# 28 Suprascapular Nerve Entrapment: Shoulder

Christopher J. Burnett and Helen W. Karl

## Introduction

The *suprascapular nerve* (SN) is a mixed sensory and motor nerve that originates from the upper trunk of the *brachial plexus* and can be a cause of shoulder pain and weakness. There are two primary sites for entrapment of the SN the clinical presentation varies depending on the site of entrapment. Patients with proximal SN entrapment (at the suprascapular notch) primarily complain of poorly localized posterolateral shoulder pain and weakness. Diagnosis is made by injection at the suprascapular notch, using a peripheral nerve stimulator (PNS), fluoroscopy, ultrasound (US), or CT scan. Treatment includes cryoneuroablation, pulsed radiofrequency (PRF), surgery, or peripheral stimulation. Entrapment of the distal SN at the spinoglenoid notch causes much less pain and is discussed in Chapter 34.

## Clinical Presentation (Table 28.1)

Signs and symptoms of SN entrapment depend on the location of nerve compression. Entrapment at the *suprascapular notch* results in significant, sudden onset of shoulder pain due to compression of the deep sensory fibers innervating the *glenohumeral* and *acromioclavicular joints* [2, 10]. The pain is described as a dull ache in the posterolateral aspect of the shoulder and scapular regions (Fig. 28.1) that may radiate into the ipsilateral shoulder, arm, or neck (Fig. 28.2). There can be limitations in abduction and external rotation. This condition is seen primarily in athletes or people performing repetitive overhead motions (e.g., weight lifting, baseball, tennis, swimming, carpentry). It can be triggered by a traumatic or other acute event, such as a lifting injury with the arm internally rotated (like carrying a heavy suitcase), but the onset is typically insidious, involving the dominant arm in patients (usually male) from 20 to 50 years of age. The patient may complain of shoulder weakness or fatigue, particularly in abduction and external rotation of the arm. Any forward

**Table 28.1** Occupation/exercise/trauma history relevant to suprascapular nerve entrapment

| | |
|---|---|
| Repetitive shoulder movements, especially external rotation and abduction, which usually cause entrapment at the spinoglenoid fossa [1] | Sports: baseball [2]; weight lifting [3]; swimming [2]; dancing [2]; tennis [4]; volleyball [2, 3] |
| | Carpentry [5] |
| Surgical positioning | Knee-chest position with the scapula protracted [2] |
| Carrying heavy objects [3] | Meat packers [3] |
| | Newsreel cameramen [3] |
| | Roofers [6] |
| Stretch and direct trauma | Fracture of scapula, humerus, clavicle [3] |
| | Anterior shoulder dislocation [3] |
| | Shoulder surgery [7] |
| | Skeet shooting [8] |
| Space occupying lesions are often associated with a trauma history | Ganglion cyst [3, 5]; lipoma [2]; hematoma [3]; tumor [3] |
| Other | Insertion of the spinoglenoid ligament onto the scapulohumeral joint, causing tension on the ligament (trapping the nerve) with arm movements [9] |

**Electronic supplementary material** The online version of this chapter (doi:10.1007/978-3-319-27482-9_28) contains supplementary material, which is available to authorized users.

C.J. Burnett, MD (✉)
Pain Management Division, Department of Anesthesiology, Baylor Scott and White Memorial Hospital, Temple, TX, USA
e-mail: Christopher.Burnett@BSWHealth.org

H.W. Karl, MD
Department of Anesthesiology and Pain Medicine, University of Washington, Seattle Children's Hospital, Seattle, WA, USA
e-mail: helen.karl@seattlechildrens.org


A.M. Trescot (ed.), *Peripheral Nerve Entrapments: Clinical Diagnosis and Management*, DOI 10.1007/978-3-319-27482-9_28

**Fig. 28.1** Patient description of proximal suprascapular nerve pain (Image courtesy of Andrea Trescot, MD)

**Fig. 28.2** Pain pattern associated with suprascapular nerve entrapment (Image courtesy of Andrea Trescot, MD)

movement of the scapula can elicit pain, including movements as simple as reaching across the chest. Patients can also develop a "*frozen shoulder*," (adhesive capsulitis), one cause of which is unwillingness to move the shoulder joint due to pain [1, 2, 10].

If the entrapment occurs more distally, at the *spinoglenoid notch*, the patient will have isolated atrophy and weakness of the infraspinatus muscle. In this situation, pain is largely absent because the deep sensory fibers to the shoulder joint exit proximal to this entrapment site [2, 3]. Liveson et al. [8] reviewed 13 reported cases of entrapment at the spinoglenoid notch most patients did not complain of pain or weakness, but rather came to medical attention because of insidious infraspinatus atrophy. They felt that the lack of weakness complaints was due to compensation by other muscles.

Brachial neuritis can also cause suprascapular neuropathy, though, in this case, weakness is not confined to the supraspinatus and infraspinatus muscles [2].

## **Anatomy** (Table 28.2)

The suprascapular nerve originates from the fibers of the fifth and sixth cervical nerve roots, with frequent contributions (15–22 % of cases) [4] from the fourth cervical nerve root. It branches from the upper trunk of the brachial plexus and runs across the posterior cervical triangle adjacent to the omohyoid muscle. It passes under the *coracoclavicular ligament* and the *trapezius muscle* [4], then posteriorly to pass through the *suprascapular notch* (also known as the *supraspinatus notch* or *incisura scapulae*) (Fig. 28.3). Anatomic [11] and radiologic [4] studies show that the suprascapular notch can have a wide variety of shapes, ranging from almost flat, to u-shaped, to a deep groove, and even to a closed circle. The *transverse scapular ligament* encloses the superior portion of the suprascapular notch. This ligament is of variable thickness and can become partially or completely ossified, which can contribute to entrapment neuropathy. The position of the nerve in the notch is variable, making injection using anatomic landmarks alone difficult. Both the *suprascapular artery* and the *suprascapular vein* usually cross the upper edge of the scapula above the suprascapular ligament (Fig. 28.3) [1, 3, 10, 12], though a recurrent branch of the suprascapular artery may accompany the nerve through the notch [4]. Interestingly, the suprascapular notch has been found to be absent in 8% of 423 cadavers studied [13].

