

Effectiveness of new nerve blocks method on the articular branches of the suprascapular and subscapular nerves to treat shoulder pain

Sang Hoon Lee, MD^a, Hyun Hee Choi, BBA^{a,b}, Dong Gyu Lee, MD, PhD^{a,c,*} 

Abstract

To evaluate the effectiveness and safety of performing nerve blocks on the articular branches of the suprascapular and subscapular nerves for the treatment of shoulder pain caused by various pathologies.

Fifty-two patients with shoulder pain were included in this study. Suprascapular and subscapular nerve blocks were performed with 2.5 mL anesthetic solution (2 mL of 0.5% bupivacaine and 0.5 mL of 2 mg/mL dexamethasone). The subjects were evaluated before the procedure and 1, 3, and 6 months afterward by means of the numeric rating scale and the shoulder pain and disability index. A post-injection pain reduction of >50% and <50% was considered a positive and negative response to the blocks, respectively.

After nerve blocks, the mean numeric rating scale and shoulder pain and disability index scores were significantly reduced from pre-injection values, and this effect persisted for 6 months after injection. The positive and negative response groups consisted of 31 (60%) and 21 (40%) patients, respectively. The positive response group showed significantly better outcomes on the numeric rating scale and shoulder pain and disability index compared with the negative response group. No patients reported adverse effects either during or after the procedure.

Performing nerve blocks on the articular branches of the suprascapular and subscapular nerves resulted in positive outcomes for shoulder pain patients. Regardless of shoulder pathology, this new injection method can be safely used in shoulder pain patients.

Abbreviations: AP = anteroposterior, GH = glenohumeral, NRS = numeric rating scale, SC = subscapular, SLAP = superior labral tear from anterior to posterior, SPADI = shoulder pain and disability index, SSN = suprascapular nerve, VAS = visual analog scale.

Keywords: nerve block, numeric rating scale, shoulder pain, shoulder pain and disability index, subscapular nerve, suprascapular nerve

1. Introduction

Shoulder pain has a high prevalence (between 6.9% and 26%) amongst elderly patients.^[1] Therefore, the treatment of shoulder pain is of significant social importance for improving patients' quality of life. Many treatment modalities are used, of which the

most common are exercise, steroid injection, and nerve block. However, as shoulder pain has a variety of potential causes, it can be difficult to select an effective treatment option.

The suprascapular and axillary nerves are known to innervate most of the shoulder joint area. Compared with the suprascapular nerve (SSN), the axillary nerve can be difficult to block, because its anatomical location raises challenges in terms of image guidance.^[2,3] Moreover, it has long been understood that the SSN innervates 70% of the shoulder joint.^[4] Therefore, SSN block has been adopted for the treatment of shoulder pain.^[5,6] In spite of a positive effect, the SSN block was not widely conducted for the shoulder pain. The suprascapular notch, which is the ideal target of the SSN, is located deep anatomically and close to the lungs. The targeting of suprascapular notch has a potential risk of pneumothorax. Besides, the suprascapular artery accompanies with SSN. These factors lower the clinical approach. Therefore, there is a need for a safe and effective procedure reducing the psychological burden of the operator and potential risk of the procedure.

Moreover, in contrast to previous findings, a recent anatomical study reported that the articular branch of the SSN innervates only the posterosuperior portion of the shoulder joint, while the subscapular (SC) nerve innervates the anterosuperior portion of the shoulder joint.^[7] Given that the superior area of the shoulder joint is a common site of pathologies that cause shoulder pain such as impingement and rotator cuff tear,^[8,9] it follows that SSN and SC nerve block together could be a more effective strategy to control shoulder pain than a single SSN block. Furthermore,

Editor: Eric Bush.

The authors have no funding and conflicts of interest to disclose.

The datasets generated during and/or analyzed during the present study are available from the corresponding author on reasonable request.

^a Department of Radiology, Madi Pain Management Center, ^b Madi Research and Development Center, Jeonju, ^c Department of Physical Medicine and Rehabilitation, College of Medicine, Yeungnam University, Daegu, Republic of Korea.

