Original Article
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Three-Dimensional Morphological Analysis of the Suprascapular Notch in Patients with Arthroscopic Rotator Cuff Repair

Kyu Cheol Noh, MD, Sanghyeon Lee, MD*, Chang Won Park, MD*, Haotian Bai, MD†, Jung-Youn Kim, MD*

Department of Orthopedic Surgery, Dongtan Sacred Heart Hospital, Hallym University Medical Center, Hwaseong,
**Department of Orthopedic Surgery, Hallym University Kangnam Sacred Heart Hospital, Seoul, Korea*
†Department of Orthopedic Surgery, The Second Hospital of Jilin University, Changchun, China

Background: The morphology of the suprascapular notch (SSN) and the ossification of the superior transverse suprascapular ligament (STSL) are risk factors for injury of the suprascapular nerve (SN) during arthroscopic shoulder procedures. The purpose of the current study was to compare preoperative clinical and radiologic characteristics between patients with and without STSL ossification and to evaluate SSN morphology in patients who underwent arthroscopic rotator cuff repair using a 3-dimensional (3D) reconstructed model.

Methods: Patients who underwent arthroscopic rotator cuff repair and were given a computed tomography (CT) scan from March 2018 to August 2019 were included in this study. Patients were divided into 2 groups: those without STSL ossification (group I) and those with STSL ossification (group II). Tear size of the rotator cuff and fatty infiltration of rotator cuff muscles were assessed in preoperative magnetic resonance imaging. The morphology of the SSN was classified following Rengachary's classification. The transverse and vertical diameters of the SSN and the distances from anatomical landmarks to the STSL were measured. All measurements were completed using a 3D CT reconstructed scapula model.

Results: A total of 200 patients were included in this study. One hundred seventy-eight patients (89.0%) without STSL ossification were included in group I, and 22 patients (11.0%) with STSL ossification were included in group II. Group II showed a significantly advanced age (61.0 ± 7.4 vs. 71.0 ± 7.3 years, $p < 0.001$) and a shorter transverse diameter of SSN (10.7 ± 3.1 mm vs. 6.1 ± 3.7 mm, $p < 0.001$) than group I. In the logistic regression analysis, age was an independent prognostic factor for STSL ossification (odds ratio, 1.201; 95% confidence interval, 1.112–1.296; $p < 0.001$). Patients in type VI showed significantly shorter transverse diameters than other types ($p < 0.001$). The patient with type I showed a significantly shorter distance from the articular surface of the glenoid to the SSN than those with other types ($p < 0.001$).

Conclusions: In the 3D morphological analysis, age was the independent factor associated with STSL ossification in patients who underwent arthroscopic rotator cuff repair. Type VI showed significantly shorter transverse diameters than other types. Type I showed a significantly shorter distance from the articular surface of the glenoid to the SSN than other types.

Keywords: *Rotator cuff, Scapula, Anatomy, Computed tomography*

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Correspondence to: Jung-Youn Kim, MD
Department of Orthopedic Surgery, Hallym University Kangnam Sacred Heart Hospital, 1 Singil-ro, Yeongdeungpo-gu, Seoul 07441, Korea
Tel: +82-2-829-5165, Fax: +82-2-829-5164, E-mail: kimjungyoun@daum.net
Kyu Cheol Noh and Sanghyeon Lee contributed equally to this study as co-first authors.

The suprascapular nerve (SN) could be at risk due to traction of medially retracted posterosuperior rotator cuff and surgical procedures near the suprascapular notch (SSN) such as superior transverse scapular ligament release.[1] Arthroscopic procedures such as muscle advancement, arthroscopic release, and interval slide are performed to achieve the repair without undue tension of the medially retracted tendon; however, they may carry the potential risk of causing SN injury.[2] SN injury during arthroscopic surgery could result in weakness of the repaired rotator cuff and poor clinical outcomes. However, limited information about the SSN morphology of patients with arthroscopic rotator cuff repair is available.

