Anatomical and Ultrasonographic Analyses of the Levator Labii Superioris Alaeque Nasi Muscle at the Level of the Nasal Ala

Hyun Jin Park & Mi-Sun Hur

SUMMARY: We aimed to determine the width of the levator labii superioris alaeque nasi muscle (LLSAN) at the level of the nasal ala through cadaveric dissections and ultrasonography (US), to provide essential anatomical information for use during both invasive and noninvasive procedures in the nasal ala region. The LLSAN was investigated in the 40 hemifaces of 20 Korean cadavers, comprising 10 males and 10 females with a mean age of 73.6 years. The LLSAN width of the 40 specimens at the level of the midpoint of the nasal ala was 5.02±2.35 mm (mean±standard deviation), and ranged from 1.45 mm to 10.11 mm. The LLSAN widths were 5.96±2.36 mm and 3.93±1.89 mm in males and females, respectively, with ranges of 2.40–10.11 mm and 1.45–6.96 mm, respectively. The LLSAN widths on the left and right sides were 4.77±2.72 mm and 5.26±1.99 mm, respectively. The proportions of the LLSAN fibers inserting into the nasal ala and upper lip were similar in 13 specimens (32.5 %), while more fibers inserted into the nasal ala in 11 specimens (27.5 %) and more fibers inserted fibers of the LLSAN into the upper lip in 16 specimens (40 %). When clinicians need to target or avoid the LLSAN, the present width and range data can be helpful for ensuring the efficacy and safely of both invasive and noninvasive procedures. In addition, the possibility of asymmetry in the width of the LLSAN in the nasal ala region should be confirmed by US before performing such procedures.

KEY WORDS: Levator labii superioris alaeque nasi muscle; Nasal ala; Upper lip.

INTRODUCTION

The levator labii superioris alaeque nasi muscle (LLSAN) originates from the frontal process of the maxilla and runs parallel with the nose. As the LLSAN descends, a proportion of its fibers insert into the skin and the greater alar cartilage of the nose, while the main proportion pass obliquely downward to the skin and musculature of the upper lip (Morris, 1947; Hollinshead, 1982). According to an electromyography study of the nasal muscles, the LLSAN is more closely related to facial expression than to respiratory function (Bruintjes et al., 1996). The LLSAN is a superficial elevator muscle of the nose and the upper lip utilized in oral-facial expression (Delle Chiaie, 2021). Since the LLSAN is the only facial muscle that raises the upper lip and the nasal ala superiorly and medially, this muscle can play an important role in expressions involving the nose and lips moving simultaneously in the midface area.

The LLSAN is one of important muscles targeted in botulinum-toxin injections for excessive gingival display (also called gummy smile) and for modifying the nasolabial folds (NLFs) (Pessa & Brown, 1992; Hwang et al., 2009; Nasr et al., 2016; Myung et al., 2021). Facial reconstruction surgeries such as the pedicled LLSAN flap, LLSAN-nasalis island flap, and the LLSAN flap also utilize the LLSAN for reconstructing nasal and vermilion defects (Kuwahara et al., 2018; Moore 2nd et al., 2019; Iyer et al., 2021). Thus, knowledge of the width of the LLSAN is required to ensure safe and effective surgical procedures and outcomes.

In the present study, we aimed to determine the width of the LLSAN at the level of the nasal ala through cadaveric dissections and ultrasonography (US), to provide essential anatomical information for use during both invasive and noninvasive procedures in the nasal ala region.

MATERIAL AND METHOD

Cadaveric investigation of the LLSAN at the level of the nasal ala. The LLSAN was investigated in the 40 hemifaces of 20 Korean cadavers, comprising 10 males and...
10 females with a mean age of 73.6 years (age range 40–94 years). None of the cadaveric specimens had congenital malformations, pathological findings, or a history of surgery or trauma. The study was conducted in accordance with the ethical principles for medical research involving human subjects of the Declaration of Helsinki. All authors were well informed about the WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects, and confirmed that the present study was consistent with that declaration. The study was approved by the Institutional Review Board (IRB) of Catholic Kwandong University (IRB number CKU-21-01-0803).

The facial skin, subcutaneous layer, and midface muscles were carefully dissected. The LLSAN width was measured from the midpoint of the nasal ala to the lateral margin of the muscle. All measurements were made using digital calipers (Digital Electronic Caliper, Fine Science Tools, Heidelberg, Germany).