* Correspondence: Dong Gyu Lee, Department of Rehabilitation Medicine and Spine Center, Yeungnam University College of Medicine, 170 Hyeonchung-ro, Nam-gu, Daegu 42415, Republic of Korea (e-mail: painfree@yu.ac.kr).

Copyright © 2020 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Lee SH, Choi HH, Lee DG. Effectiveness of new nerve blocks method on the articular branches of the suprascapular and subscapular nerves to treat shoulder pain. *Medicine* 2020;99:35(e22050).

Received: 11 March 2020 / Received in final form: 10 June 2020 / Accepted: 2 August 2020

<http://dx.doi.org/10.1097/MD.00000000000022050>

therefore, in this study, we aimed to evaluate the effectiveness and safety of using both SSN and SC nerve blocks for shoulder pain caused by various pathologies.

2. Methods

2.1. Subjects

This study was a prospective clinical trial including shoulder pain patients who visited the outpatient pain clinic. The Institutional Review Board approved this study and patients who met the inclusion and exclusion criteria provided written informed consent. The following inclusion criteria were used:

1. a complaint of shoulder pain of any etiology,
2. a previous lack of response to medication and subdeltoid or intra-articular injections,
3. visual analog scale (VAS) score of >5 even after conservative management, and
4. normal activity hampered by the restricted active range of motion of the shoulder joint.

Exclusion criteria were as follows:

1. pain due to other diseases, such as malignancy, cervical radicular pain, stroke, or uncontrolled diabetes,
2. any coagulopathies,
3. a skin infection over the shoulder area,
4. an allergy to local anesthetics,
5. uncontrolled hypertension.

All diagnoses were confirmed using ultrasonography or magnetic resonance imaging. SSN and SC nerve blocks were performed on all included patients. Numeric rating scale (NRS) and shoulder pain and disability index (SPADI) were evaluated pre-injection, as well as 1, 3, and 6 months after injection. The percentage of pain reduction was evaluated at several minutes

after injection. A post-injection pain reduction of $>50\%$ and $<50\%$ was considered a positive and negative response to the block, respectively. An independent assessor evaluated the clinical outcomes, SPADI, NRS, and pain reduction. Pain medication and physiotherapy were permitted.

2.2. Technique for the SSN block

The patient was placed in the oblique supine decubitus position with a frame support under the shoulder and the hip, and the head turned approximately 15° to the opposite side. After aseptic skin preparation, a C-arm fluoroscopic unit (Ziehm Vision FD, Ziehm Imaging, Germany) was adjusted to obtain the true anteroposterior (AP) view of the glenohumeral (GH) joint (Grashey view), which allows the assessment of the GH joint space (double line) and the lateral border of the articular surface of the scapular bone.^[10] After achieving the true AP view, the C-arm fluoroscopic unit was tilted 15° to 20° cranially. The entry point of the needle was just medial to the junction of the clavicle and scapular spine. After standard skin infiltration with 1% lidocaine HCl (Lidocaine, Daihan Pharmaceuticals, Seoul, Korea), a 22-gauge 3.5-inch spinal needle (Quincke, Becton Dickinson, Delhi, India) was advanced perpendicularly. The needle tip was aimed towards the 1 cm medial to lateral superior edge of the scapular glenoid, and advanced until it contacted the scapula at the superior surface of the suprascapular fossa (Fig. 1A). After the needle touched the bone, the C-arm was rotated to obtain the scapular Y-view to visualize the suprascapular fossa (Fig. 1B). As previously reported, the anatomical target point was the midline between the suprascapular and spinoglenoid notches.^[7] Based on the scapular Y-view, the needle tip was adjusted to reach the optimal target point (Fig. 1B). After aspiration to avoid the risk of intravascular injection, approximately 0.5 mL of contrast agent (iopamidol, Isovue-M-300, Bracco Diagnostics, Princeton, NJ) was injected