The morphology of the SSN and the degree of ossification of the superior transverse suprascapular ligament (STSL) are risk factors for injury of the SN during arthroscopic shoulder procedures.[1] In addition, the ossification of STSL could be the risk factor for SN injury during the arthroscopic decompression procedures.[3] During the ossified STSL release, an osteotomy is required because the ossified STSL cannot be released with arthroscopic scissors or radiofrequency ablation, which could increase the risk of nerve injury.[4] Therefore, preoperative identification of the STSL and the anatomical morphology of the SSN are necessary to prevent this kind of iatrogenic injury. However, factors related to SSN ossification in the patients who underwent arthroscopic rotator cuff repair are unknown.

Previous morphological classification studies mainly focused on dry cadaver specimens.[5-7] Cadaver specimens were limited in terms of age, gender, race, and region, which generally could not be determined or selected, as well as a small sample size. In addition, using cadavers to measure the relationship between the SSN and anatomical landmarks can be challenging and yield inaccurate results due to the complex 3-dimensional (3D) shape of the scapula.[8] When measuring using conventional computed tomography (CT), the accuracy of measurements can be compromised depending on the orientation of the CT plane relative to the arrangement of the scapula.[9] Three-dimensional CT data have recently been used as the data source for morphological classification studies.[10] Compared with data from cadaveric scapulae, the characteristics of the samples are easier to control position and measure. In addition, there is an advantage that the shape of the SSN can be known through the preoperative measurement using the CT scan. These methods can overcome the limitations of traditional morphological analysis using cadaver specimens or conventional CT, allowing for enhanced anatomical analysis.

The current study aimed to compare preoperative clinical and radiologic characteristics between patients with and without STSL ossification and to evaluate SSN morphology in patients who underwent arthroscopic rotator cuff repair using a 3D-reconstructed model. We hypothesized that age would be a clinical factor related to STSL ossification in patients who underwent arthroscopic rotator cuff repair and the SSN diameters would be smaller in the patients with STSL ossification.

METHODS

The protocol and all procedures of the study were reviewed and approved by the Institutional Review Board of Kangnam Sacred Heart Hospital, Hallym University College of Medicine (IRB No. 2020-08-012), and informed consent was obtained from all participants included in this study.

Patient Selection

We retrospectively reviewed the prospectively collected data of patients with symptomatic rotator cuff tears who underwent arthroscopic rotator cuff repair between March 2018 and August 2019. The inclusion criteria were as follows: (1) patients were diagnosed with rotator cuff tears through magnetic resonance imaging (MRI) and confirmed intraoperatively and (2) patients received CT scans before surgery. The exclusion criteria were (1) patients with a previous history of fractures, tumors, or surgeries on the affected shoulder; (2) patients who could not tolerate the CT or MRI scan; (3) patients with shoulder instability, infection, or glenohumeral osteoarthritis; and (4) patients with neurologic or systemic disease influencing the shoulder joint. All patients who underwent arthroscopic rotator cuff repair underwent MRI and CT scans to assess SSN morphology and STSL ossification within 1 month before arthroscopic surgery.

Patients were divided into 2 groups depending on STSL ossification: patients without STSL ossification (group I) and patients with STSL ossification (group II). In addition, patients were divided into 6 subgroups according to the Rengachary classification.

Clinical and Radiologic Evaluations

All patients preoperatively completed questionnaires about arm dominance, occupation, symptom duration, and demographics, such as age, sex, smoking status, and history of diabetes mellitus (DM) and hyperlipidemia. The occupation was classified as heavy manual labor with high-demand shoulder activity, including farm, factory, construction, and nonmanual labor. Body mass index was calculated as the body weight in kilograms divided by the square of the height in meters. A nerve conduction study was not performed because the patients did not show symptoms of SN neuropathy.

Tear size of the rotator cuff and fatty infiltration of rotator cuff muscles were assessed in preoperative MRI. The tear size was measured on the coronal and sagittal images of preoperative and postoperative MRI. The anteroposterior tear size was estimated as the longest distance between the anterior and posterior margins of the tear on oblique sagittal images, and the mediolateral tear size was measured as the longest distance between the most medial margin of the retracted cuff and the greater tuberosity on coronal images. Fatty infiltration was evaluated according to the Goutallier classification as modified by Fuchs et al.[11] for each cuff muscle on sagittal MRI sections.