Differences in the LLSAN width between males and females or between left and right sides were analyzed statistically using the Kruskal–Wallis test, with P<0.05 considered to indicate statistical significance. Statistical calculations were carried out using PRISM software (version 3.0.3, GraphPad Software, San Diego, CA, USA).

US of the LLSAN at the level of the nasal ala. US scans of four volunteers (two males and two females; mean age 34.3 years) were obtained with a real-time two-dimensional B-mode US device (ECUBE 15, Alpinion Medical Systems, Seoul, Korea) with a high-frequency hockey-stick transducer (8–15 MHz; IO8-17T, Alpinion Medical Systems). Each volunteer was placed in the Fowler’s position, and facial landmarks were marked on the face. Nontoxic ultrasonic gel (Meditop Sono Jelly, Meditop, Seoul, Korea) was applied before the US scanning process. Volunteers were recruited via a bulletin-board announcement by Catholic Kwandong University. All volunteers were given detailed verbal and written explanations about the experiment, and the researchers in charge answered any questions that the volunteers had before the experiment started. Volunteers who had undergone orthopedic surgery or cosmetic surgery in the facial region were excluded, as were patients with allergies related to ultrasonic gels or diseases such as skin cancer. US scanning was performed at the midpoint of the nasal ala.

RESULTS

The LLSAN width of the 40 specimens at the level of the midpoint of the nasal ala was 5.02±2.35 mm (mean±standard deviation), and ranged from 1.45 mm to 10.11 mm (Fig. 1). The LLSAN widths were 5.96±2.36 mm and 3.93±1.89 mm in males and females, respectively, with ranges of 2.40–10.11 mm and 1.45–6.96 mm, respectively. The LLSAN widths on the left and right sides were 4.77±2.72 mm and 5.26±1.99 mm, respectively (Table I). The LLSAN widths on the left and right sides exceeded 5 mm in seven cadavers (35.0 %; five males and two females), and were smaller than 3 mm in three cadavers (15.0 %; two females and one male). The LLSAN was...
significantly wider (by approximately 1.5-fold) in males than in females, but there was no statistically significant difference between the left and right sides.

Width asymmetries exceeding 3 mm between the left and right sides were found in 5 of 20 cadavers (25 %; 2 males and 3 females). The width asymmetry of the LLSAN between the left and right sides was 2.0±1.8 mm (range 0.1–7.7 mm). There was no significant difference in the asymmetry ratio between males and females.

The proportions of the LLSAN fibers inserting into the nasal ala and upper lip were similar in 13 specimens (32.5 %), while more fibers inserted into the nasal ala in 11 specimens (27.5 %) and more fibers inserted fibers of the LLSAN into the upper lip in 16 specimens (40 %) (Fig. 2).

The US scans at the midpoint of the nasal ala revealed that the total thickness of the skin, subcutaneous tissue, and LLSAN was 0.43±0.08 mm (range 0.33–0.49 mm), while the thickness of the skin and subcutaneous tissue was 0.37±0.07 mm (range 0.25–0.42 mm), and the thickness of the LLSAN was 0.06±0.01 mm (range 0.04–0.07 mm) (Fig. 3 and Table II).

Table I. LLSAN width at the midpoint of the nasal ala (unit: mm).

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
<td>Total</td>
<td>Right</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>5.66±2.17</td>
<td>6.27±2.64</td>
<td>5.96±2.36</td>
<td>4.80±1.80</td>
</tr>
<tr>
<td>Minimum</td>
<td>2.40</td>
<td>2.61</td>
<td>2.40</td>
<td>2.35</td>
</tr>
<tr>
<td>Maximum</td>
<td>8.36</td>
<td>10.11</td>
<td>10.11</td>
<td>6.96</td>
</tr>
</tbody>
</table>

Maximum 0.49 0.42 0.07
Mean±SD 0.43±0.08 0.37±0.07 0.06±0.01

(1992) reported the LLSAN as the primary facial muscle treatments aimed at modifying the NLFs. Pessa and Brown addition, the LLSAN is an excellent target structure for be effective for clinically treating gummy smile. In the three muscles was proposed, and was demonstrated to point for botulinum toxin around the converging area of LLSAN, and zygomaticus minor muscle—converge in the elevator muscles—levator labii superioris muscle (LLS), the target of treatments for gummy smile. The three lip lateral margin of the LLSAN at the level of the nasal ala. thought that the artery of the pedicle is located near the ala is located slightly lateral to the nasal sill. Thus, it is 1.45–10.11 mm). The most prominent point of the nasal was the superior labial artery just deep to the LLSAN and (2019), reported that the source of the vascular pedicle procedures and reconstructive surgeries. Moore 2nd the skin (within 0.4 mm) at the level of the nasal ala. This means that the difference between the minimum and maximum LLSAN widths was approximately 10 mm, and that the maximum LLSAN width was almost twice the mean width. The combined depth of the skin and subcutaneous tissue was a mean of 0.37 mm, while the total depth of the skin, subcutaneous tissue, and LLSAN was a mean of 0.43 mm. Thus, the LLSAN is very close to the skin (within 0.4 mm) at the level of the nasal ala.

