Reviews

Outcomes after minimally invasive and surgical management of suprascapular nerve entrapment: A systematic review

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Background

The prevalence of suprascapular neuropathy is higher than previously estimated. Recent literature highlights a myriad of treatment options for patients ranging from conservative treatment and minimally invasive options to surgical management. However, there are no comprehensive review articles comparing these treatment modalities.

Objective

The purpose of this review article is to summarize the current state of knowledge on suprascapular nerve entrapment and to compare minimally invasive treatments to surgical treatments.

Methods

The literature search was performed in Mendeley. Search fields were varied redundant. All articles were screened by title and abstract and a preliminary decision to include an article was made. A full-text screening was performed on the selected articles. Any question regarding the inclusion of an article was discussed by 3 authors until an agreement was reached.

Results

Recent studies have further elucidated the pathoanatomy and described several risk factors for entrapment ranging. Four studies met our inclusion criteria regarding peripheral nerve stimulation with good pain and clinical outcomes. Two studies met our inclusion criteria regarding pulsed radiofrequency and showed promising pain and clinical outcomes. One study met our inclusion criteria regarding transcutaneous electrical nerve stimulation and showed good results that were equivalent to pulsed radiofrequency. Surgical treatment has shifted to become nearly all arthroscopic and surgical outcomes remain higher than minimally invasive treatments.

Conclusions

Many recently elucidated anatomical factors predispose to entrapment. A history of overhead sports or known rotator cuff disease can heighten a clinician's suspicion. Entrapment at the suprascapular notch is more common overall, yet young athletes may be predisposed to isolated spinoglenoid notch entrapment. Pulsed radiofrequency, peripheral nerve stimulation, and transcutaneous electrical nerve stimulation may be effective in treating patients with suprascapular nerve entrapment. Arthroscopic treatment remains the gold-standard in patients with refractory entrapment symptoms.

1. INTRODUCTION

Suprascapular nerve entrapment (SSN) is a rare cause of shoulder weakness and pain that can result in significant impairment. The suprascapular nerve is susceptible to compression due to its complex path from its origin in the upper trunk of the brachial plexus to the tortuous course through the scapular foramen. Emerging literature shows that the prevalence of suprascapular neuropathy is higher than previously estimated, creating a growing interest in the diagnosis and management of this condition.[1-5]

Table 1. Our inclusion and exclusion criteria as applied during the title/abstract screening and full-text screening.

Inclusion Criteria	Exclusion Criteria
• Suprascapular nerve entrapment • Use of conservative, minimally invasive, or surgical treatment options • Level III Evidence and higher	• Other causes of shoulder pain • Absence of a studied treatment option • Absence of clinical, functional, or radiographic outcomes • Expert Opinion or Case Reports

The literature is lacking in a comparison of treatment options thus making the decision for operative intervention difficult. Therefore, there remains no consensus on the optimal timing of surgical nerve release. The purpose of this review article is to summarize the current state of knowledge of suprascapular nerve entrapment, to determine the efficacy of minimally invasive treatment, and provide a comparison to surgical treatments. This review can provide information for anesthesiologists and orthopedic surgeons in the diagnosis and management of refractory suprascapular nerve palsy.

2. MATERIALS AND METHODS

SEARCH STRATEGY

The literature search was performed using through Medical Search Headings (MeSH) in Mendeley version 1.19.8. Articles published between January 1975 to December 2021 were Search fields were varied until no new articles were collected at which point the search was considered exhaustive. This resulted in 216 articles.

STUDY SCREENING AND SELECTION

All articles were screened by title and abstract. An initial decision to include a given article was made based on relevance of the information within the abstract as determined by our inclusion/exclusion criteria (**Table 1**). This constructed a list of 64 preliminarily included articles. These articles then underwent a full-text screening process, which resulted in 10 articles included in the data synthesis. Any question regarding the inclusion of an article was discussed by all authors until an agreement was reached. The bibliographies of these articles were also hand-searched to identify any missing articles.

DATA COLLECTION

The data elements extracted from the articles included article title, lead author, journal, intervention, study type, number of cases, year, outcome measures, and results. Due to heterogeneous data, a meta-analysis could not be performed, and all data was summarized descriptively. Descriptive statistics were carried out through table formation using Microsoft Word V2008 Build 13127.21842.