Morphological Analysis of SSN

The morphology of SSN was evaluated according to the classification proposed by Rengachary et al.[7] This method divided the scapulae into 6 types. Type I is a scapula with an absent SSN; type 2 is a scapula with a shallow V-shaped SSN; type III is a scapula with a U-shaped SSN; type IV is a scapula with a deep V-shaped SSN; type V is a scapula with partial ossification of the STSL; and type VI is a scapula with total ossification of the STSL. The classification was performed by 2 independent researchers (CWP and HB). If there was a difference of opinion, a third senior researcher (JYK) made the final determination. All CT scans (Lightspeed Ultra 16 CT, Siemens) were collected and exported by 1 researcher (HB) using a picture archiving and communication (PACS) system program (Infinity Healthcare). Then, the 3D models were reconstructed by the Amira program (version 6.7.0, Thermo Fisher Scientific).

A customized acryl geometric cube was used to compare the measured values obtained from CT images and actual measurements to assess the accuracy of the measurement methods using CT images.[12] The edge-to-edge distance of each side (A to J), the diameter of the 2 holes (K and M), and the diagonal length (L) were measured (Fig. 1). Using the CT image, identical measurements were conducted on the PACS system, and 3D-reconstructed models were used using the Amira program. Each distance was measured 10 times, and the average value was recorded. The discrepancy between the measurement sets was calculated and compared between the 2 modalities.

In the 3D-reconstructed models created using Amira, we measured the vertical diameter as the distance between the deepest point of the SSN and an imaginary line connecting the medial and lateral peaks of the SSN and the transverse diameter as the longest distance between the medial and lateral walls of the SSN. The posterior, lateral, and anterolateral portals are most commonly used for the arthroscopic SN decompression procedure.[13] For complete dissection of the superior transverse scapular ligament (STSL), Lafosse et al.[13] also described a portal called the SSN portal, which is located on the most posterior part of the clavicular articular facet on the acromion. Therefore, we measured the distances from the 4 anatomical landmarks to the SSN: the distance from the articular surface of the glenoid to the SSN; the distance from the posterolateral and anterolateral corners of the acromion to the SSN; and the distance from the most posterior part of the clavicular articular facet on the acromion to the SSN (SSN portal) (Fig. 2).[13] Distances were measured as the shortest distances from the lateral border of the SSN to each anatomical landmark. All measurements were performed by 2 independent researchers (CWP and HB) in a blinded manner to identify the reliability and reproducibility of the area measurement. All measures were re-evaluated with 2-week intervals to assess intra- and interobserver reliability using the intraclass correlation coefficient (ICC).

Statistical Analysis

All statistical analyses were conducted using SPSS version 23.0 (IBM Corp). Summary statistics are presented as means with standard deviations for continuous variables and the number of subjects with percentages for categorical variables. For continuous variables, Student *t*-test was used to compare mean differences between the 2 groups. For categorical variables, we used the chi-square test or Fisher's exact test to test the proportion differences between the groups. To identify factors related to STSL ossification, we selected candidate factors that satisfied $p < 0.1$

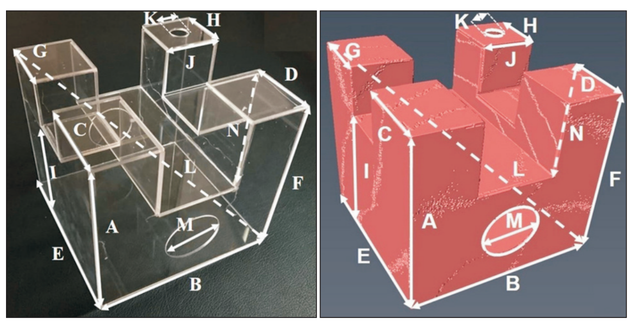

Fig. 1. The customized acrylic cube (left) and 3-dimensional-reconstructed model (right). The edge-to-edge distance of each side (A to J), the diameter of the 2 holes (K and M), and the diagonal length (L) were measured.