After passing through the suprascapular notch, the nerve travels underneath the *supraspinatus muscle* and provides its motor innervation. The SN, in combination with the *lateral pectoral nerve* [7], also supplies sensory branches to the shoulder capsule, *glenohumeral joint*, the *acromioclavicular (AC) joint*, the *coracoclavicular ligament*, and the

**Table 28.2** Suprascapular nerve anatomy

| | |
|---|---|
| Origin | A direct branch of the upper trunk of the brachial plexus (C4-C6) |
| General route | Crosses the posterior neck, under the trapezius, toward the suprascapular foramen, through the suprascapular notch/foramen, and then through the spinoglenoid notch |
| Sensory distribution [7] | Glenohumeral joint (shoulder joint) |
| | Acromioclavicular joint (shoulder joint) |
| | Subacromial bursa |
| | A patch of skin on the lateral upper shoulder |
| Motor innervation: 2 of the 4 rotator cuff muscles | Supraspinatus: Abducts humerus, especially the first 20–30° |
| | Infraspinatus: externally rotates humerus. The posterior deltoid and teres minor muscles also perform this function, so isolated infraspinatus muscle dysfunction may be asymptomatic [4] |

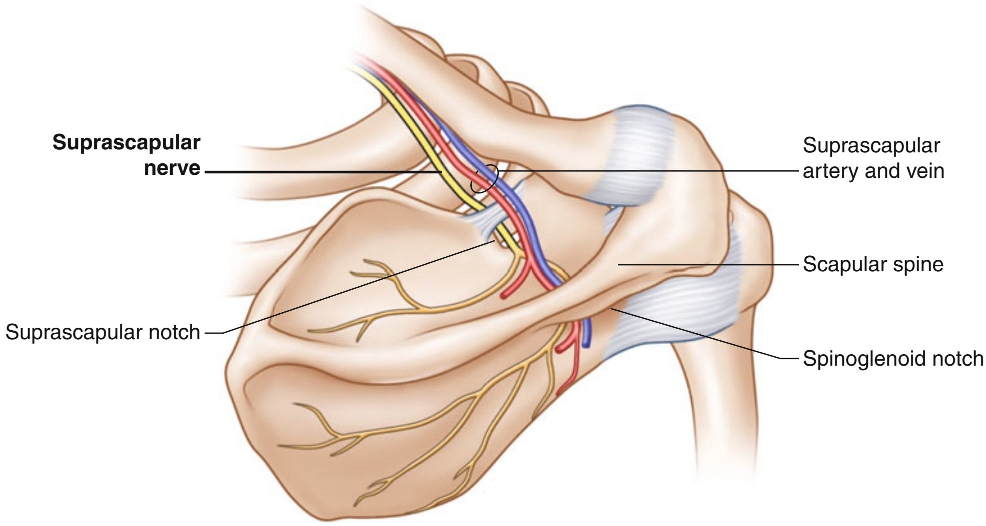


**Fig. 28.3** Anatomy of the suprascapular nerve; note the suprascapular nerve (in *yellow*) as it passes underneath the transverse scapular ligament in the suprascapular notch. Note also that the suprascapular artery and vein lie above the transverse scapular ligament. Sensory branches from the shoulder joint not shown (Image courtesy of Springer)

*subacromial bursa* [4]. It has been estimated that the suprascapular nerve provides up to 70 % of the sensory innervation of the shoulder joint [10]. After innervating the supraspinatus muscle, the suprascapular nerve travels inferolaterally toward the rim of the *glenoid fossa*. It then makes a tight turn around the lateral edge of the scapular spine, beneath the *spinoglenoid ligament* (also known as the *inferior transverse scapular ligament*) [3], which creates a fibro-osseous tunnel called the *spinoglenoid notch* (or *infraspinatus notch*) through which the suprascapular nerve courses toward the *infraspinatus fossa* (Fig. 28.4). Here, the nerve provides motor innervation to the *infraspinatus muscle* [2, 3, 10, 14]. There is anatomic and clinical evidence for a small cutaneous branch, which in some people provides sensory innervation to a patch of skin on the lateral aspect of the upper shoulder [6, 15].

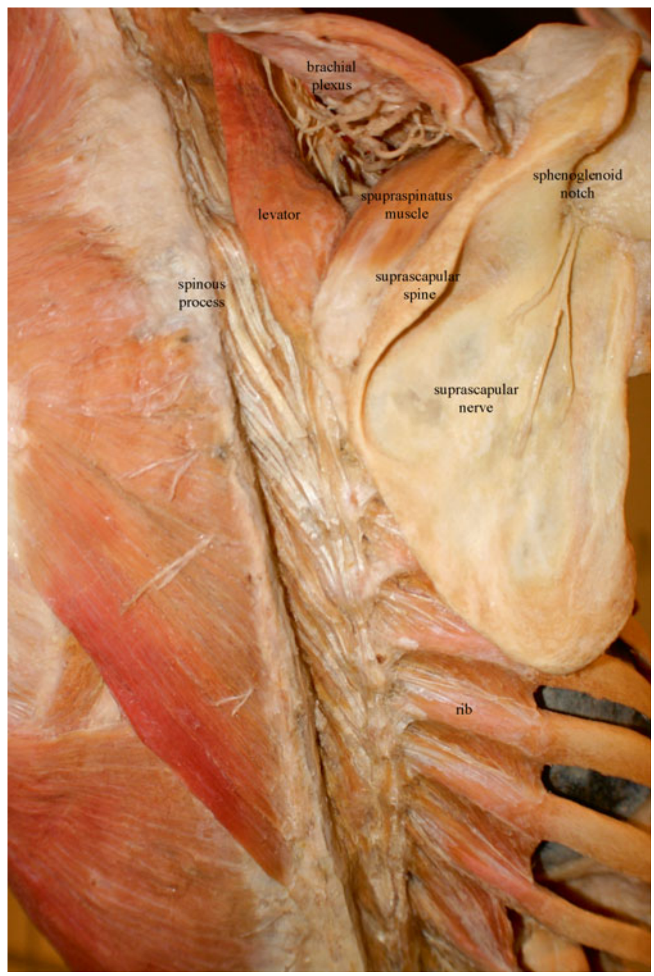


**Fig. 28.4** Suprascapular anatomy, modified from an image from *Bodies*, *The Exhibition*, with permission (Image courtesy of Andrea Trescot, MD)

## Entrapment

The anatomical course of the SN presents three distinct potential sites of entrapment: cervical origin, suprascapular notch, and spinoglenoid notch. The most common site of its entrapment is at the suprascapular notch. Kopell and Thompson [16] first described entrapment of the suprascapular nerve at the suprascapular notch in 1959. The nerve has little freedom of movement there, while the shoulder and scapula are extremely mobile. Rotator cuff tears can contribute to SN entrapment as the supraspinatus and/or infraspinatus muscle retracts [10]. The SN can be impinged by the sharp inferior border of the suprascapular ligament at the site of angulation at the notch, or by bony overgrowth, ligament thickening, or collocation of the artery and the nerve in the canal.

Similarly, spinoglenoid notch entrapment, first described in 1981 [17], occurs because the notch is a relatively fixed tunnel through which the nerve passes, limiting its mobility and predisposing to entrapment (see Chap. 34) [1, 2, 8, 10, 13]. Liveson and colleagues [8] suggest that the spinoglenoid entrapment may be more common than the entrapment at the suprascapular notch and needs to be recognized to avoid treatment of the wrong condition.