3. RESULTS

3.1 ETIOLOGY

Suprascapular neuropathy is the result of compression or traction of the suprascapular nerve somewhere along its long and tortuous course from the neck to the shoulder. Primary causes are characterized refer to anatomical entrapment of the suprascapular nerve in the absence of other obvious pathology. Repetitive overhead use can cause impingement of the suprascapular nerve most often in athletes and overhead laborers. Prior trauma is suspected to play a role in the majority of suprascapular neuropathy cases.[6,7] Primary entrapment more commonly occurs via the superior transverse scapular ligament at the suprascapular notch[8]; however, primary entrapment can also occur at the spinoglenoid notch.[4,9]

Numerous secondary conditions have also been recognized in the etiology of suprascapular nerve entrapment. SSN can be the result of systemic conditions including systemic lupus erythematosus and rheumatoid arthritis. Space occupying lesions such as ganglion cysts, bone cysts, and paralabral cysts can cause compression of the suprascapular nerve resulting in SSN. Shoulder injury is also a significant secondary etiology of SSN. Existing literature does suggest a relationship between suprascapular neve palsy and rotator cuff injury. Other injuries that constitute secondary etiologies of SSN are fractures, dislocation, and joint injuries. Other causes of SSN include iatrogenic injury and malignancies such as osteosarcoma, can cause space occupying lesions that compress the suprascapular nerve.[1,4]

3.2 EPIDEMIOLOGY

It has been estimated that SSN constitutes 1-4% of shoulder pain.[4,6,7] Suprascapular neuropathy occurs particularly in athletes and laborers that perform repetitive overhead movements. SSN has been studied in specific athletic populations including volleyball, baseball, tennis, and badminton players.[10,11] A retrospective study found that 4.4% of asymptomatic major league pitchers demonstrated atrophy of the infraspinatus muscle.[12]

3.3 RISK FACTORS

Risk factors include repetitive overhead movements, other concomitant shoulder pathology, injury, and anatomical variants. Populations that perform repeated overhead movements include athletes and overhead laborers. Within volleyball players, four independent range of motion parameters have been found to correlate with SSN: increased external rotation, increased, horizontal flexion, increased forward flexion, and protraction. It is important to note that all patients in this study had entrapment at the spinoglenoid notch.[11]

A high incidence rate of concurrent suprascapular neuropathy in the setting of preexisting rotator cuff disease has been shown. This is likely due to a progressive traction injury on the suprascapular nerve as the rotator cuff retracts.[13]

Several anatomic variants have also been described as risk factors. These include variations in the path of the suprascapular nerve, hypertrophy of the inferior transverse scapular ligament, changes in the retro scapular vascularity, a narrow suprascapular notch, variations in the structure of the superior transverse scapular ligament. These are discussed furthered under **'Pathoanatomy.'**

3.4 ANATOMY

The suprascapular nerve (SSN) arises from the brachial plexus, formed by the ventral rami of nerve roots C5 and C6, sometimes C4.[14,15] It courses laterally along the brachial divisions between the anterior and middle scalene muscles. It then bends posterolateral underneath the inferior belly of the omohyoid muscle and over the superior border of the scapula. The nerve passes through the suprascapular notch, located medial to the base of the cricoid process, and under the superior transverse scapular ligament (STSL). Most commonly the suprascapular artery and vein course above the STSL, but may pass under with the SSN in some instances.[16] The nerve then enters the supraspinous fossa where branches diverge within 1 cm of the suprascapular notch to innervated the supraspinatus muscle.[17] The nerve continues inferior lateral passing through the spinoglenoid notch. This notch sits between supraglenoid tubercle and the base of the spine of the scapula. Generally, both the SSN and the corresponding artery and nerve run inferior to the inferior transverse scapular ligament (spinoglenoid ligament) runs over the SSN. To enter the infraspinous fossa the nerve curves medially around the base of the scapular spine where nerve branches innervate the infraspinatus muscle.[14]

3.5 PATHOANATOMY

ENTRAPMENT AT THE SUPRASCAPULAR NOTCH

The suprascapular notch is the most common site of suprascapular nerve neuropathy. A superior transverse suprascapular ligament that is ossified, bifurcated, or band-shaped may predispose a patient to developing SSN.[4,18] Other factors that may play a role in the pathoanatomy include a narrow or deep (V-shaped) notch. The shape of the SSN, which is classified according to the Rengachary's classification, is in part, dependent on the sex of the patient. Men are more likely to have a V-shape notch (28.45%) than compared to women (18.66%).[18] The complete ossification of the STSL has been found in 3.7% to 6.3% of the US cohort and can decrease the size of the foramen increasing risk of entrapment.[19,20]