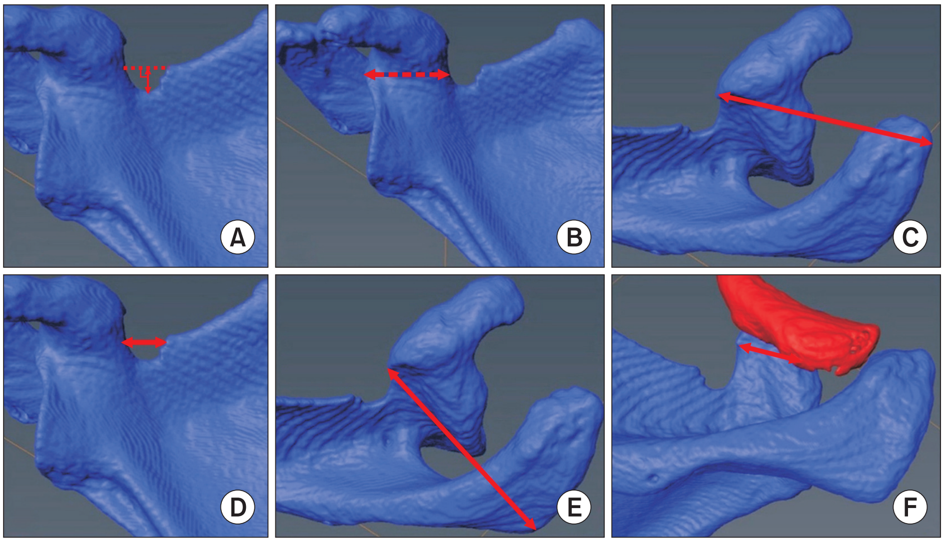

Fig. 2. Schematic diagram of the 6 measurements. (A) Vertical diameter of the suprascapular notch (SSN). (B) Transverse diameter of the SSN. (C) Distance from the articular surface of the glenoid to the SSN. (D) Distance from the posterolateral corner of the acromion to the SSN. (E) Distance from the anterolateral corner of the acromion to the SSN. (F) Distance from the SSN portal to the SSN. The scapula is shown in blue, and the clavicle is shown in red.

in univariate analysis. The impact of factors on STSL ossification was estimated by logistic regression analysis. Age, vertical and transverse diameter of SSN, and the distances from the anatomical landmarks to the SSN in 6 types of Rengachary classification were compared using one-way analysis of variance (ANOVA). When statistically significant ($p < 0.05$) differences were identified with ANOVA, Tukey post hoc tests were used to compare each of the 6 groups to determine which groups were significantly different. Reliability was assessed using ICCs and a 2-way, mixed effects model, assuming a single measurement and absolute agreement.[14] The level of significance was set at 2-tailed $p < 0.05$ for all tests.

RESULTS

A total of 211 patients underwent arthroscopic rotator cuff repair during the study period. Of the 211 patients, 11 were excluded due to 6 revision surgeries, 2 osteoarthritis, and 3 missed imaging studies. Consequently, a total of 200 patients were included in this study. The mean age of all patients was 63.4 ± 9.8 years. Seventy-four patients were male, and 126 were female. The right shoulder was dominantly affected in 69% of cases, and the left shoulder in 31% of cases. One hundred fifty-four patients (77%) had full-thickness rotator cuff tears.

The intra- and interobserver agreement of the measurement of the 3D-reconstructed model was excellent, with an ICC of 0.93 (95% confidence interval [CI], 0.89–0.96; $p < 0.001$) for the intraobserver reliability and 0.89 (95% CI, 0.84–0.93; $p < 0.001$) for interobserver reliability. One hundred seventy-eight (89.0%) patients without STSL ossification were included in group I and

Table 1. Comparisons of Preoperative Parameters between Patients without STSL Ossification (Group I) and Patients with STSL Ossification (Group II)