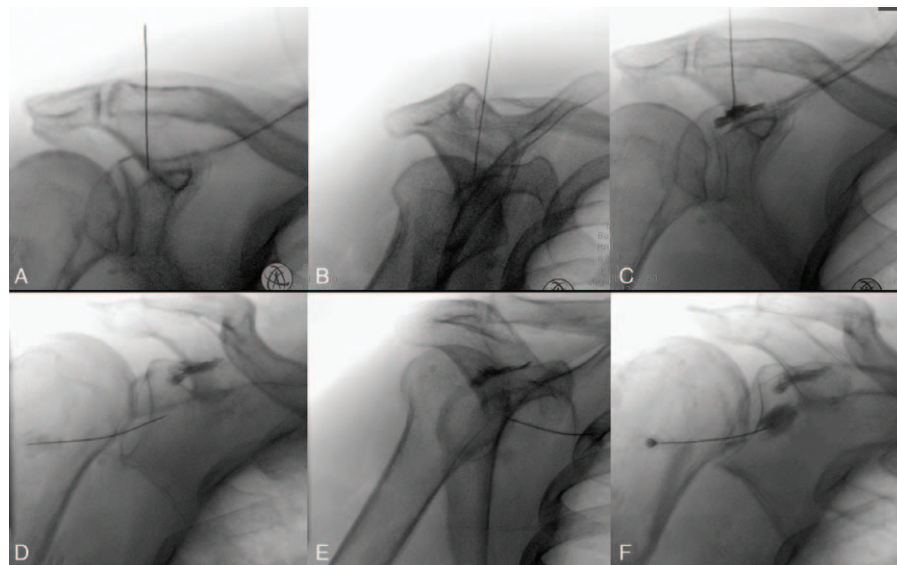


Figure 1. The needle positions for performing nerve blocks on the articular branches of the suprascapular nerve (SSN) and subscapular (SC) nerve. The position of the needle tip for blocking the articular branch of the SSN was the midpoint between the suprascapular and spinoglenoid notches (A and B). The contrast media spread between the suprascapular fossa and the suprascapular muscle, where the articular branch of the SSN passes (C). The position of the needle tip for blocking the articular branch of the SC nerve was at the superior border of the subscapularis, deep to the coracoid process (D and E). The contrast media spread over the underlying margin of the rim of the anterior glenoid fossa, where the articular branch of the superior SC nerve is located (F).

to ensure lack of intravascular flow, after which an anesthetic solution consisting of 2 mL of 0.5% bupivacaine and 0.5 mL of dexamethasone palmitate (2 mg/mL dexamethasone, Mitsubishi Tanabe Pharma, Korea) was injected (Fig. 1C).

2.3. Technique for the genicular branch of the SC nerve block

The patient was placed in the supine position with the shoulder slightly externally rotated and the head rotated approximately 15° contralaterally. The two frame supports under the shoulder and the hip were removed to open up the anterior surface. The C-arm fluoroscopic unit was then readjusted to obtain the true AP view of the GH joint. As the optimal needle entry position for this block is just below the coracoid process (Fig. 1D), the C-arm fluoroscopic unit was tilted 15° to 20° caudally to avoid the bony obstacle of the coracoid process. A 22-gauge 3.5-inch spinal needle (Quincke, Becton Dickinson, Delhi, India) was then advanced medially and superiorly, with the tip aimed toward the 1 cm medial to lateral edge of the scapular glenoid and the upper second quarter of the glenoid ring. The needle was advanced until the tip contacted the bone at the anterior surface of the SC fossa. After the bone was touched, the C-arm was rotated to obtain the scapular Y-view to visualize the SC fossa (Fig. 1E). The target point was at the superior border of the subscapularis and the anterior surface of the SC fossa, deep to the coracoid process. After aspiration to avoid the risk of intravascular injection, ~0.5 mL of contrast agent was injected to ensure lack of intravascular flow (Fig. 1F), after which the previously described anesthetic solution consisting of 2 mL of 0.5% bupivacaine and 0.5 mL of dexamethasone palmitate was injected.

2.4. Statistics

Paired *t* tests and Wilcoxon signed-rank tests were used for the statistical analysis of factors in demographic data. The clinical course was analyzed using a repeated measures analysis of variance. Moreover, to analyze the effects on the positive and negative response groups, a two-way factor repeated measures analysis of variance was performed. Pearson's Chi-squared test was used to evaluate the frequency distribution of shoulder pathology between groups. Data input and statistical calculations

were conducted using SPSS version 23.0 (SPSS Inc, Chicago, IL), and a *P*-value of <.05 was regarded as statistically significant.