There are also anatomic variations in course of the suprascapular artery and vein that have been reported.[20-22] The coursing of the vessels inferior to the STLS, instead of superior, has been documented in several case studies, can cause crowding of the foramen and increase risk for entrapment.[16,23] One cadaveric study discovered that the presence of a vessel passing under the superior suprascapular ligament, which may increase the likelihood of suprascapular nerve becoming entrapped.[24]

In a variation where the suprascapular nerve runs under the anterior coracoscapular ligament or between the ACSL and the superior transverse suprascapular ligament, there is a an increased risk of suprascapular neuropathy.[4]

ENTRAPMENT AT THE SPINOGLENOID NOTCH

Entrapment at the spinoglenoid notch is believed to be more closely associated with cyst formation and positional changes of the shoulder rather than anatomical variations. The spinoglenoid ligament is attached to the posterior capsule of the shoulder. Thus, internal rotation of the shoulder increases tension and thereby compression of the SSN.[25] This is one reason for which entrapment at the spinoglenoid notch is commonly seen in sports that require repetitive overhead movements i.e. baseball, tennis, volleyball. The proximity of the shoulder capsule to the spinoglenoid notch also leaves the SSN vulnerable for compression by cysts that can develop as a consequence of labral tears.[26] A 2018 systematic review, found a paralabral cyst in the to be the most to be the most commonly reported etiology of suprascapular neuropathy.[27]

Hypertrophy of the inferior transverse scapular ligament has also been shown as a pathoanatomic cause of SSN.[28] Another anatomical risk factor for SSN is enlargement of the veins of the spinoglenoid notch. A study comparing the diameter of vascular structures in the spinoglenoid notch found a higher average diameter of veins in patients with shoulder pain than in age matched controls.[29]

3.6 CLINICAL PRESENTATION

The chief complaint of a patient with SSN entrapment will typically be deep, posterior shoulder pain that is characterized as dull, burning, or aching. Shoulder pain is the most commonly associated symptom and will be seen in 97.8% of patients who are diagnosed SSN entrapment.[30] The pain is unilateral, can radiate to the neck or arm and may be accompanied by shoulder weakness. 40% of patients will be able to recall a specific event as related to the onset of their symptoms.[31] A history of repetitive overhead movements may also be a part of the patient history.[32]

During a physical exam, atrophy may be noted in the supraspinatus and/or infraspinatus muscles. Muscle atrophy is considered a late clinical presentation that is reported as visible in only 15-34% of cases in volleyball players.[32] If entrapment is located at the supraspinal notch both muscles can be atrophied, however, if the injury is about the spinoglenoid notch isolated infraspinatus muscle atrophy may occur.

Injury about the spinoglenoid notch may present with tenderness to palpation deep and posterior to the acromioclavicular joint. Pain may be elicited on cross-body shoulder adduction or internal rotation due to increased tension of the spinoglenoid ligament secondary to position changes of the glenohumeral joint.[25] With injury about the suprascapular notch the tenderness may be noted posterior to the clavicle in the region between the scapular spine and clavicle with weakness to both abduction and external rotation of the shoulder.[15]

3.7 DIFFERENTIAL DIAGNOSIS

A differential diagnosis for SSN entrapment includes a cervical disc injury, cervical radiculopathy (involving C5-T1), rotator cuff injury, subacromial impingement syndrome, and superior labrum lesions. SSN entrapment is often lower on the list of differentials due to its estimated 4.3% prevalence among clinical cases of shoulder pain.[15] Rotator cuff injuries are the most common causes of shoulder pain in the general population, can be acute or chronic and classically involve the supraspinatus tendon.[33] Subacromial impingement syndrome, like SSN entrapment, will frequently have a history of repetitive overhead movements involving sports or training.