Variable	Group I (n=178)	Group II (n=22)	*p*-value
Age (yr)	61.0 ± 7.4	71.0 ± 7.3	< 0.001
Sex (male : female)	77 : 101	7 : 15	0.365
Involvement of dominant side (%)	106 (59.6)	10 (45.5)	0.254
Heavy labor occupations (%)	30 (16.9)	4 (3.7)	0.772
BMI (kg/m^2)	24.9 ± 3.0	25.3 ± 3.0	0.731
DM (%)	16 (9.0)	5 (22.7)	0.062
Smoking (%)	22 (12.4)	6 (27.3)	0.094
Trauma involvement (%)	19 (43.2)	25 (46.3)	0.758
Symptom duration (mo)	11.7 ± 12.4	13.2 ± 14.6	0.609
Full-thickness tear (%)	135 (75.8)	19 (86.4)	0.269
Fatty infiltration			
Supraspinatus	1.1 ± 0.7	1.0 ± 0.7	0.520
Infraspinatus	0.8 ± 0.6	0.7 ± 0.6	0.318
Subscapularis	0.4 ± 0.6	0.6 ± 0.7	0.412
AP tear size (mm)	18.9 ± 6.4	19.9 ± 7.4	0.514
ML tear size (mm)	21.9 ± 5.7	22.6 ± 5.0	0.557
Vertical diameter of SSN	6.1 ± 2.4	7.0 ± 2.2	0.098
Transverse diameter of SSN (mm)	10.7 ± 3.1	6.1 ± 3.7	< 0.001

Values are presented as mean ± standard deviation or number (%).
STSL: superior transverse suprascapular ligament, BMI: body mass index, DM: diabetes mellitus, AP: anteroposterior, ML: mediolateral, SSN: suprascapular notch.

22 (11.0%) patients with STSL ossification were included in group II. Compared to group I, group II showed a significantly advanced age and a shorter transverse diameter of SSN. There were no significant differences in the other demographic parameters (Table 1). Among the candidate demographic factors for STSL ossification, age, DM, and smoking were significant factors in the univariate analysis. Based on these factors, a multiple logistic regression analysis was performed. Age was an independent prognostic factor for STSL ossification (Table 2).

In the comparison of the accuracy of the measured values obtained from CT images and the 3D-reconstructed model created with the Amira, the discrepancy between the measurements and actual lengths was significantly lower in the Amira 3D reconstruction than in the CT image of the PACS system (0.3 ± 0.3 vs. 1.5 ± 1.4 mm, p = 0.011).

All 6 types of SSNs were observed (Table 3). The most frequent type was type I (30.5%). Patients with type V and VI were significantly older than those in the other 4 groups. The vertical diameter of type V was significantly longer than that of type II. Patients with type II showed significantly longer transverse diameters than other groups. Patients with type VI showed significantly shorter transverse diameters than other groups. In the measurements of the distances from the 4 anatomical landmarks to the SSN, the patient with type I showed a significantly shorter distance from the articular surface of the glenoid to the SSN than patients with other types. There was no significant difference between each type in other parameters (Table 4).

Table 2. Significant Factors for Superior Transverse Suprascapular Ligament Ossification Determined Using Multiple Logistic Regression Analysis

Variable	OR	95% CI	*p*-value
Age	1.201	1.112–1.296	< 0.001
Smoking	2.881	0.848–9.787	0.090
Diabetes mellitus	2.446	0.698–8.564	0.162

OR: odds ratio, CI: confidence interval.

Table 3. Comparisons of Preoperative Parameters of Patients with 6 Types of Rengachary Classification

Variable	Type I (n = 61)	Type II (n = 47)	Type III (n = 48)	Type IV (n = 22)	Type V (n = 11)	Type VI (n = 11)	*p*-value
Age (yr)	59.3 ± 8.6	61.9 ± 6.9	61.9 ± 6.4	62.1 ± 6.7	70.4 ± 6.8	71.6 ± 8.2	< 0.001
Sex (male : female)	26 : 35	22 : 25	20 : 28	9 : 13	4 : 7	3 : 8	0.918
Involvement of dominant side (%)	33 (54.1)	27 (57.4)	31 (64.6)	15 (68.2)	4 (36.4)	6 (54.5)	0.510
Vertical diameter (mm)	-	5.5 ± 2.3	6.6 ± 2.2	6.3 ± 2.8	7.9 ± 2.7	6.2 ± 1.2	0.032
Transverse diameter (mm)	-	12.2 ± 3.6	10.2 ± 2.2	8.4 ± 2.1	8.8 ± 3.5	3.5 ± 0.7	< 0.001

Values are presented as mean ± standard deviation or number (%).