## Physical Examination

Begin the physical examination of a patient with suspected SN entrapment by inspecting for atrophy of the supraspinatus or infraspinatus muscles. Atrophy is most easily visualized in the infraspinatus muscle, because the trapezius muscle can obscure the supraspinatus (Fig. 28.5). The clinician should evaluate the active range of motion of the shoulder, comparing it to the contralateral side, and looking specifically for limitation of abduction in the plane of the scapula or limitation of external rotation with the arm held in 90° of abduction. Specific provocative tests may reveal supraspinatus and/or infraspinatus weakness (see below) [18]. The clinician should then palpate the suprascapular notch to elicit pain (Video 28.1). The notch can be found by placing a hand on the patient's affected shoulder with the fingertips on the clavicle. The clinician then presses their thumb along the distal third of the scapular spine ("the Vulcan death grip") (Fig. 28.6). The examiner should then move their thumb inferiorly and laterally to palpate the spinoglenoid notch and evaluate for potential entrapment at that site [1, 2, 10, 14, 19]. Weakness in the initial 20–30° of arm abduction and forearm external rotation in comparison to the non-affected side may be noted. The *cross-body adduction test* described by Kopell and Thompson [16] (Fig. 28.7), which is performed by having the patient elevate the arm to 90° and forcibly adduct the arm across their chest, can tighten the spinoglenoid ligament and compress the nerve to reproduce the patient's symptoms.

**Fig. 28.5** Physical exam of supraspinatus and infraspinatus atrophy from suprascapular nerve entrapment. *Arrow* shows left infraspinatus atrophy (Image courtesy of Andrea Trescot, MD)

**Fig. 28.6** Palpation of the suprascapular notch to elicit pain (Image courtesy of Andrea Trescot, MD)

**Fig. 28.7** Cross-body adduction test (Image courtesy of Andrea Trescot, MD)

## Differential Diagnosis (Table 28.3)

The differential diagnosis of shoulder pain includes *rotator cuff pathology* [10] or other joint related abnormalities, *shoulder impingement syndrome* [23], *labral tear*, *adhesive capsulitis* [10], *Parsonage-Turner syndrome* [2, 10], *thoracic outlet syndrome* (Chap. 33), and pain referred from cervical structures [23]. Parsonage-Turner syndrome almost always

**Table 28.3** Differential diagnosis of chronic shoulder pain

| | Potential distinguishing features |
|---|---|
| C5-6 radiculopathy | Usually have neck pain, decreased arm reflexes, as well as shoulder weakness [2] |
| Upper thoracic radiculopathy | MRI of the thorax will show HNP |
| Brachial plexopathy | Usually have weakness beyond the SN distribution; reflex and sensory changes [2] |
| Rotator cuff injury | Pain with passive movement; pain on palpation other than at suprascapular notch [2, 10]. Seen well on MRI |
| Glenohumeral joint pathology | Both active and passive range of motion are limited [12, 20] |
| Paralabral/ganglion cyst | Usually associated with labral tears; seen well on MRI [5, 19] |
| Varicosities | Compression in spinoglenoid notch [21] |
| Adhesive capsulitis | "Frozen shoulder" [12]. More likely in older patients and those with diabetes or thyroid disease [22] |
| Brachial neuritis (Parsonage-Turner) | Involvement of other nerves of the brachial plexus; frequently a sudden onset; may be bilateral. Patients are generally older, perhaps with a history of recent vaccination or infection [4, 10] |

**Table 28.4** Relationship between muscle pathology and nerve entrapment

| Denervated muscle | Suspected nerve entrapment |
|---|---|
| Supraspinatus and infraspinatus muscle | Suprascapular nerve at suprascapular notch |
| Trapezius muscle | Spinal accessory nerve (Chap. 27) |
| Isolated infraspinatus muscle | Suprascapular nerve at spinoglenoid (Chap. 28) |
| Serratus anterior muscle | Long thoracic nerve (Chap. 30) |
| Teres minor muscle | Axillary nerve at quadrilateral space (Chap. 31) |
| Rhomboid and/or levator muscle | Dorsal scapular nerve at scalene muscle (Chap. 32) |

**Table 28.5** Diagnostic tests for suprascapular nerve entrapment

| | Potential distinguishing features |
|---|---|
| Physical exam | Atrophy of supraspinatus, infraspinatus; weakness with abduction/external rotation; cross-body adductor test |
| Ultrasound | May show edema of the muscle |
| Electrodiagnostic studies | Needle EMG should show axonal loss limited to SN distribution. Motor NCSs may show reduced amplitude |
| MRI | Edema, atrophy, or fatty infiltration of supraspinatus and/or infraspinatus muscles |

affects the SN but may involve the axillary nerve (Chap. 31) in 50 % of the cases [10]. The possibility of axillary nerve entrapment should also be considered.

## Diagnostic Studies (Tables 28.4 and 28.5)

Diagnosis may be aided by electrodiagnostic studies, magnetic resonance imaging, or high-resolution ultrasonography. X-rays may show an unusual suprascapular notch. EMG/NCV can show denervation changes, such as an increase in distal motor latency and signs of denervation

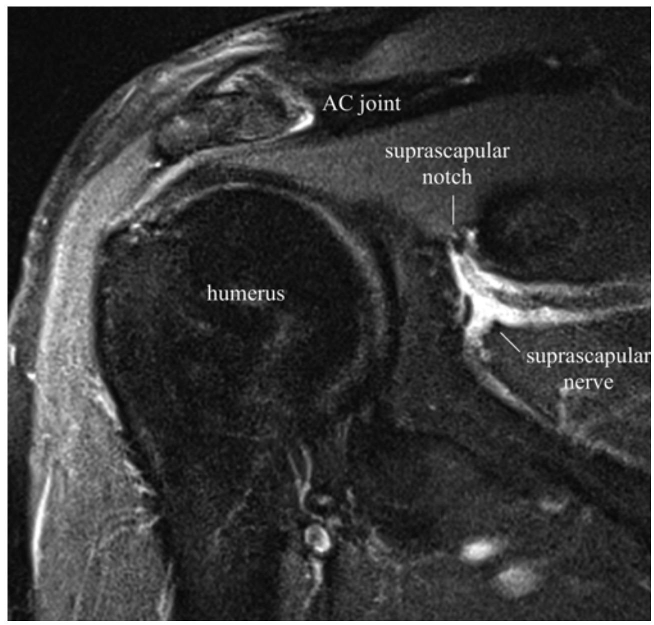


**Fig. 28.8** MRI showing the suprascapular nerve (Image courtesy of Andrea Trescot, MD)

(increased spontaneous activity, positive sharp waves, fibrillation, polyphasic activity, decreased amplitude evoked potentials, and single unit recruitment of normal motor unit potentials) [4]. MRI (Fig. 28.8) may show atrophy, tumors, or cysts and may identify other causes of shoulder pain, such as rotator cuff tears or cervical radiculopathy. Edema of the denervated muscle (supraspinatus and/or infraspinatus) (Figs. 28.9 and 28.10) (Table 28.4) may be the surest and earliest characteristic sign of SN entrapment [4] and can help to differentiate SN entrapment from pure rotator cuff tears. US may also be useful for diagnosis; Polguj et al. [24] looked at 60 shoulders, comparing the evaluation of the suprascapular notch by US and CT; US was able to correctly evaluate the shape and size of the suprascapular notch in 42 of those patients.