3.8 DIAGNOSIS

A thorough physical exam, radiographs, magnetic resonance imaging (MRI), and electrodiagnostic tests are used to diagnose SSN entrapment. Although a patient's history and clinical presentation may cause suspicion for SSN entrapment, further diagnostic testing is required to confirm SSN entrapment.[34]

Following the physical exam, standard shoulder radiographs, including scapular-Y, axillary views, and a true AP, should be taken to evaluate bony sources of potential entrapment. This includes fractures, exuberant callus formation, osseous dysplasia, and bony. In addition to standard shoulder radiographs a Stryker notch view (with the beam directed 15° to 30° cephalad) will allow for evaluation of osseous notch variants. Only if the nerve entrapment appears of an osseous origin based on radiographs, computed tomography (CT) scans should be obtained for better characterization. However, MRI is the imaging modality of choice for visualization for space occupying lesions, such as paralabral and synovial cysts. MRI is more accurate than CT or ultrasonography for evaluation of spinoglenoid notch distension.[35] When combined with arthrography, MRI's sensitivity to identify labral abnormalities is enhanced.[14,15,36]

Electrodiagnostic testing, including electromyography (EMG) and nerve conduction studies, are the gold standard to diagnose or confirm SSN entrapment.[37] EMG and nerve conduction velocity testing will show diminished amplitude, prolonged motor latency and the presence of fibrillations (denervation) indicative of a peripheral neuropathy.[14]

Electrodiagnostic testing of a patient with shoulder weakness will have an accuracy of around 90%.[38] In cases with a negative EMG, but high clinical suspicion, some authors recommend a trial of local anesthetic injections. If a patient receives relief of pain following ultrasound guided injections of the suprascapular or spinoglenoid notches, the diagnosis of SSN entrapment may still be supported.[14]

3.9 CONSERVATIVE TREATMENT

There is consensus in the literature that treatment should begin with conservative management though ideal non-operative regimens have not been established.[1] In the absence of compression of the suprascapular nerve, complete resolution can be achieved with nonsteroidal anti-inflammatory drugs (NSAIDs) and physical therapy (PT) for 6-8 months.[2] Physical therapy should include a comprehensive program focused on the rotator cuff, deltoid, and stretching/strengthening of the periscapular muscles.[3] When determining the length of this treatment regimen, the clinician must consider the duration of symptoms, etiology of the entrapment, and whether there is significant muscle atrophy. While adequate pain relief can be achieved through a comprehensive plan of NSAIDs and physical therapy, once muscle bulk and motor strength are diminished, damage may be irreversible.[4] Therefore, patients diagnosed within six-month window of symptom onset have better outcomes with conservative treatment than patients with chronic symptoms lasting longer than six months. The results of our literature search did not reveal any clear success rates regarding nonoperative treatment.

3.10 MINIMALLY INVASIVE TREATMENT

It is well understood that interneurons within the spinal cord contain GABAergic inhibitor signals which can modulate ascending pain signals.[39] The goal of minimally invasive treatment is stimulation of these GABAergic inhibitory interneurons to modulate and decrease ascending pain signals. There have been recent advances in nonsurgical modalities of pain management including neuromodulation with peripheral nerve stimulation,[40] pulsed radiofrequency,[41] and transcutaneous electrical nerve stimulation (TENS).[42]

3.11 PERIPHERAL NERVE STIMULATION

With ultrasound guided transducer placement as demonstrated, it is possible to target the suprascapular nerve within the infraspinous fossa for nonsurgical neuromodulation.[43] These FDA-approved devices can solve previous problems of off-label peripheral nerve stimulators in terms of their long-term stability, complexity, and effectiveness.[39] These wireless systems have introduced the opportunity for management of chronic neuropathic pain through target nerve stimulation resulting in paresthesia in the given nerve distribution.[39] The results of our literature search regarding peripheral nerve stimulation are summarized in **Table 2**. In a clinical trial, percutaneous implantation of a cylindrical lead near the suprascapular nerve and brachial plexus was done in 26 patients and 28 implants. Of the 20 patients, 12 patients were very satisfied, six were satisfied, and two were poorly satisfied.[44] A case series of five patients conducted showed similar findings with visual analog scale (VAS) scores of patients decreasing from 6-8/10 to 0-2/10 and significant improvement in walking distance and standing tolerance.[45] Oswald et al. shows similar results to previous trials. In a trial of 39 patients and 42 implants to the suprascapular nerve, brachial plexus, and intercostal nerve, 78% of participants noticed an improvement in their pain. There was a greater than 50% reduction in opioid consumption in 89% of patients and a 72% improvement in activity.[46] While these pilot studies show peripheral nerve stimulation to be safe, durable, and effective for treatment of neuropathic pain, there remains a need for more large-scale, randomized, placebo-controlled clinical trials to further evaluate the efficacy of this form of treatment.