Table 4. Distances from the Anatomical Landmarks to the SSN

Variable	Type I (n = 61)	Type II (n = 47)	Type III (n = 48)	Type IV (n = 22)	Type V (n = 11)	Type VI (n = 11)	*p*-value
Anterolateral	60.4 ± 3.8	61.3 ± 4.5	61.6 ± 6.1	62.1 ± 6.7	62.3 ± 5.0	61.9 ± 4.6	0.520
Posterolateral	61.9 ± 4.7	61.2 ± 4.6	63.0 ± 7.0	60.3 ± 5.3	62.4 ± 4.1	61.0 ± 5.2	0.661
Glenoid	28.5 ± 2.1	30.7 ± 3.8	31.2 ± 3.8	32.6 ± 3.7	33.3 ± 5.0	34.0 ± 5.9	< 0.001
SSN portal	30.1 ± 4.6	29.8 ± 3.6	30.3 ± 3.9	29.8 ± 3.2	30.4 ± 2.9	30.2 ± 3.1	0.584

Values are presented as mean ± standard deviation.
SSN: suprascapular notch, Anterolateral: distance from the anterolateral corner of the acromion to the SSN, Posterolateral: distance from the posterolateral corner of the acromion to the SSN, Glenoid: distance from the articular surface of the glenoid to the SSN, SSN portal: distance from the most posterior part of the clavicular articular facet on the acromion to the SSN.

DISCUSSION

The most important finding of the current study was that age was the independent factor associated with STSL ossification in patients who underwent arthroscopic rotator cuff repair. In the 3D morphological analysis, type VI showed significantly shorter transverse diameters than other types. Type I showed a significantly shorter distance from the articular surface of the glenoid to the SSN than other types.

Treatment of suprascapular neuropathy consisted of surgical decompression through an open incision.[15] Because of the depth of the SN, this open procedure requires an extensive dissection and may lead to the formation of a large postoperative scar, which may finally result in difficulties with recovery and even secondary compression. Lafosse et al.[13] first used shoulder arthroscopy in SN decompression and achieved good outcomes. It should be noted that any arthroscopic SN decompression technique must be carried out based on a skilled shoulder arthroscopy technique; otherwise, it may cause many adverse consequences, such as SN injury. To avoid this kind of injury, previous research mainly focused on the anatomy of the scapula,[16] the distribution of nerves and muscles on the scapular spine, the risk of medial retraction of the supraspinatus muscles after SN injury, and the definition of the safe zone of SN procedures.[17] Previous cadaveric studies have suggested the distances from various anatomical landmarks to the SSN. Bigliani et al.[18] analyzed 90 cadaver shoulders and reported that the average distance from the supraglenoid tubercle to the SSN was 3.0 cm. Warner et al.[19] reported a commonly cited set of measurements in 1992, which stated that the average distance from the posterolateral corner of the acromion to the base of the scapular spine is 4.5 cm. In 2007, Barwood et al.[20] studied 8 cadaveric shoulders and reported 4 sets of measurements that helped to locate the SSN. In that study, the distance from the lateral edge of the trapezoid ligament to the medial edge of the conical ligament was 19.3 ± 2.6 mm. In 2016, Knudsen et al.[21] reported the anatomic landmarks for arthroscopic SN decompression based on findings in 23 cadaveric scapulae. However, measuring the distances using cadavers could lead to imprecise outcomes owing to the intricate 3D configuration of the scapula and small sample sizes.

Various studies have reported radiological measurements. Dietrich et al.[22] conducted a quantitative analysis of 10 fresh cadaveric shoulders in which measurements were obtained on roentgenogram images. However, due to the characteristics of the imaging modality, the results were easily influenced by the positions of the samples. The measurement using conventional CT images has a problem in that all measures are made with the cross-sectional image of the model. Therefore, small rotations of the 3D model can change the cross-sectional image and lead to entirely different results.[9] Recently, 3D CT scans have become common, and there are reports that CT before arthroscopic SN release is helpful.[3] With the help of the advanced 3D reconstruction technique provided by Amira software, we obtained 3D models that precisely represented actual shoulders. Meanwhile, through the Amira software, we also acquired actual 3D measurements, which were used to measure the distance or area directly, regardless of the position of the model. We measured the mean distance from anatomical landmarks to the SSN. All measurements were performed on 3D-reconstructed models created using advanced software. It allowed us to perform measurements directly on the 3D models, regardless of the positioning of the models and any irregularities in the models, making our results more convincing and accurate. This method can address the constraints inherent in conventional morphological analysis utilizing cadaver specimens or standard CT scans, thereby enabling improved anatomical analysis. Our results showed that the mean distance from the articular surface of the glenoid to the SSN in patients with type I SSN was much shorter than that in patients with other types. When performing arthroscopic SN decompression on patients with type I SSNs, surgeons should avoid far medial dissection.

