



The extended fibers of the alar part of the nasalis connect to the levator labii superioris, zygomaticus minor, and skin adjacent to the nasal ala

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Abstract

Purpose This study aimed to elucidate the positions of the extended fibers of the alar part of the nasalis (Na), and their connections to the levator labii superioris (LLS), zygomaticus minor (Zmi), and adjacent skin near the nasal ala.

Methods The extended fibers of the Na were investigated in 54 specimens obtained from 27 embalmed adult South Korean cadavers.

Results In 51.9% of the specimens, some fibers of the Na extended over the alar facial crease, intermingling or blending with the LLS or Zmi, and attached to the skin lateral to the nasal ala. The quantity and distribution of these extended fibers varied: some fibers of the Na extended and intermingled or blended with the LLS in 25.9%, while another 25.9% exhibited the Na extending in a distinctive fan shape with longer fibers, and combining with both the LLS and Zmi. However, the Na had no extended fibers that reached the LLS, Zmi, or skin near the nasal ala in 48.1%.

Conclusion Contraction of the Na and its extended fibers can influence the nasal ala and also the laterally located skin and muscles, directing them inferomedially toward the incisive fossa of the maxilla, which is the origin of the nasalis. These insights offer a deeper understanding of the role and actions of facial muscles in facial expression. They will be instrumental in the comprehension and analysis of nose and mouth movements, and in conducting electromyographic analyses in this region.

Keywords Alar part of the nasalis · Levator labii superioris · Zygomaticus minor · Nasal ala

Introduction

The nasalis, a major intrinsic nasal muscle, comprises two parts: the alar and the transverse [8, 13–15]. The alar part of the nasalis (Na) assists in nares dilatation, while the transverse part of the nasalis (Nt) compresses the nose, contracts the nostrils, and narrows the vestibules [2, 7]. Standring described that the Na elongates the nose, and Griesman stated that this is caused by both the Na and Nt [6, 15].

Conversely, Morris described that the Na pulls the nostril down, while the Nt pulls it laterally and upward [13].

In the literature it is reported that the Na attaches to the maxilla above the lateral incisor and canine, medial to the Nt, and the Nt attaches to the maxilla above and lateral to the incisive fossa [8, 13, 15]. Wu and Yin found that the Na and Nt originate from the incisive fossa [18]. Hur et al. found that the Na originates alongside the Nt from the maxilla, ascending to attach to the alar facial crease and the adjacent deep surface of external alar lobule skin [11]. They also found that the anterolateral muscle fibers of the Na ascend anterolaterally, penetrating between the medial fibers of the levator labii superioris (LLS) and occasionally attaching to the midface skin adjacent to the nasal ala. However, there have been no detailed reports on the prevalence and anatomical features of the extended fibers of the nasalis.

Understanding the action and clinical significance of the Na requires the extended fibers of the Na to be characterized.

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The action of the Na has been described slightly differently previously. Standing found that the Na pulls the alae and the posterior part of the columella downward and laterally, thereby assisting in widening the nares [15]. However, Hur et al. found that the Na ascends superolaterally and attaches to the alar facial crease, primarily pulling the ala inferomedially [11]. Ozturan et al. found that the Na moves the ala and dilates the valve area by pulling the hinge area laterally, with activity occurring during normal respiration [14].

Clinically, damage to the Na can cause the external nasal valve to collapse [7]. Moreover, wedge excisions for alar base reduction, which are performed at the site that covers the alar facial crease where the Na attaches, can impact the attachment and action of the muscle and its extended fibers [12, 16]. The nasalis is also crucial in correcting cleft lip deformities [1, 17]. Attia et al. demonstrated improved nasal symmetry by dissecting both the origin and abnormal insertion of the nasalis, and repairing the origin [1].