3. Results

A total of 52 patients were included in this study (19 patients had cuff arthropathy or osteoarthritis; 22 patients had rotator cuff disorders such as full thickness tears, partial tears, or impingement disorders; 4 patients had adhesive capsulitis; 6 patients had calcific deposition tendon disorders; and 1 patient had a superior labral tear from anterior to posterior [SLAP]) (Table 1). Mean NRS was 6.19 ± 0.49 . Mean duration of symptoms was 10.47 ± 13.81 months. The mean total pain score and disability score were 66.67 ± 0.55 and 66.00 ± 6.85 . After the nerve blocks, mean NRS and SPADI scores showed a statistically significant reduction compared with pre-injection values (Table 2, Fig. 2). All patients showed decreased functional scores and decreased pain scores post-injection. The reduction in pain and SPADI scores lasted up to 6 months after injection. When patients were classified based on their immediate response to injection, the positive and negative response groups consisted of 31 (60%) and 21 (40%) patients, respectively (Table 1). The diagnostic frequency of shoulder pathology was statistically no different between these groups. The positive response group showed better outcomes on NRS and SPADI compared with the negative response group (Table 2).

All patients were followed up for 6 months after injection. No patients underwent a shoulder operation in the follow-up period, and none reported adverse effects during and after the procedure.

4. Discussion

Blocking the articular branches of the suprascapular and SC nerves resulted in statistically and clinically significant shoulder pain reduction which was maintained for 6 months. The positive group had better outcomes than the negative group. Moreover, there were no significant adverse effects of the nerve blocks. Therefore, performing nerve blocks on the articular branches of the SSN and SC nerves is a safe option for the treatment of shoulder pain.

The SSN supplies the suprascapular and infrascapular muscles. Moreover, since the SSN has been recognized to innervate ~70% of the shoulder joint, SSN block is widely employed for shoulder

Table 1
Demographic data.

	Total subjects (N=52)	Negative response (N=21)	Positive response (N=31)	<i>P</i> ^a
Age	66.35 ± 11.47	63.43 ± 13.05	68.32 ± 10.00	.133
Sex (male: female)	12:40	5:16	7:24	.919
Duration (month)	10.47 ± 13.81	10.22 ± 13.14	10.63 ± 14.46	.97
Mean NRS	6.19 ± 0.49	6.14 ± 0.57	6.23 ± 0.43	.629
Mean pain SPADI	66.67 ± 0.55	66.33 ± 4.90	66.9 ± 3.24	.643
Mean disability SPADI	66.00 ± 6.85	68.10 ± 8.63	64.58 ± 5.00	.069
Diagnosis				
Cuff arthropathy	19 (66.5%)	6 (28.6%)	13 (41.9%)	.379
Rotator cuff disorders	22 (42.3%)	9 (42.9%)	13 (41.9%)	
Adhesive capsulitis	4 (7.7%)	1 (4.8%)	3 (9.7%)	
Calcify tendinopathy	6 (11.5%)	4 (19.0%)	2 (6.5%)	
SLAP	1 (1.9%)	1 (4.8%)	0 (0%)	

NRS=numeric rating scale, SPADI=shoulder pain and disability index.

^a Comparison between negative and positive response groups

Table 2
Effects of blocking the articular branches of the suprascapular and subscapular nerves for chronic shoulder pain, as determined by two-factor repeated analysis of variance.