Hill et al. [25] retrospectively reviewed 65 consecutive patients diagnosed with SN neuropathy and contacted them

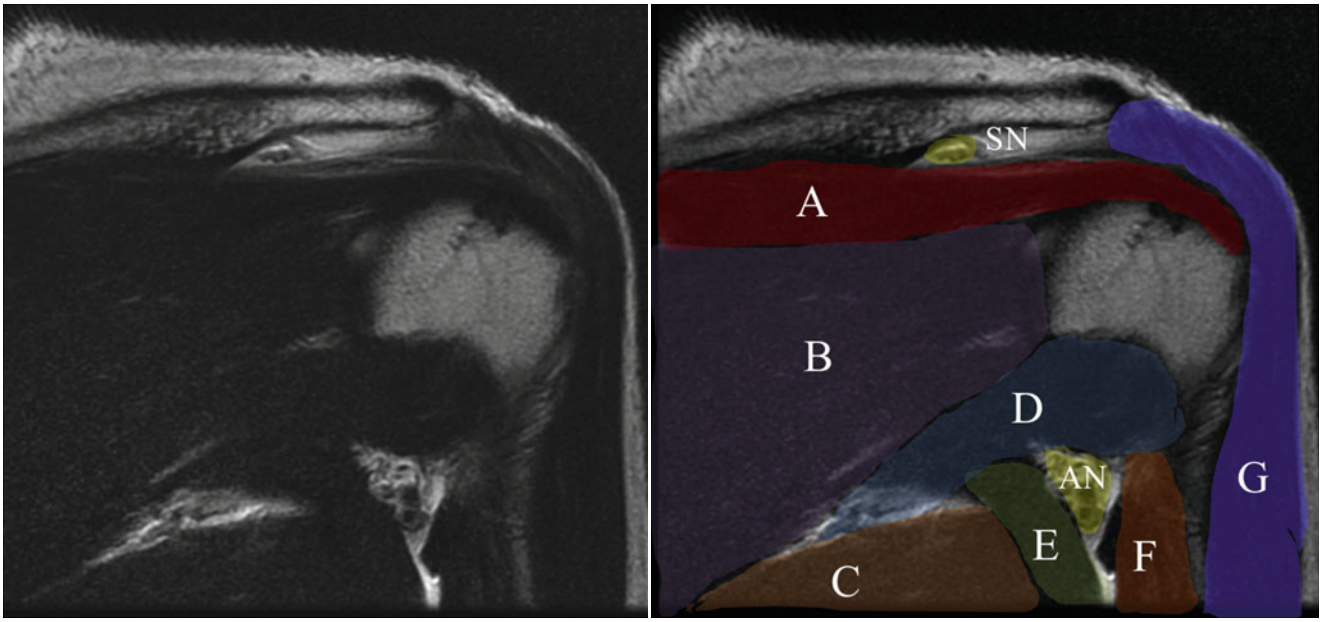


**Fig. 28.9** Labeled MRI of the shoulder. *SN* suprascapular nerve, *AN* axillary nerve and axillary vessels, *A* supraspinatus muscle, *B* infraspinatus muscle, *C* teres major, *D* teres minor, *E* long head of the triceps muscle, *F* short head of the triceps, *G* deltoid muscle (Image courtesy of Andrea Trescot, MD)

