiplegic patients to help determine the cause of the pain [69]. Using suprascapular nerve conduction studies along with the block procedure, it was concluded that a lesion of the
suprascapular nerve was not responsible for the painful contracted shoulder of a hemiplegic patient, although such a lesion may exist incidentally.

Authors’ experience

The authors have limited experience with suprascapular nerve blocks; this is due in large part to the authors’ willingness to perform and familiarity with GH joint and AC joint injections. The authors consider suprascapular injections to be second-line procedures because compared with GH joint and AC joint injections, suprascapular nerve blocks are technically more difficult to perform, carry with them potentially greater morbidity, and cause concomitant rotator cuff weakness. The authors prefer to use fluoroscopic and electromyographic guidance. Suprascapular nerve blocks offer another potentially important treatment tool in the management of shoulder pain.

Technique

To the authors’ knowledge, the first article describing a suprascapular nerve block was published in 1989 [70]. Since that time, several slight variations of this technique for suprascapular nerve blocks have been described [71–75]. A PubMed literature search revealed only one study that compared the different injection techniques. Specifically a suprascapular nerve block technique using electromyography to localize the needle (also called near-nerve electromyography technique) was compared with a landmark-guided technique in patients with adhesive capsulitis [76]. The near-nerve electromyography technique was believed to be more successful in providing and maintaining pain relief for the 60-minute study period.

A suprascapular nerve block can be performed as follows (Fig. 9):

The patient is seated with the arms at the side.
The scapular spine is palpated, and the vertebral and acromial ends are marked.
A line is drawn to connect these two points, and this line is bisected.
The bisection point and the acromial end of the scapular spine are bisected.
A small amount (eg, 1 mL) of 1% lidocaine is injected into the soft tissue located 1.5 cm anterior to scapular spine, using a 30G needle.
A 25G, 1.5-inch needle is inserted and advanced until the patient reports paresthesias radiating to the shoulder consistent with good needle positioning or the needle contacts bone. If the needle contacts bone, it is withdrawn approximately half of the way out and redirected medially or laterally until paresthesias are reported.
Alternatively, if a nerve stimulator–adapted needle is used, needle placement is confirmed by movement of the supraspinatus and infraspinatus muscles in response to electrical stimuli [26].
Different solution volumes and compositions for the subsequent injection have been described as follows: (1) 5-mL solution containing either 1% lidocaine [26] or 1% lidocaine and the equivalent of 25 mg of hydrocortisone [71] or (2) 10 mL of a solution containing 1% lidocaine and 40 mg of methylprednisolone. Epinephrine also has been added to injection solutions, presumably for its vasoconstrictive properties. The authors do not add this to their injection solutions.

Fig. 9. Suprascapular nerve block. (A) Standard setup for suprascapular nerve block. (B) Skeleton representation of suprascapular nerve block. (C) Alternative approach to suprascapular nerve block.
A successfully placed injection is characterized by weakness of the supraspinatus and infraspinatus muscles and resolution of shoulder pain if the pain is originating from the GH joint or the AC joint.

When using the above-described technique, several points of caution to keep in mind are as follows:

Intraneural injection may result in suprascapular nerve damage but can be safeguarded against by asking the patient about severe pain with injection and promptly repositioning the needle if this is to occur.

Hematoma and intravascular injection are possible due to the close proximity of the suprascapular vessels.

Pneumothorax is possible if the needle is advanced beyond the scapula and into the pleura.

The aforementioned side effects potentially can be avoided using a protocol described by Dangoisse et al [74]. This technique involves introducing the needle parallel to the blade of the scapula (ie, away from the direction of the lung and the suprascapular nerve and vessels) and injecting the solution into the floor of the supraspinous fossa (see Fig. 9C). Dangoisse et al reported that this is an easy and safe technique and does not run the risk of pneumothorax or damage to the suprascapular nerve or vessels, as can occur when the needle is introduced into the supraspinous fossa perpendicular to the blade of the scapula then enters the scapular notch.

Although no publications were found using a PubMed literature search on the use of fluoroscopic guidance for suprascapular nerve blocks, fluoroscopy may add a margin of safety to the procedure. In particular, fluoroscopic guidance combined with the injection of contrast dye can help to diminish the possibility of inadvertent intravascular injection. In addition, needle depth relative to the scapula can be assessed better with fluoroscopic guidance.

The question of whether or not to add corticosteroid to the injection solution was addressed in small study (n = 58 shoulders in 29 patients) of rheumatoid arthritis patients [77]. In this study, the injections were performed with bupivacaine and epinephrine plus methylprednisolone compared with bupivacaine and epinephrine. Although significant improvements were noted in measures of pain, stiffness, and range of most movements for both treatments (3 months) compared with baseline, the results favored bupivacaine and epinephrine. The study authors concluded that the addition of methylprednisolone to the mixture conferred no benefit in these patients.

Sternoclavicular joint injection

General comments

The SC joint is formed by the sternal end of the clavicle, the manubrium of the sternum, and the cartilage of the first rib. It is a true synovial joint
that contains a meniscus and is covered by a loose fibrous capsule that is reinforced by the anterior and posterior SC ligaments. The SC joint acts as a fulcrum for all motions of the shoulder girdle [71]. Despite relative excess use over a lifetime, the SC joint usually is only a late and relatively mild site of osteoarthritic involvement [78]. Although osteoarthritis is the most common disorder of the SC joint, the osteoarthritic SC joint also generally does not cause significant functional impairment [79]. Other pathologic conditions that might necessitate injections or aspiration of the SC joint have been described. Traumatic SC joint dislocations can occur but are relatively rare [80]. Case reports of infections of the SC joint have been published [81]. Other miscellaneous conditions of the SC joint include renal failure–related amyloid deposition and a Charcot joint in a patient with syringomyelia [82,83]. As a result of the relative scarcity of its involvement in pathology, the SC joint is not one of the more commonly injected structures about the shoulder girdle. For patients who do not respond to injections and other conservative treatment of SC osteoarthritis, resection arthroplasty is an option [84].

**Literature review**

There are no published studies on injections of the SC joint.

**Authors’ experience**

The authors do not have a significant amount of experience with SC joint injection compared with other shoulder region injection procedures. The authors’ collective impression is that it is a relatively easy injection to perform because the joint is superficial and easy to palpate. Fluoroscopy should not be necessary to perform the injection. The authors have had no complications from the injection procedure to date.

**Technique**

The patient can be positioned either lying supine or sitting up (Fig. 10). The joint can be palpated by identifying the joint medial to the end of the clavicle while having the patient protract and retract the shoulder. The needle should be inserted perpendicularly into the joint and the injection performed. One recommendation for the injectate is 1 mL of 0.25% bupivacaine and 40 mg of methylprednisolone using a 25G needle [43]. Care should be taken not to insert the needle too deeply because of the presence of major vessels posterior to the joint. Specifically the left common carotid artery and the brachiocephalic vein lie behind the left SC joint. The brachiocephalic artery lies behind the right SC joint. All of these vessels theoretically are susceptible to injury [43].
Shoulder injection procedures are powerful diagnostic and therapeutic tools for the care of patients with osteoarthritis and other pathologic conditions of the shoulder-girdle region. Although questions regarding many of the details of the specific procedures still need to be answered, a modest body of literature is available. The musculoskeletal physiatrist is in a good position to contribute to this knowledge base through further clinical research.

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