Variable	Group	Time, mean ± SD				F (P)		
		Pre-injection ¹⁾	1 month ²⁾	3 month ³⁾	6 month ⁴⁾	Time	Group	Time* Group
NRS	Total subjects (N=52)	6.19±0.07	3.33±0.27	3.15±0.29	3.06±0.30	82.87 (0.000)* 1>2,3,4,5 [†]	—	—
	Negative response (N=21)	6.14±0.57	4.67±1.74	4.57±1.91	4.57±2.04	90.20 (0.000)* 1>2,3,4,5 [†]	26.06 (.000)*	17.95 (.000)*
SPADI Pain score	Positive response (N=31)	6.23±0.43	2.42±1.57	2.19±1.62	2.03±1.64			
	Total subjects (N=52)	66.67±0.55	46.19±2.03	45.04±2.17	43.92±2.19	89.73 (0.000)* 1>2,3,4,5 [†]	—	—
	Negative response (N=21)	66.33±4.90	55.86±13.30	55.90±14.69	54.86±14.68	102.28 (0.000)* 1>2,3,4,5 [†]	23.72 (.000)*	21.45 (.000)*
	Positive response (N=31)	66.90±3.24	39.65±11.73	37.68±11.50	36.52±11.90			
Disability score	Total subjects (N=52)	66.00±0.95	47.35±2.26	46.60±2.39	45.44±2.44	89.52 (0.000)* 1>2,3,4,5 [†]	—	—
	Negative response (N=21)	68.10±8.63	58.29±14.05	58.05±15.77	56.90±15.85	97.87 (0.000)* 1>2,3,4,5 [†]	21.12 (.000)*	17.76 (.000)*
	Positive response (N=31)	64.58±5.00	39.94±13.38	38.84±13.60	37.68±14.29			

NRS=Numeric rating scale, SPADI=shoulder pain and disability index.

* Statistically significant with P<.05.

[†] Multiple comparison result by contrast.

pain treatment and for regional anesthesia in surgery.^[4,11] At the suprascapular notch, the SSN sends a branch to the acromioclavicular joint and glenohumeral joint. Therefore, the suprascapular notch has widely been adopted as the ideal location for performing SSN blocks to treat shoulder pain. However, a recent anatomical study reported that the articular branch of the SSN

innervated only the posterosuperior part of the shoulder joint.^[7,12] The anterosuperior quadrant of the shoulder joint was mostly innervated by the articular branch of the superior SC nerve, and occasionally by the lateral pectoral nerve. Therefore, the SSN is only responsible for innervating one quarter of the shoulder joint.