We found that the average width of the type II SSN (shallow V-shaped notch) was the widest, and the average depth of the type V SSN (partial ossification of the STSL) was the deepest. Studies have shown that the width and depth of the SSN are about twice the diameter of the SN.[23] Dunkelgrun et al.[24] believed that the U-type SSN had a relatively large area to allow the SN to pass through it, while the bottom of the SSN was relatively smooth, so the friction of the SN is less than that seen in type IV (deep V-shaped SSN). When the surrounding soft tissues are damaged, swelling and compression occur in the SSN because of inflammatory reactions, which lead to repeated stretching and frictional damage to the SN when patients move their upper extremities.[25] In addition, ossification of the STSLs can narrow the suprascapular foramen and compress the underlying SN. The accompanying suprascapular arteries and veins may also cause such compression.[26] Clinical observations have also shown that most patients with suprascapular neuropathy have a narrow SSN.[1,7] Therefore, the morphological and anatomical characteristics of the SSN and its classification should be considered before arthroscopic procedures.

There have been many studies on the morphology and classification of the SSN, the results of which vary between different countries and populations. In 1979, Rengachary et al.[7] proposed an oft-cited classification system that divides the SSN into 6 types according to shape. They also concluded that U-shaped notches are the most common, accounting for 48% of cases, and narrow V-shaped notches are the least common, accounting for about 3%. They suggested that the V-shaped notch is the narrowest type and the leading cause of suprascapular neuropathy. Since then, many cadaveric studies of SSN-related classification of ethnic groups in different countries have been reported. Agrawal et al.[5] divided the SSN into 5 types through a study of 728 samples of dry cadaver scapulae from North Indians; Bayramoglu et al.[6] reported 5 types of SSN, common to Nigerians; and other researchers investigated the SSN classification of Italians,[27] Greeks,[28] and Americans.[29] However, these studies have limitations in that they were performed by dry scapula of cadavers, and there is no study on the morphological classification of SSN in the Korean population, especially in patients with rotator cuff tears. According to Rengachary's classification, all 6 SSN types were observed in the current study. The morphology of the SSN was, to some extent, correlated with the patient's age.[23] Patients with type V and VI SSN were older than others. This may be due to the gradual ossification of the STSLs with aging, which leads to the closure of the SSN. These findings are consistent with those of previous studies.[25] In other previously reported studies, type I was reported in a relatively small number, and type III to IV accounted for the majority. However, type I was the most dominant type in this study, and the frequency of ossification (type VI) was about 6%, similar to the previous reports.[27,29] There may be differences in that this study analyzed patients with rotator cuff tears, and it is thought that there may also be racial differences, but further research is needed.

The current study has some limitations. First, all patients in this study came from the same institution, which may have resulted in a regional limitation. Further multicenter research is necessary to increase the sample size and diversity. Second, due to the limitations of the reconstruction technique and data source, we could not build a high-resolution reconstructed 3D model based on the MRI data. The soft tissues, such as muscles, blood vessels, and ligaments, were not analyzed. Thin-slice MRI data and updated software could be used to address this problem. Third, all results of the current study were based on patients with rotator cuff tears, so our conclusions, especially the classification system, may not be applicable to the general population.

In the 3D morphological analysis, age was the independent factor associated with STSL ossification in patients who underwent arthroscopic rotator cuff repair. Type VI showed significantly shorter transverse diameters than other types. Type I showed a significantly shorter distance from the articular surface of the glenoid to the SSN than other types.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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ORCID

Kyu Cheol Noh https://orcid.org/0000-0001-8738-2977
Sanghyeon Lee https://orcid.org/0000-0002-7272-9744
Jung-Youn Kim https://orcid.org/0000-0002-9194-6525

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