The movements of the nose and mouth are both larger and more delicate in the area near the nasal ala, which is the site of the Na. These movements involve both the nasalis and upper lip elevators such as the levator labii superioris alaeque nasi (LLSAN), LLS, and zygomaticus minor (Zmi). It is therefore vital to analyze the anatomical relationships among the extended fibers of the Na in order to understand nose and upper lip movements, as well as facial expressions.

The aim of this study was to elucidate the positions of the extended fibers of the Na and their connections to the LLS, Zmi, and skin adjacent to the nasal ala. Such information will enhance our understanding of nose and mouth movements and aid in various surgical procedures for this area, such as cleft lip surgery and electromyographic analyses.

Materials and methods

The extended fibers of the Na were investigated in 54 specimens obtained from 27 embalmed South Korean adult cadavers, comprising 15 males and 12 females. The mean age of the cadavers was 73 years, with an age range of 40 to 94 years. Muscles of the midface including the nose and upper lip were removed from the facial bones. The inner surfaces of these muscles were carefully dissected under a surgical microscope (OPMI 1FC, Carl Zeiss, Oberkochen, Germany).

The Nt, located deep to the nasal ala, was inferomedially reflected. The infraorbital nerves and arteries and the connective tissue between the LLS and Na were subsequently removed to expose the extended fibers of the Na. The Na, which attaches to the alar facial crease, was identified, along with its extended fibers. The number of and anatomical relationships among the extended fibers of the Na were

also examined along with its surrounding structures. These extended fibers were traced to determine their courses and attachment sites.

All cadavers were legally donated to the Catholic Kwandong University College of Medicine. The study was conducted in accordance with the Declaration of Helsinki. No cadaver donor was from a vulnerable population, and each donor or their next of kin provided written informed consent. This study received approval by the Institutional Review Board of the Catholic Kwandong University (no. CKU-21-01-0403).

Results

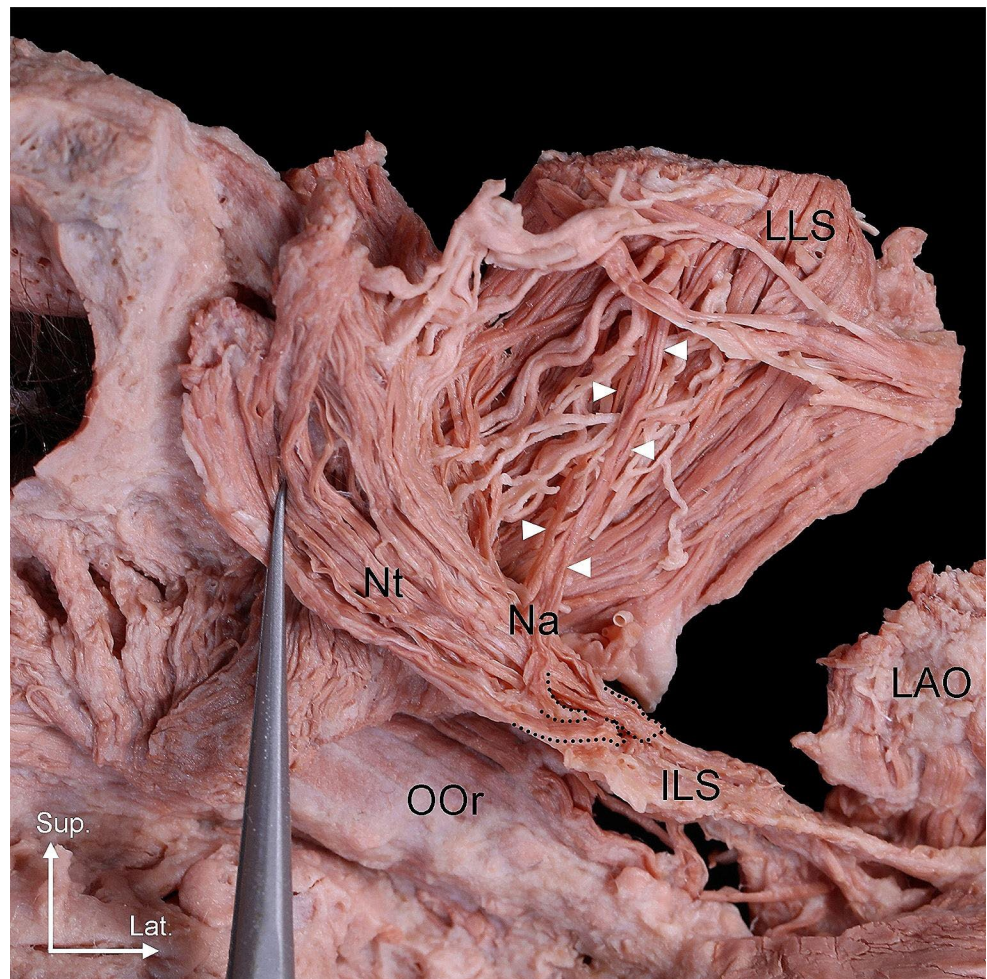
Some fibers of the Na extended over the alar facial crease, combining or blending with the LLS or Zmi. The intermingled fibers attached to the skin lateral to the nasal ala in 28 of the 54 specimens (51.9%). This type of extended fiber was present in 16 of 27 cadavers (9 males and 7 females): bilaterally in 13 (8 males and 5 females) and unilaterally in 3 (1 male and 2 females).