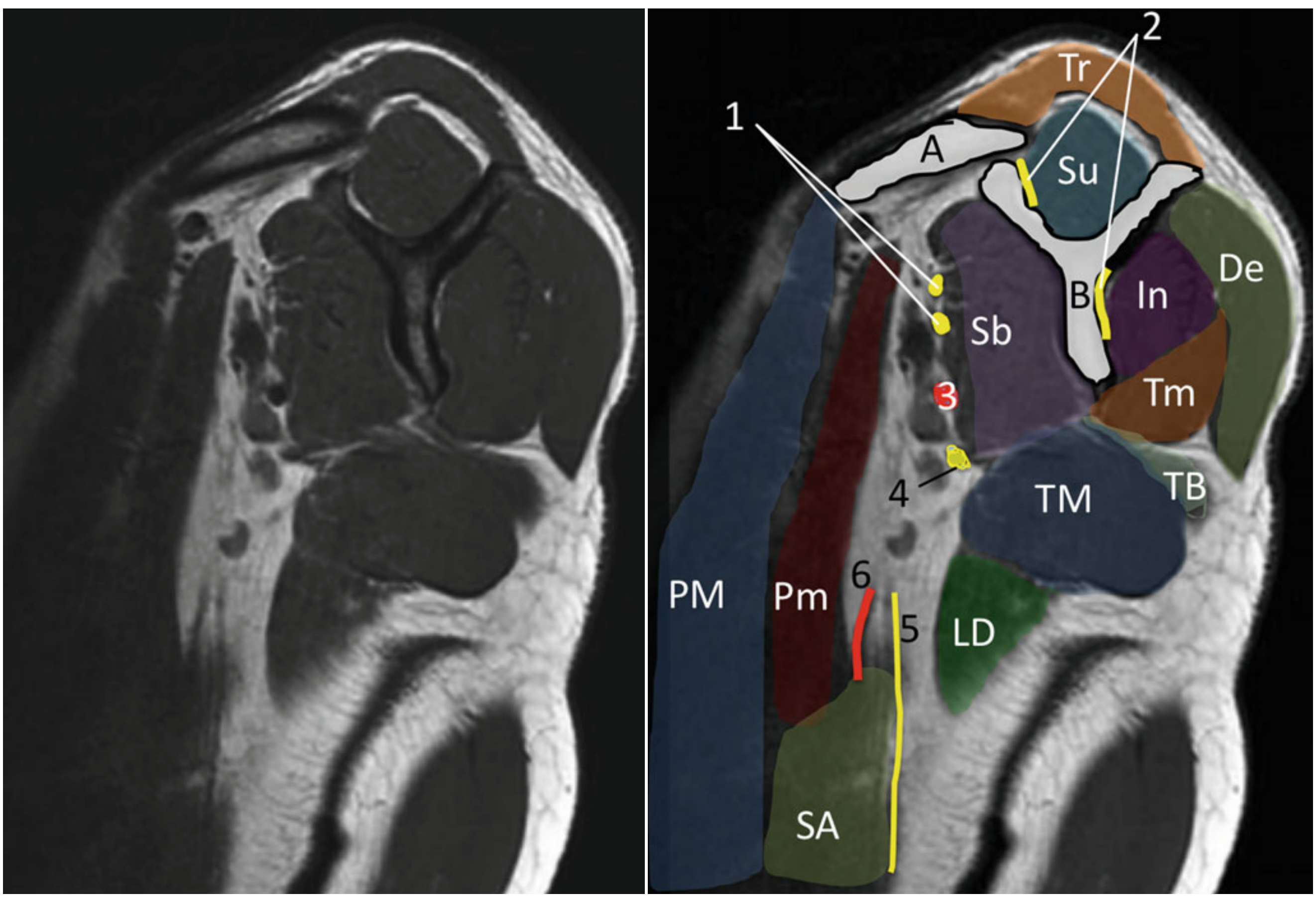


**Fig. 28.10** Sagittal MRI image of the scapular structures. *A* clavicle, *B* scapula, *De* deltoid muscle, *In* infraspinatus muscle, *LD* latissimus dorsi muscle, *PM* pectoralis major muscle, *Pm* pectoralis minor muscle, *Sb* subscapularis muscle, *Su* suprascapular muscle, *TM* teres major muscle, *Tm* teres minor muscle, *Tr* trapezius muscle, *TB* triceps brachii muscle, (*1*) brachial plexus, (*2*) suprascapular nerve, (*3*) axillary artery, (*4*) suprascapular nerve, (*5*) long thoracic nerve, (*6*) long thoracic artery (Image courtesy of Andrea Trescot, MD)

5 years later. Fibrillation potentials were observed in 81 % of the patients. Seventy-five percent underwent at least one MRI, while 11 % had CT scan and five patients underwent US evaluation (four of the five also had an MRI; there was complete concordance between those two tests regarding cyst identification). Labral and rotator cuff tears were seen in more than 40 % of the patients.

The diagnosis of an axillary nerve (AN) entrapment depends on a high level of suspicion from the clinician. AN (Chap. 31) or SN entrapment should be considered when there appear to be several shoulder muscles involved [10]. Physical exam and diagnostic injections provide significant diagnostic clues, which can be confirmed by MRI, US, and electrodiagnostic studies.

## Identification and Treatment of Contributing Factors

One common contributing factor of SN entrapment arises from overuse of the muscles of the rotator cuff. Because this nerve supplies the muscles that allow for the abduction and external rotation of the arm, overuse of these muscles, especially the supraspinatus, can lead to muscle spasms. These spasms can potentially trap the suprascapular nerve as it enters the scapular notch.

The suprascapular notch itself is highly variable in shape and size, which may contribute to impingement. Similarly, the transverse scapular ligament can vary significantly in its thickness and shape and may also be partially or completely calcified [10, 11].

Mass lesions can also contribute to SN entrapment, specifically a lipoma or ganglion cyst near the nerve. The latter is often associated with labral tears and has a tendency to form near the spinoglenoid notch [19].

## Injection Techniques

### Landmark-Guided Injection Technique

There are multiple approaches for landmark-guided injections of the SN. We will describe two different approaches, one with and one without the use of a peripheral nerve stimulator. To perform the first landmark-guided technique, the patient is placed in a seated or prone position with their arms to their sides. The clinician begins by inserting a 25-gauge, 2-inch needle at the distal third of the scapula and directing it vertically down to the scapular spine (Video 28.1). The needle is then advanced anteriorly and superiorly, maintaining contact with the scapula until it is felt to advance into the scapular notch (Fig. 28.11). After negative aspiration for blood or air, the planned injectate can be administered. Pneumothorax is a significant clinical concern with this

**Fig. 28.11** Vertical approach for landmark-guided injection of the suprascapular nerve (Image courtesy of Andrea Trescot, MD)

**Fig. 28.12** Horizontal approach for landmark-guided injection of the suprascapular nerve (Image courtesy of Andrea Trescot, MD)

technique, as the cupola of the lung lies in close proximity to the nerve at this location [26].

The second landmark-guided technique uses a horizontal instead of vertical needle position. In this approach, the patient is positioned in the seated or prone position with their arms relaxed at the sides. The distal third of the scapular spine is palpated, and a 25-gauge, 2-inch needle is advanced just above the scapular spine, perpendicular to the skin (Fig. 28.12). This technique is easily modified to add a peripheral nerve stimulator (Fig. 28.13). Initial target needle position is the posterior wall of the lateral border of the scapular spine, parallel to the floor and lateral to the scapular notch. The needle is advanced medially in the plane of the scapular spine with the use of continuous motor stimulation until the needle tip is near the nerve, as evidenced by external rotation of the shoulder, indicating contraction of the infraspinatus and supraspinatus muscles. After negative aspiration for blood or air, the planned injectate can be administered. By utilizing the bone as a backdrop, the risk of pneumothorax is

**Fig. 28.13** Horizontal suprascapular landmark-guided injection with peripheral nerve stimulator (Image courtesy of Andrea Trescot, MD)

negligible. Having the patient place their hand on the opposite shoulder further decreases the risk of pneumothorax, by moving the scapula away from the chest wall and underlying pleura [19].

### Fluoroscopic-Guided Injection Technique

Using the fluoroscopic-guided technique, the patient is placed prone on the fluoroscopy table, with the arms at the sides and the head turned to the contralateral side. Initially, straight AP fluoroscopic imaging is used to identify the T2 and T3 levels. Cephalocaudal tilt of the fluoroscope will help optimize the view of the suprascapular notch. The skin and subcutaneous tissue at the inferior aspect of the suprascapular notch is anesthetized, and a 22- or 25-gauge, 2-inch needle is advanced toward this target in a coaxial fluoroscopic view until contact is made with the scapula (Fig. 28.14). The needle is then withdrawn slightly and advanced in the cephalad direction no more than 1 cm toward the suprascapular notch. A paresthesia may be encountered, either from direct needle contact with the nerve or as a result of muscle spasm compressing the nerve. Many advocate the use of a nerve stimulator for improved safety and efficacy. Careful aspiration should be performed for blood or air. Contrast can be injected to further verify needle placement, and the planned injectate can be administered [12].