3.12 PULSED RADIOFREQUENCY MODULATION

Pulsed radiofrequency (PRF) is a variation of conventional continuous radiofrequency (CRF) that offers pain control without the tissue destruction associated with CRF.[47] With CRF, tissue destruction can be achieved with probe temperatures reaching 60 °C to 80 °C, causing coagulative necrosis in the tissue and surrounding nerves, inhibiting the transmission of pain signals. In contrast to CRF, PRF uses short duration, high-voltage bursts of approximately 20 ms duration and a silent phase of 480 ms allowing heat elimination. Although the biological mechanism of how PRF reduces pain is not entirely understood, it is postulated that the magnitude of the electric fields are capable of disrupting pain signals at the neuronal membranes.[43,47] The results of our literature search regarding pulsed radiofrequency are summarized in **Table 3**. Of note, the literature was sparse and only revealed one ongoing clinical trial and one case series that met our inclusion criteria. Jang et al. studied 11 patients with chronic shoulder pain of more than six months who did not respond to intra-articular injections who were evaluated with VAS and Oxford Shoulder Score (OSS) prior to receiving PRF intervention.[48] Baseline measurements for VAS and OSS scores were 6.4 ± 1.49 and 22.7 ± 8.1 respectively. After six months, VAS and OSS were 1.0 ± 0.73 and 41.5 ± 6.65 respectively. At the nine month follow up, patients' VAS and OSS scores were 1.5 ± 1.23 and 41.0 ± 6.67 respectively. Additionally, after nine months, 10 patients (90.9%) reported pain relief that was statistically significant. Furthermore, no complications were reported from the procedure. Currently, there is an ongoing randomized controlled blind trial comparing the use of lidocaine injection nerve block with and without PRF intervention.[49] The results of this ongoing study will be the first to undergo formal efficacy study for PRF stimulation for shoulder joint pain. This is necessary for proving efficacy of large-scale use of PRF for patients with intractable shoulder pain.

3.13 TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION

Transcutaneous electrical nerve stimulation (TENS) is a noninvasive intervention used in the treatment of chronic pain conditions. TENS administered high (>50Hz) or low (<10Hz) frequency electrical currents through adhesive cutaneous pads.[50] It is proposed the analgesic effects experienced with TENS occurs through modulation of the dorsal horn and brain-stem centers mediating descending inhibition. A clinical trial (see **Table 4**) of 40 patients compared efficacy of PRF with physical therapy and TENS with physical therapy on shoulder pain using VAS, ROM, SPADI, and short form 36 scales.[50] There was no statistically significant difference between the two treatment groups (18). The result of this trial adds another conservative treatment option to the physician's armamentarium in the treatment of chronic shoulder pain.

3.14 OPERATIVE TREATMENT

While a patient with an overuse injury causing neuropathy will unlikely benefit from surgery and should be managed conservatively with pharmacological or minimally invasive solutions, those with nerve entrapment and muscle atrophy should be considered for surgical decompression. The current literature has shown that patients with suprascapular nerve entrapment have better outcomes with arthroscopic intervention (see **Table 5**).[27,30,51,52] Causes of suprascapular palsy and nerve entrapment can include compression from tumors, ganglion cysts, traction injuries, direct trauma, or fractures. While there has not been a consensus whether a ganglion cyst or labral lesion should be treated during a decompression, some evidence suggests repairing a labral tear may decompress the cyst and resolve the suprascapular neuropathy.[27,30] However, Superior Labral tear from Anterior to Posterior (SLAP) repair with cyst decompression as compared to SLAP repair alone demonstrates no significant differences in the mean VAS score or the Constant Rowe scores, suggesting repair of the labral lesion alone may be sufficient.[27,30] Further studies should be conducted to evaluate the overall benefit of labral lesion repair and cyst decompression.

Systematic reviews demonstrate comprehensive benefits of arthroscopic techniques in suprascapular nerve entrapment.[27,30] Momaya et al. included 21 studies consisting of 276 shoulders from 275 patients. In 203 patients, suprascapular neuropathy was reported. In 221 shoulders, the most common symptom associated with suprascapular nerve entrapment was deep posterior shoulder pain with a mean duration of symptoms for 19 months. Additionally, muscle atrophy was noted in 182 patients. The most frequently reported outcome scores were of the VAS with 84% of ideal maximum and Constant-Murley with 89% of maximum.[30] Memon et al. reported on 259 patients and 269 shoulders managed with arthroscopic surgery. From the study, 96% of patients reported significant improvement or complete resolution of their pre-operative pain and strength with a low rate of complications.[27] Plancher et al. reported on 12 patients treated with spinoglenoid ligament release for suprascapular nerve entrapment. Of the 12 patients, seven patients had complete relief in pain, three had significant reduction in pain, one failed to return to activities, and one patient was lost to follow up.[51] Lobão Gonçalves reports on 19 patients and 20 shoulders that underwent arthroscopic suprascapular nerve decompression. Patients reported using the UCLA scale, SF-36, raw pain scale and Simple Shoulder Test. Of the 19 patients, 18 reported an improvement in pain.[52]