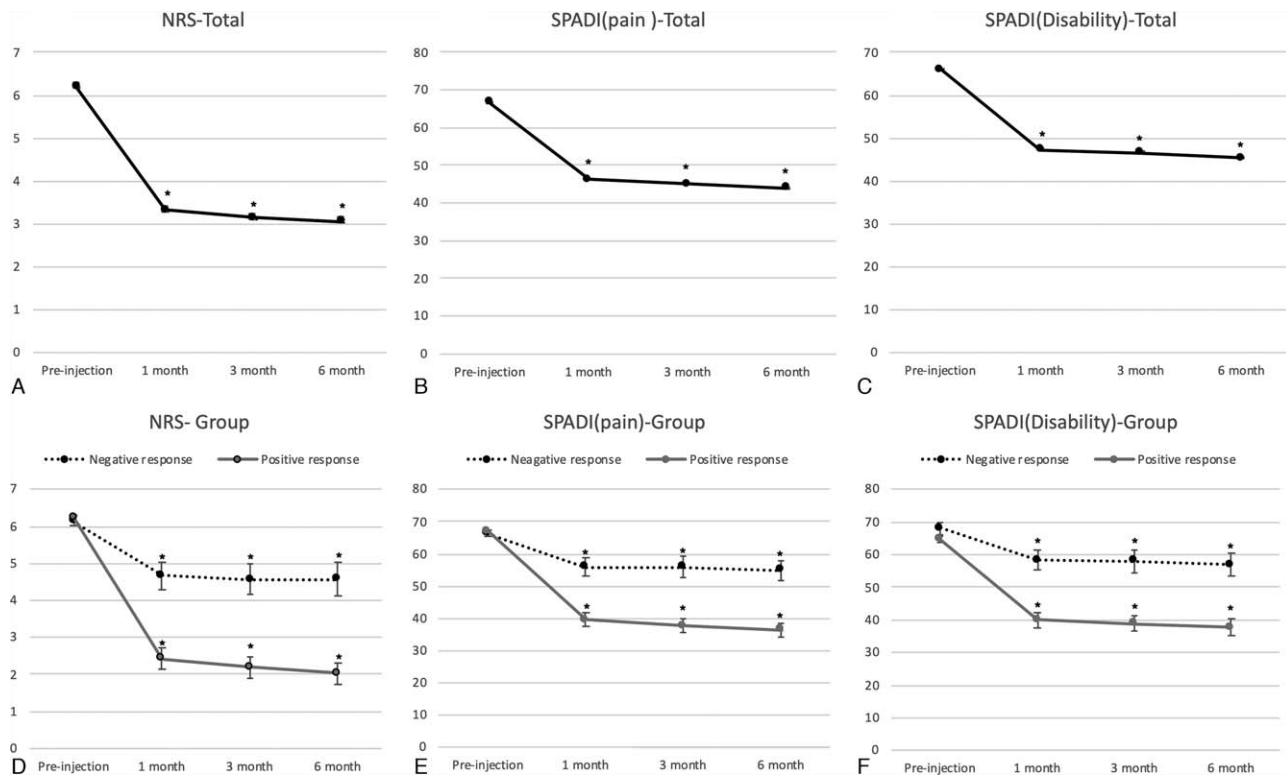


Figure 2. Numeric rating scale (NRS) and shoulder pain and disability index (SPADI) results for shoulder pain patients. NRS and SPADI scores were statistically significantly reduced after nerve blocks of the articular branches of the suprascapular and subscapular nerves (A, B, and C). The positive response group showed better outcomes than the negative response group (D, E, and F).

The posterosuperior quadrant is a major site of pathologies that can cause shoulder pain, most notably rotator cuff pathology and labral injury.^[13,14] The anterosuperior quadrant is also the site of common sources of shoulder pain including rotator interval pathology and SC tendon pathology.^[15–17] Therefore, it can be inferred that blocking the articular branches of the SSN and the SC nerve together could be a reasonable strategy to treat common causes of shoulder pain.

For local anesthetics to be effective, they must diffuse across epineurium, perineurium, and transmembrane barriers, and then penetrate into the cytoplasm. As the SSN at the suprascapular notch has both motor and sensory portions, there are greater barriers to overcome here than at the distal part where our novel target point is situated.^[18] The volume of local anesthetic typically used for SSN block at the suprascapular notch is 10 mL.^[19,20] At the new target point, the nerve innervating the supraspinatus muscle is already branched. Moreover, the articular branch to the GH joint originates around this new target point. Our procedure used only 2.5 mL of local anesthetic for each articular branch. Branching of the supraspinatus innervating nerve reduces its circumferential area, which increases the penetration of the anesthetic agent and decreases the amount of local anesthetic required for the block. Therefore, the new target point can be an effective site for SSN block even when using a much smaller amount of local anesthetic than for conventional SSN block at the suprascapular notch.

Performing the SSN block within the suprascapular notch is associated with a small risk of pneumothorax with an incidence of <1%.^[21] Bone touch technique is one of the ways to increase safety and accuracy in fluoroscopic-guided procedures. The target point of the new technique is over the supraspinatus fossa of the scapula. The supraspinatus fossa is like a barrier against the lungs that improves the safety and increases the accessibility of the procedure. This new target point for the SSN block can effectively block the distal articular branch of the SSN and increase the convenience of the injection procedure owing to the suprascapular fossa.

SSN nerve block with local anesthetic and/or steroid has been shown to be effective in treating shoulder pain.^[19,20,22] This treatment has been efficacious in various shoulder pathologies including supraspinatus tendinopathy, frozen shoulder, and nonspecific shoulder pain.^[23,24] In our research, blocking the articular branches of the SSN and SC nerve also resulted in effective functional improvement and pain reduction in shoulder pain caused by various pathologies. There was no statistically significant difference between the negative and positive groups in the distribution of shoulder pathology. The effect of the block appeared to depend not on the shoulder pathology but on the immediate injection response. We therefore speculated that the effect on pain reduction was due not only to the effect of the steroid, but also to the effective articular branch block.