### Ultrasound-Guided Injection Technique (US)

US injections of the SN were first described by Harmon and Hearty in 2007 [27]. The patient is placed in a seated position with their ipsilateral hand resting on their contralateral shoulder. The initial US scan is performed in the sagittal plane at the superior border of the scapula, with the transducer placed parallel to the scapular spine, to identify the pleura at a depth of approximately 4 cm (Fig. 28.15). The US probe is moved laterally and then cephalad to visualize the suprascapular fossa. The transducer is moved in small increments laterally and/or superiorly until the suprascapular notch is visualized (Fig. 28.16). The SN will appear as a round, hyperechoic structure beneath the transverse scapular ligament. A 22-gauge, 2-inch (or longer) needle is inserted in the longitudinal axis of the ultrasound beam (in-plane) and advanced under full US visualization until the needle tip is in proximity to the SN. The use of a stimulating needle (such as in Fig. 28.17) or a peripheral nerve stimulator can aid

**Fig. 28.14** Fluoroscopic image of suprascapular notch located just above the needle (Image courtesy of Christopher Burnett, MD)

**Fig. 28.15** Ultrasound transducer placed over the suprascapular notch (Image courtesy of Andrea Trescot, MD)

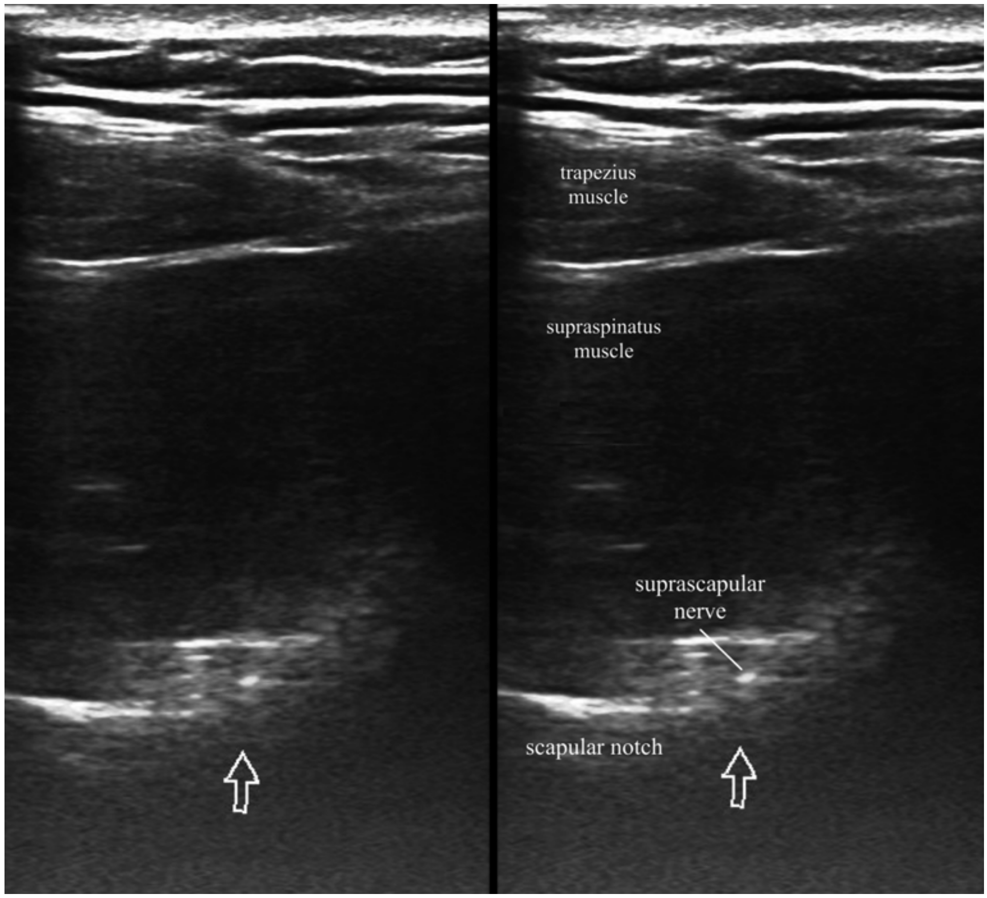


**Fig. 28.16** Composite ultrasound image of suprascapular notch and suprascapular nerve (Image courtesy of Andrea Trescot, MD)

in localization of the nerve. It is important not to go too deep and to visualize the needle at all times. The needle is introduced in-plane either from medial to lateral or lateral to medial. If a stimulator is used, you will see a rhythmic external rotation and abduction of the shoulder. After threshold current is established and after a negative aspiration for blood or air, the planned injectate can be administered. Real-time imaging can be used to watch local anesthetic spread around the nerve [27].

More recently, an anterior approach to the SN has been described, which visualizes the suprascapular nerve branching off the superior trunk of the brachial plexus, deep to the omohyoid muscle (Fig. 28.18) [28]. The authors initially scanned 60 volunteers at both the suprascapular notch and the supraclavicular region and then placed needles into cadavers using the same technique to confirm the location. They were able to visualize the SN in the supraclavicular region in 81 % of the volunteers, but only 36 % of the time could the SN be seen at the suprascapular notch; they were able to place the needle correctly in cadavers 95 % of the time. Unfortunately, this is in close proximity to the brachial plexus (which potentially increases the risk of unintended spread of local anesthetic), as well as the pleura (potentially increasing the risk of pneumothorax).

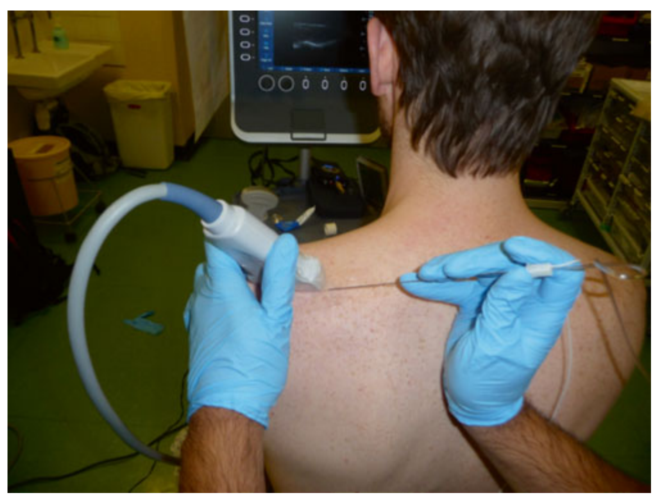

**Fig. 28.17** Ultrasound-directed injection of the suprascapular nerve (Image courtesy of Christopher Burnett, MD)

## CT Guided Injection

Schneider-Kolsky et al. [29] performed SN injections under CT guidance on 40 consecutive patients, noting sustained (>3 weeks) relief in 10 of 35 patients. Shanahan and col-


**Fig. 28.18** Ultrasound image of supraclavicular anterior approach to the suprascapular nerve. *Single arrow* = suprascapular nerve, *double arrow* = brachial plexus; *OM* omohyoid muscle (Image courtesy of Dr. Róbert Rapčan, Bardejov, Slovakia)

leagues [22] randomized 77 shoulders to either landmark-guided (blind) suprascapular procedures (using 11 cc of local anesthetic and steroid) or CT-guided suprascapular injections (using 3 cc of local anesthetic and steroid) and found similar efficacy; neither group had any complications, and both techniques offered similar efficacy.