The extended fibers of the Na traversed the infraorbital plexus before blending or combining with the LLS. These sporadically arranged fibers were enveloped by the infraorbital plexus, embedded in fat and connective tissue, and positioned deep to the LLS (Fig. 1). The fibers of the Na that intermingled with the LLS passed through the inserting fibers of the LLSAN, positioned lateral to the inserting fibers of the LLSAN near the nasal ala or the medial nasolabial fold.

The quantity of these extended fibers varied among specimens, as shown in Fig. 2, and were categorized into the following types:

1. Type I ($n = 14$, 25.9%), in which some fibers of the Na extended and intermingled or blended often with the medial fibers and sometimes with the lateral fibers of the LLS.
2. Type II ($n = 14$, 25.9%), in which some fibers of the Na extended in a fan shape with distinctive, longer fibers, then intermingled or blended with both the LLS and Zmi. The fibers were located between the alar facial crease and the incisivus labii superioris.
3. Type III ($n = 26$, 48.1%), in which the Na had no fibers extending to the LLS, Zmi, or skin near the nasal ala.

Fig. 1 The extended fibers (arrowheads) of the alar part of the nasalis (Na) traverse the infraorbital plexus before blending or combining with the levator labii superioris (LLS). These sporadically arranged fibers are enveloped by the infraorbital plexus, embedded in fat and connective tissue, and positioned deep to the LLS. The transverse part of the nasalis (Nt) was posteromedially reflected to reveal the Na and its extended fibers. *ILS* incisivus labii superioris, *LAO* levator anguli oris, *OOr* orbicularis oris, *Lat.* lateral, *Sup.* superior



Discussion

This study has revealed the intricate anatomical relationships between the Na and adjacent facial structures, particularly the LLS, Zmi, and skin near the nasal ala. Extended fibers of the Na were found in 51.9% of the specimens in the present study with varying numbers of muscle fibers that blended or interdigitated with the adjacent muscles. These extended fibers appeared to be a specialized component of the nasal muscles that enable delicate and intricate movements in the nasolabial area. This finding could have implications for surgical procedures in this area, particularly in cases where both muscle function and cosmetic outcomes are of paramount importance such as in cleft lip repair.