Forty percentage of patients showed a negative response to the nerve blocks. Therefore, performing nerve blocks on the articular branches of the SSN and SC nerve cannot block all of the pain generated within the shoulder joint. The inferior GH ligament has been strongly associated with frozen shoulder,^[25] and the axillary nerve is responsible for innervating the inferior part of the GH joint. Bone marrow edema within the glenoid and humeral head can also be a source of shoulder pain.^[26,27] It is not known whether genicular nerve block is effective in reducing the pain caused by bone marrow edema. Moreover, innervation to the anterosuperior part of the GH joint shows a minor anatomical variation: some

patients have no articular branch from the superior SC nerve, and instead receive innervation from a direct branch from the posterior cord or the lateral pectoral nerve.^[7,12] The above factors provide reasons for the negative responses to our nerve blocks of the articular branches of the SSN and SC nerve.

Intra-articular steroid injection has been utilized to treat frozen shoulder and GH arthritis, because the pathology of these conditions is known to be localized within the intra-articular space and surrounding structures. However, SSN block with only local anesthetic has shown a comparable effect to intra-articular steroid injection for chronic shoulder pain.^[5] Moreover, SSN block with steroid and local anesthetic has resulted in a faster and more complete resolution of shoulder pain.^[28] Consistent with these previous findings, our study also found that nerve blocks using both local anesthetic and steroid were effective in treating shoulder pain regardless of the shoulder pathology. Therefore, nerve blocks of the articular branches of the suprascapular and SC nerves can be effective in treating various shoulder pathologies. However, considering that intra-articular steroid injection is a commonly used treatment approach for patients with frozen shoulder, further studies are required to elucidate the effectiveness of this new nerve block method in treating frozen shoulder.

A limitation of our research is that there was no control or placebo group in this study. However, our study was the first to explore the treatment of shoulder pain by targeting the articular branches of the suprascapular and SC nerves. Moreover, we performed subgroup analysis according to the response to the nerve blocks, providing additional information for analyzing the effect of our procedure.

5. Conclusions

In conclusion, performing nerve blocks on the articular branches of the SSN and SC nerve was effective in reducing shoulder pain. Patients who had an immediate positive response to the blocks experienced a better therapeutic effect than patients who did not. Regardless of shoulder pathology, this new injection method can be safely used in shoulder pain patients. Further studies are needed to compare this technique to other conventional procedures in shoulder pain.

Author contributions

Sang Hoon Lee: first author, writing-original draft, Study design. Hyun Hee Choi: Data curation, formal analysis. Dong Gyu Lee: Corresponding author: conceptualization, supervision, Writhing, revise & editing.

References

- [1] Luime JJ, Koes BW, Hendriksen IJ, et al. Prevalence and incidence of shoulder pain in the general population; a systematic review. *Scand J Rheumatol* 2004;33:73–81.
- [2] Standing S. *Gray's Anatomy e-Book: The Anatomical Basis of Clinical Practice*. 2015;Elsevier Health Sciences,
- [3] Gruber H, Peer S, Gruber L, et al. Ultrasound imaging of the axillary nerve and its role in the diagnosis of traumatic impairment. *Ultraschall Med* 2014;35:332–8.
- [4] Ritchie ED, Tong D, Chung F, et al. Suprascapular nerve block for postoperative pain relief in arthroscopic shoulder surgery: a new modality? *Anesth Analg* 1997;84:1306–12.
- [5] Chang KV, Hung CY, Wu WT, et al. Comparison of the effectiveness of suprascapular nerve block with physical therapy, placebo, and intra-articular injection in management of chronic shoulder pain: a meta-analysis of randomized controlled trials. *Arch Phys Med Rehabil* 2016;97:1366–80.