Table 2. A summary of the results on peripheral nerve stimulation for treatment of suprascapular neuropathy.

Article Title	Lead Author	Journal	Intervention	Study Type	Number of Cases	Year	Outcome Measures	Results	Conclusions
Facilitation of diagnostic and percutaneous trial lead placement with ultrasound guidance for peripheral nerve stimulation suprascapular neuralgia	Bouche, B	Regional Anesthesia and Pain Medicine	Medtronic implantation of articular branches as well as the cutaneous branches of saphenous nerve.	Case series	5 patients	2011	Visual Analog Scale (VAS), various functional testing	VAS scores at 12 months demonstrated a decrease in pain score from from 6-8/10 to 0-2/10. Siignificant improvement in walking distance, in standing and in sitting tolerances. 3 out of 5 patients were able to return to work.	Peripheral nerve stimulation may be an effective treatment for suprascapular neuralgia.
Peripheral Nerve Stimulation of Brachial Plexus Nerve Roots and Supra-Scapular Nerve for Chronic Refractory Neuropathic Pain of the Upper Limb	Bénédicte Bouche	Neuromodulation	Peripheral nerve stimulation of brachial plexus and suprascapular nerve with implanted electrodes	Clinical trial	26 patients (28 implants)	2017		20 patients followed up 27.5 mean month follow up had mean pain relief of 67.1% 17 patients improved >50% 12 improved >70% 11 patients after 2 year follow up reported pain relief >68% 12/20 very satisfied 6/20 satisfied 2/20 poorly satisfied	
Prospective case series on the use of peripheral nerve stimulation for focal mononeuropathy treatment	Oswald, Jessica	Pain Management	Bioness Stimrouter system implanted on SSN, Brachial plexus, and intercostal nerve	Clinical trial	39 patients (42 implants)	2019		78% of the participants noticed an improvement in their pain. average preprocedural score of 8 improving to 2 post-implant 72% improvement in activity with the greatest observed in the brachial plexus (80%) and suprascapular nerve (80%) and smallest in the intercostal nerve (40%). 89% of those implanted with a peripheral nerve stimulator experienced a greater than 50% reduction in opioid consumption	Peripheral nerve stimulation may safe and effective at improving patient clinical scores and pain medication dependence.

Table 3. A summary of the results on pulsed radiofrequency neuromodulation for treatment of suprascapular neuropathy.

Article Title	Lead Author	Journal	Intervention	Study Type	Number of Cases	Year	Outcome Measures	Results	Conclusions
Pulsed radiofrequency of suprascapular nerve and shoulder joint for chronic shoulder pain	*Clinical trial currently underway*		Pulsed Radiofrequency Neuromodulation	Clinical Trial	150	Currently underway	*Clinical trial currently underway*		
Effect of Pulsed Radiofrequency Neuromodulation on Clinical Improvements in the Patients of Chronic Intractable Shoulder Pain	Jang	J Korean Neurosurg	Pulsed Radiofrequency Neuromodulation	Case series	11	2013	Visual Analog scale (VAS), Oxford Shoulder Score (OSS)	Statistically significant improvement in VAS scores and OSS scores maintained at 9 months follow-up.	Pulsed radiofrequency is an effective treatment modality for intractable shoulder pain and may be effective in treating suprascapular nerve entrapment.

Table 4. A summary of the results on transcutaneous electrical nerve stimulation for treatment of suprascapular neuropathy.