## Neurolytic/Surgical Technique

### Cryoneuroablation

Trescot [30] described a cryoneuroablation technique for the SN. The patient is positioned seated (for blind or US-directed procedures) (Fig. 28.19) or prone (for fluoroscopic-directed procedures). A 12-gauge introducer is advanced into the suprascapular notch, parallel to the direction of the nerve and perpendicular to the scapula. Consider using fluoroscopy or US if the superior border of the scapula is not easily palpated. The 2.0-mm probe is then advanced through the catheter, and the nerve is identified using sensory or motor stimulation, this being one of the few nerves with significant motor function that is amenable to cryoneuroablation.

### Radiofrequency Lesioning

The use of either pulsed radiofrequency ablation (at 42 °C for 120 s) [31] or thermal radiofrequency ablation (at 80 °C for 60 s) [12] of the SN has been described and found to be a safe and effective way to obtain longer-term pain resolution.

### Neuromodulation

Peripheral field stimulation has been growing as a treatment option. George Arcos, DO, described five patients with chronic, persistent shoulder pain and dysfunction, with the earliest cases placed in approximately August 2011. He places two leads, and the vertical lead is placed 1 cm lateral to the spinous process, with cranial tip at the superior scapular border. The second lead is then placed parallel to the spine of the scapula, with a cranial to caudal trajectory (Fig. 28.20). The leads converge at the superior medial scapular border. By "stacking" anodal current, he states that he is able to cover pain in the entire intrascapular region, or laterally to the shoulder, axilla, and even proximal arm. He states that the patients are all at full function, with no opioid use (personal communication). Elahi and Reddy described a patient with intractable shoulder pain after seven shoulder surgeries (including hemiathroplasty) who was treated with a suprascapular peripheral nerve stimulator placed under US guidance (Fig. 28.21) [32].

**Fig. 28.19** Cryoneuroablation of the suprascapular nerve (Image courtesy of Andrea Trescot, MD)

### Surgery

Surgical decompression of the SN may be considered in patients who have significant muscle wasting, weakness, or intractable pain and who have failed non-operative therapy. Traditionally, an open surgical approach was used to decompress the suprascapular or spinoglenoid notch. More recently,

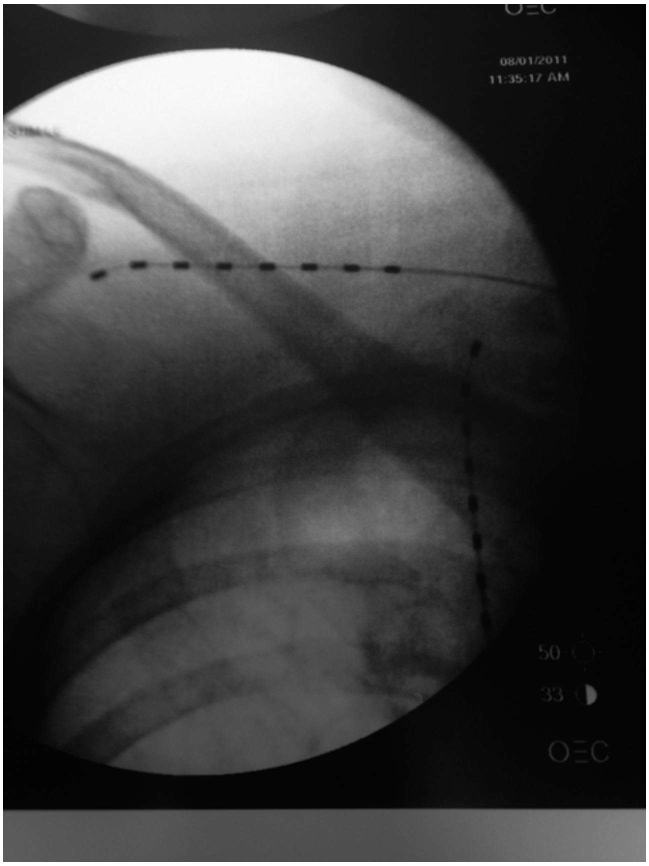

**Fig. 28.20** Peripheral stimulation of the suprascapular nerve (Image courtesy of George Arcos, DO)

arthroscopic surgical approaches have been described for SN decompression [2, 20, 33]. Shah et al. [34] described the results of 27 patients who underwent arthroscopic decompression of the SN confirmed preoperatively with MRI and EMG findings, and followed them for an average of 22.5 months (with three lost to follow-up). Seventy-one percent (17/24) noted sustained pain relief and return of function.

## Complications

Complications for SN block include pneumothorax, direct needle trauma to the neurovascular bundle, intravascular injection, or infection [26].

## Summary

The SN is a cause of sometimes vague shoulder and scapular pain. Recognition of this pathology can save patients unnecessary and often fruitless evaluations. Use of the SN injection for diagnosis as well as for treatment of conditions such as adhesive capsulitis (frozen shoulder) may offer significant relief.

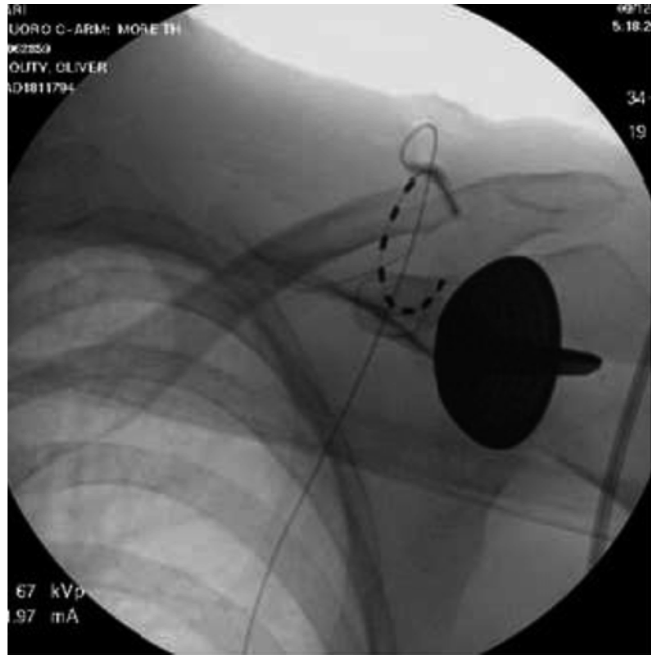

**Fig. 28.21** Fluoroscopic imaging of a peripheral suprascapular stimulation lead placed under ultrasound guidance (Image from Elahi and Reddy [32], with permission from the American Society of Interventional Pain Physicians)