An electromyography (EMG) study found the Na to be particularly active while the nose is pulled down [3]. The upper lip elevators include the LLS, LLSAN, and Zmi, which are lateral to the nasal ala. However, no depressor muscle exists to pull the skin and upper lip downward. The extended fibers of the Na, especially in its fan-like shape, may therefore assist in pulling the area lateral to the nasal ala toward the incisive fossa, which complements the Na

moving the nasal ala. Moreover, the extended fibers may transfer tension to the skin and muscles lateral to the nasal ala when the nose is pulled downward. The extended fibers attached to the dermis near the medial nasolabial fold were often also attached to the skin near the nasal ala after combining with the LLS. It was therefore thought that the medial nasolabial fold may deepen further when the extended fibers of the Na contract.

This pattern of extended fibers in the Na was also similarly found in a previous study, in which the author noted that some short muscle fibers branched from the superficial part of the originating fibers of the incisivus labii inferioris (ILI) and its inferior bundle [10]. These short muscle fibers descended inferolaterally, and intermingled with the depressor labii inferioris and attached to the skin adjacent to the inferior margin of the ILI. These intermingled fibers were observed in 78.8% of the specimens in varying quantities. These short muscle fibers originating from the ILI and its inferior bundle in the mandible appeared to correspond to the extended fibers of the Na observed in the maxilla in the present study. While the extended fibers of the Na may inferomedially pull the skin and muscles lateral toward the