Article Title	Lead Author	Journal	Intervention	Study Type	Number of Cases	Year	Outcome Measures	Results	Conclusions
Pulsed radiofrequency versus conventional transcutaneous electrical nerve stimulation in painful shoulder: a prospective, randomized study	Onur Kıvılcım Korkmaz	Clinical Rehabilitation	Pulsed Radiofrequency or Transcutaneous Electrical Nerve Stimulation	Controlled Trial	40 patients	2010	Visual Analog Scale (VAS), Range of motion, Shoulder pain and disability index (SPADI.)	Significant improvement (decrease) in visual analogue scale at 1 week, 4 weeks, and 12 weeks at night, at rest, and during movement for both pulsed radiofrequency and transcutaneous stimulation. Significant improvement in range of motion at 1 week, 4 weeks, and 12 weeks for both pulsed radiofrequency and transcutaneous stimulation. Significant improvement (decrease) in SPADI sores at 1 week, 4 weeks, and 12 weeks for both pulsed radiofrequency and transcutaneous electrical nerve stimulation.	Both pulsed radiofrequecy and transcutaneous electrical nerve stimulation provide symptom relief and improvement in the painful shoulder with and may work equally well when compared to one another.

Table 5. A summary of the results on arthroscopic release of the superior transverse scapular ligament (STSL) for treatment of suprascapular neuropathy.

Article Title	Lead Author	Journal	Intervention	Number of Cases	Year	Outcome Measures	Results
Arthroscopic management of suprascapular neuropathy of the shoulder improves pain and functional outcomes with minimal complication rates	Memon	Memon Knee Surg Sports Traumatol Arthrosc	Arthroscopic release of the superior transverse scapular ligament	259 patients (269 shoulders)	2017	NRS Visual Analog Scale Subjective Shoulder value American Shoulder and Elbow Surgeons Score Simple Shoulder Test (SST) University of California Los Angeles Rating Scale	96% reported significant improvement or complete resolution from their pre-operative symptoms with improvement in pain and strength. Low complication rates. Patients managed with arthroscopic surgery can expect significant improvement in pain and functional outcomes.
Clinical outcomes of suprascapular nerve decompression: a systematic review	Momaya	J Shoulder Elbow Surg		203 patients (226 shoulders)		Visual analog scale Subjective shoulder value (SSV) American Shoulder and Elbow Surgeons score (ASES score) University of California-Los Angeles rating scale (UCLA rating scale) Constant-Murley Simple Shoulder Test (SST) Functional score Disabilities of the Arm, Shoulder, and Hand score (DASH) Rowe 36-Item Short Form Health Survey Penn Shoulder Score (PSS)	Decrease (improvement) in visual analog scale, disabilities of the arm, shoulder, and hand score. Increase (improvement) in the SST, ASES score, UCLA rating scale, Constant-Murley, SST, functional score, Rowe, PSS
Endoscopic Release of the Spinoglenoid Ligament: A Safe and Efficacious Alternative to an Open Approach	K. Plancher	Arthroscopy: The Journal of Arthroscopic & Related Surgery	Arthroscopic release of the spinoglenoid ligament	12 patients		Patient reported resolution of symptoms and return to activities	7/11 complete relief 3/11 significant reduction in pain 1/11 failed to return to activities

Article Title	Lead Author	Journal	Intervention	Number of Cases	Year	Outcome Measures	Results
Suprascapular Nerve Arthroscopic Release Outcomes	Lobão Gonçalves, Mario Henrique	Arthroscopy: The Journal of Arthroscopic & Related Surgery	Arthroscopic release of the superior transverse scapular ligament	19 patients (20 shoulders)	2008-2011	University of California-Los Angeles rating scale, Short Form 36, Standard 0-10 pain scale, Simple Shoulder Test	18/19 patients reported improvement in pain

4. CONCLUSIONS

This condition can present as a primary disease or can be secondary to many other pathologies including but not limited to systemic conditions, traumatic injury, ganglion cysts, bone cysts, and paralabral cysts. A history of overhead sports volleyball, baseball, or in younger patients and known rotator cuff disease in older patients can further heighten a clinician's suspicion. Entrapment at the suprascapular notch is more common overall, yet certain populations may be more predisposed to isolated spinoglenoid notch including younger athletes. Many recently elucidated anatomical factors predispose to entrapment including variations in the course of the nerve, variations in the superior transverse scapular ligament, and changes in vascularity. Conservative therapy may be successful in some patients; however, there are limited outcome studies regarding their efficacy. Pulsed radiofrequency, peripheral nerve stimulation, and transcutaneous electrical nerve stimulation may be effective in treating patients with suprascapular nerve entrapment. Surgical treatment has shifted to become nearly all arthroscopic and remains the gold-standard in patients with nerve entrapment syndrome refractory for treatment.

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