The LLSAN has clinical implications in aesthetic procedures and reconstructive surgeries. Moore 2nd et al. (2019), reported that the source of the vascular pedicle was the superior labial artery just deep to the LLSAN and that the pedicled LLSAN flap provides a durable reconstructive option that only requires a single stage of reconstruction. Those authors reported that the mean distance from the lateral margin of the nasal sill laterally to the pedicle was 6.3 mm (range 0–12 mm) and that almost all pedicles were located were within 1 cm laterally to the nasal sill, while there was more variation in the depth of the pedicle. In the present study, the mean width of the LLSAN at the level of the nasal ala was 5.02 mm (range 1.45–10.11 mm). The most prominent point of the nasal ala is located slightly lateral to the nasal sill. Thus, it is thought that the artery of the pedicle is located near the lateral margin of the LLSAN at the level of the nasal ala.

Hwang et al. (2009), reported that the LLSAN is the target of treatments for gummy smile. The three lip elevator muscles—levator labii superiors muscle (LLS), LLSAN, and zygomaticus minor muscle—converge in the area lateral to the ala. A safe and reproducible injection point for botulinum toxin around the converging area of the three muscles was proposed, and was demonstrated to be effective for clinically treating gummy smile. In addition, the LLSAN is an excellent target structure for treatments aimed at modifying the NLFs. Pessa and Brown (1992) reported the LLSAN as the primary facial muscle responsible for producing the medial NLF, and also suggested that the LLSAN and LLS contribute significantly to the etiology of the prominent NLFs that occur with aging. In addition, the constant pull of the LLSAN will deepen the NLFs over time (Chiaie, 2021).

DISCUSSION

This study investigated the width and depth of the LLSAN at the level of the nasal ala, where several procedures are performed that target this muscle. The LLSAN width varied markedly at the level of the nasal ala, from 1.45 mm to 10.11 mm, with a mean of 5.02 mm. This means that the difference between the minimum and maximum LLSAN widths was approximately 10 mm, and that the maximum LLSAN width was almost twice the mean width. The combined depth of the skin and subcutaneous tissue was a mean of 0.37 mm, while the total depth of the skin, subcutaneous tissue, and LLSAN was a mean of 0.43 mm. Thus, the LLSAN is very close to the skin (within 0.4 mm) at the level of the nasal ala.

This study investigated the width, depth, and insertion ratio of the LLSAN at the midlevel of the nasal ala, which is a frequently used injection point for botulinum-toxin treatments and a major surgical area in nose and upper-lip reconstruction. When targeting the LLSAN at the level of the nasal ala, it is suggested that needle injections be performed within 5 mm laterally and at a depth of 0.4 mm. When clinicians need to target or avoid the LLSAN, the present width and range data can be helpful for ensuring the efficacy and safety of both invasive and noninvasive procedures. In addition, the possibility of asymmetry in the width of the LLSAN in the nasal ala region should be confirmed by US before performing such procedures (Fig. 3).

CONCLUSION

This study investigated the width, depth, and insertion ratio of the LLSAN at the midlevel of the nasal ala, which is a frequently used injection point for botulinum-toxin treatments and a major surgical area in nose and upper-lip reconstruction. When targeting the LLSAN at the level of the nasal ala, it is suggested that needle injections be performed within 5 mm laterally and at a depth of 0.4 mm. When clinicians need to target or avoid the LLSAN, the present width and range data can be helpful for ensuring the efficacy and safety of both invasive and noninvasive procedures. In addition, the possibility of asymmetry in the width of the LLSAN in the nasal ala region should be confirmed by US before performing such procedures (Fig. 3).
REFERENCES


Corresponding author:
Mi-Sun Hur, PhD
Department of Anatomy
School of Medicine
Daegu Catholic University
Daegu
KOREA
E-mail: mshur@cu.ac.kr