## References


1. Linda DD, Harish S, Stewart BG, Finlay K, Parasu N, Rebello RP. Multimodality imaging of peripheral neuropathies of the upper limb and brachial plexus. Radiographics. 2010;30(5):1373–400.
2. Shapiro BE, Preston DC. Entrapment and compressive neuropathies. Med Clin N Am. 2009;93(2):285–315, vii.
3. Kim DH, Murovic JA, Tiel RL, Kline DG. Management and outcomes of 42 surgical suprascapular nerve injuries and entrapments. Neurosurgery. 2005;57(1):120–7; discussion –7.
4. Blum A, Lecocq S, Louis M, Wassel J, Moisei A, Teixeira P. The nerves around the shoulder. Eur J Radiol. 2013;82(1):2–16.
5. Iannotti JP, Ramsey ML. Arthroscopic decompression of a ganglion cyst causing suprascapular nerve compression. Arthroscopy. 1996;12(6):739–45.
6. Harbaugh KS, Swenson R, Saunders RL. Shoulder numbness in a patient with suprascapular nerve entrapment syndrome: cutaneous branch of the suprascapular nerve: case report. Neurosurgery. 2000;47(6):1452–5; discussion 5–6.
7. Ebraheim NA, Whitehead JL, Alla SR, Moral MZ, Castillo S, McCollough AL, et al. The suprascapular nerve and its articular branch to the acromioclavicular joint: an anatomic study. J Should Elb Surg. 2011;20(2):e13–7.
8. Liveson JA, Bronson MJ, Pollack MA. Suprascapular nerve lesions at the spinoglenoid notch: report of three cases and review of the literature. J Neurol Neurosurg Psychiatry. 1991;54(3):241–3.
9. Aiello I, Serra G, Traina GC, Tugnoli V. Entrapment of the suprascapular nerve at the spinoglenoid notch. Ann Neurol. 1982;12(3):314–6.
10. Budzik JF, Wavreille G, Pansini V, Moraux A, Demondion X, Cotten A. Entrapment neuropathies of the shoulder. Magn Reson Imaging Clin N Am. 2012;20(2):373–91, xii.
11. Rengachary SS, Burr D, Lucas S, Brackett CE. Suprascapular entrapment neuropathy: a clinical, anatomical, and comparative study. Part 3: comparative study. Neurosurgery. 1979;5(4):452–5.
12. Simopoulos TT, Nagda J, Aner MM. Percutaneous radiofrequency lesioning of the suprascapular nerve for the management of chronic shoulder pain: a case series. J Pain Res. 2012;5:91–7.

13. Natsis K, Totlis T, Tsikaras P, Appell HJ, Skandalakis P, Koebke J. Proposal for classification of the suprascapular notch: a study on 423 dried scapulas. Clin Anat. 2007;20(2):135–9.
14. Dong Q, Jacobson JA, Jamadar DA, Gandikota G, Brandon C, Morag Y, et al. Entrapment neuropathies in the upper and lower limbs: anatomy and MRI features. Radiol Res Pract. 2012; 2012:230679.
15. Safran MR. Nerve injury about the shoulder in athletes, part 1: suprascapular nerve and axillary nerve. Am J Sports Med. 2004;32(3):803–19.
16. Kopell HP, Thompson WA. Pain and the frozen shoulder. Surg Gynecol Obstet. 1959;109(1):92–6.
17. Ganzhorn RW, Hocker JT, Horowitz M, Switzer HE. Suprascapular-nerve entrapment. J Bone Joint Surg Am. 1981;63(3):492–4.
18. Burbank KM, Stevenson JH, Czarnecki GR, Dorfman J. Chronic shoulder pain: part I. Evaluation and diagnosis. Am Fam Physician. 2008;77(4):453–60.
19. Neal S, Fields KB. Peripheral nerve entrapment and injury in the upper extremity. Am Fam Physician. 2010;81(2):147–55.
20. Toussaint CP, Zager EL. What's new in common upper extremity entrapment neuropathies. Neurosurg Clin N Am. 2008;19(4):573–81, vi.
21. Carroll KW, Helms CA, Otte MT, Moellken SM, Fritz R. Enlarged spinoglenoid notch veins causing suprascapular nerve compression. Skelet Radiol. 2003;32(2):72–7.
22. Burbank KM, Stevenson JH, Czarnecki GR, Dorfman J. Chronic shoulder pain: part II. Treatment. Am Fam Physician. 2008;77(4):493–7.
23. Hoskins WT, Pollard HP, McDonald AJ. Quadrilateral space syndrome: a case study and review of the literature. Br J Sports Med. 2005;39(2):e9.
24. Polguj M, Synder M, Kwapisz A, Stefanczyk K, Grzelak P, Podgorshi M, et al. Clinical evaluation of the shape of the suprascapular notch—an ultrasonographic and computed tomography comparative study: application to shoulder pain syndromes. Clin Anat. 2015;28:774–9.
25. Hill LJ, Jelsing EJ, Terry MJ, Strommen JA. Evaluation, treatment, and outcomes of suprascapular neuropathy: a 5-year review. PMR. 2014;6(9):774–80.
26. Shanahan EM, Smith MD, Wetherall M, Lott CW, Slavotinek J, FitzGerald O, et al. Suprascapular nerve block in chronic shoulder pain: are the radiologists better? Ann Rheum Dis. 2004;63(9):1035–40.
27. Harmon D, Hearty C. Ultrasound-guided suprascapular nerve block technique. Pain Phys. 2007;10(6):743–6.
28. Siegenthaler A, Moriggl B, Mlekusch S, Schliessbach J, Haug M, Curatolo M, et al. Ultrasound-guided suprascapular nerve block, description of a novel supraclavicular approach. Reg Anesth Pain Med. 2012;37(3):325–8.
29. Schneider-Kolsky ME, Pike J, Connell DA. CT-guided suprascapular nerve blocks: a pilot study. Skelet Radiol. 2004;33(5):277–82.
30. Trescot AM. Cryoanalgesia in interventional pain management. Pain Phys. 2003;6(3):345–60.
31. Gofeld M, Restrepo-Garces CE, Theodore BR, Faclier G. Pulsed radiofrequency of suprascapular nerve for chronic shoulder pain: a randomized double-blind active placebo-controlled study. Pain Pract. 2013;13(2):96–103.
32. Elahi F, Reddy CG. Neuromodulation of the suprascapular nerve. Pain Phys. 2014;17(6):E769–73.
33. Lafosse L, Tomasi A, Corbett S, Baier G, Willems K, Gobezie R. Arthroscopic release of suprascapular nerve entrapment at the suprascapular notch: technique and preliminary results. Arthroscopy. 2007;23(1):34–42.
34. Shah AA, Butler RB, Sung SY, Wells JH, Higgins LD, Warner JJ. Clinical outcomes of suprascapular nerve decompression. J Should Elb Surg. 2011;20(6):975–82.