- [6] Fernandes MR, Barbosa MA, Sousa ALL, et al. Suprascapular nerve block: important procedure in clinical practice. *Rev Bras Anesthesiol* 2012;62:96–104.
- [7] Tran J, Peng PWH, Agur AMR. Anatomical study of the innervation of glenohumeral and acromioclavicular joint capsules: implications for image-guided intervention. *Reg Anesth Pain Med* 2019;doi: 10.1136/rapm-2018-100152.
- [8] Gupta A, Gupta H. The radiological assessment of shoulder pathology. *Orthop Trauma* 2018;32:144–52.
- [9] Sallay PI, Hunker PJ, Lim JK. Frequency of various tear patterns in full-thickness tears of the rotator cuff. *Arthroscopy* 2007;23:1052–9.
- [10] Koh KH, Han KY, Yoon YC, et al. True anteroposterior (Grashey) view as a screening radiograph for further imaging study in rotator cuff tear. *J Shoulder Elbow Surg* 2013;22:901–7.
- [11] Bowens C, Sripada R. Regional blockade of the shoulder: approaches and outcomes. *Anesthesiol Res Pract* 2012;2012: doi: 10.1155/2012/971963.
- [12] Eckmann MS, Bickelhaupt B, Fehl J, et al. Cadaveric study of the articular branches of the shoulder joint. *Reg Anesth Pain Med* 2017;42: 564–70.
- [13] Snyder SJ, Karzel RP, Del Pizzo W, et al. SLAP lesions of the shoulder. *Arthroscopy* 1990;6:274–9.
- [14] Tasaki A, Nimura A, Nozaki T, et al. Quantitative and qualitative analyses of subacromial impingement by kinematic open MRI. *Knee Surg Sports Traumatol Arthrosc* 2015;23:1489–97.
- [15] Hunt SA, Kwon YW, Zuckerman JD. The rotator interval: anatomy, pathology, and strategies for treatment. *J Am Acad Orthop Surg* 2007;15:218–27.
- [16] Fields BKK, Skalski MR, Patel DB, et al. Adhesive capsulitis: review of imaging findings, pathophysiology, clinical presentation, and treatment options. *Skeletal Radiol* 2019;48:1171–84.
- [17] Ono Y, Sakai T, Carroll MJ, et al. Tears of the subscapularis tendon: a critical analysis review. *JBJS Rev* 2017;5: doi: 10.2106/jbjs.rvw.16.00054.
- [18] Lennard TA, Vivian DG, Walkowski SD, et al. *Pain Procedures in Clinical Practice E-Book*. 2011;Elsevier Health Sciences,
- [19] Shanahan EM, Ahern M, Smith M, et al. Suprascapular nerve block (using bupivacaine and methylprednisolone acetate) in chronic shoulder pain. *Ann Rheum Dis* 2003;62:400–6.
- [20] Mortada MA, Ezzeldin N, Abbas SF, et al. Multiple versus single ultrasound guided suprascapular nerve block in treatment of frozen shoulder in diabetic patients. *J Back Musculoskelet Rehabil* 2017;30: 537–42.
- [21] Harmon D, Hearty C. Ultrasound-guided suprascapular nerve block technique. *Pain Physician* 2007;10:743–6.
- [22] Aydin T, Sen EI, Yardimci MY, et al. Efficacy of ultrasound-guided suprascapular nerve block treatment in patients with painful hemiplegic shoulder. *Neurol Sci* 2019;40:985–91.
- [23] Taskaynatan MA, Yilmaz B, Ozgul A, et al. Suprascapular nerve block versus steroid injection for non-specific shoulder pain. *Tohoku J Exp Med* 2005;205:19–25.
- [24] Chan CW, Peng PW. Suprascapular nerve block: a narrative review. *Reg Anesth Pain Med* 2011;36:358–73.
- [25] Gondim Teixeira PA, Balaj C, Chanson A, et al. Adhesive capsulitis of the shoulder: value of inferior glenohumeral ligament signal changes on T2-weighted fat-saturated images. *AJR Am J Roentgenol* 2012;198:W589–96.
- [26] McCauley TR, Disler DG, Tam MK. Bone marrow edema in the greater tuberosity of the humerus at MR imaging: association with rotator cuff tears and traumatic injury. *Magn Reson Imaging* 2000;18:979–84.
- [27] Veen EJD, Donders CM, Westerbeek RE, et al. Predictive findings on magnetic resonance imaging in patients with symptomatic acromioclavicular osteoarthritis. *J Shoulder Elbow Surg* 2018;27:e252–8.
- [28] Jones DS, Chattopadhyay C. Suprascapular nerve block for the treatment of frozen shoulder in primary care: a randomized trial. *Br J Gen Pract* 1999;49:39–41.