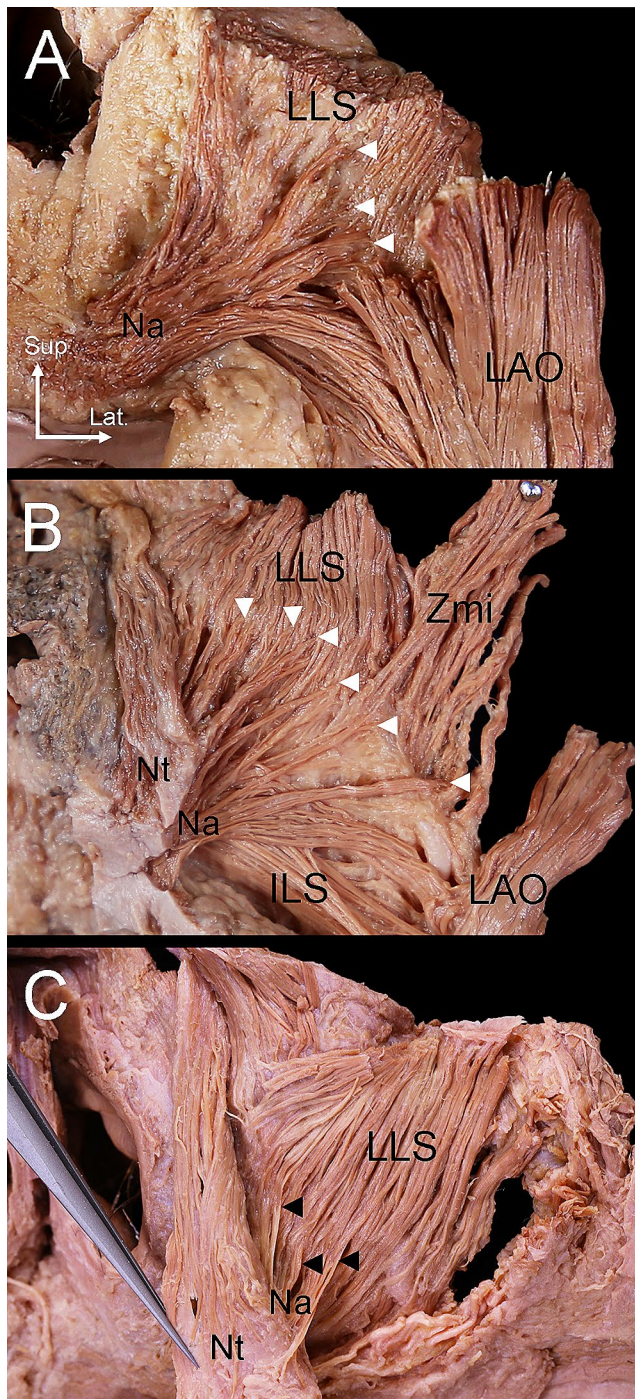


Fig. 2 The extended fibers of the Na relative to the LLS and zygomaticus minor (Zmi). (A) Some fibers (white arrowheads) of the Na ascended superolaterally to combine or blend with the deep fibers of the LLS. (B) Some fibers (white arrowheads) of the Na ascended superolaterally to combine or blend with the deep fibers of both the LLS and Zmi. (C) In contrast, the Na (black arrowheads) had no fibers extending to the LLS, Zmi, or skin near the nasal ala. The Na ascended to attach to the alar facial crease. The Nt was medially reflected to reveal the Na. *Lat.* lateral, *Sup.* superior

nasal ala, the short muscle fibers from the ILI and its inferior bundle may have the opposite effect, superomedially lifting the skin and muscles.

The intrinsic and extrinsic nasal muscles both contribute significantly to facial expression and nasal wall rigidity [14]. The EMG study conducted by Bruintjes et al. found that the functions of the nasalis, dilator naris, and apicis nasi were strongly related to respiration, with muscle activity being prominent during inspiration and increasing during exercise [3]. Those authors also suggested that these muscles probably play a role in preventing nasal valve collapse. The extended fibers of the Na may therefore be more involved in assisting the pulling of the skin lateral toward the nasal ala during heavy breathing with nasolabial movements.

The attachment of the Na is relevant in several surgical procedures. Regarding cleft lip, the Na and Nt are shifted downward and laterally from the nasal dorsum to the anterior surface of the maxilla and mixed with the facial expression muscles of the same side [17]. Attia et al. found that dissection and repair of both the origin and insertion points of the nasalis muscle can cause the nasal width, columellar height, and nasal tip projection to be similar to those of the normal population within the same age group [1]. This highlights the importance of understanding the normal anatomy of the Na and its extended fibers for cleft lip correction surgery.

Alar base reduction is also performed when the nasal base is too wide. Alar base reduction with alar wedge excision involves removing a wedge of tissue from the nostril base. Alar wedge excision with V-Y advancement (involving a V-shaped incision and Y-shaped closure) also involves the skin near the nasal ala and the alar facial crease. The edge of the nasal ala is then pulled inward to narrow the nasal base, and is fixed using sutures [12, 16]. The alar facial crease is also incised to correct hanging ala [5]. Given that the Na is attached to the alar facial crease, the Na and its extended fibers can both be affected and repositioned when the incision made in the alar facial crease is sutured. Knowledge of the extended fibers of the Na and their connections may therefore influence surgical techniques, and could help in obtaining more-natural outcomes by preserving or reconstructing the functional anatomy. This could improve both aesthetic aspects and functional ones such as nasal breathing.

The nasalis of chimpanzees and gorillas is well defined but not further differentiated and has become fully independent of the buccolabial musculature [4]. In contrast, the Nt and Na components are often still found in humans in a broad, primitive connection with the m. caninus-orbicularis oris [9]. The extended fibers of the differentiated Na in humans may therefore be closely associated with facial expression and delicate movements of the nose and mouth.

In conclusion, contraction of the Na along with its extended fibers can pull both the nasal ala but also the skin and muscles located lateral to the nasal ala, directing them inferomedially toward the incisive fossa of the maxilla, which is the origin of the nasalis. These findings provide precise and valuable insights into the actions of facial muscles and expressions, and will be useful in comprehending and analyzing nose and mouth movements, and in conducting electromyographic analyses in this area.

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Author contributions H.J.P.: Conceptualization; Investigation; Methodology; Data Curation; Formal analysis; Writing; Visualization; Resources. M.S.H.: Conceptualization; Investigation; Methodology; Data Curation; Formal analysis; Writing; Visualization; Resources; Supervision; Project administration. All authors reviewed the manuscript.

Data availability No datasets were generated or analysed during the current study.

Declarations

Ethical approval This study received approval from the Institutional Review Board of the Catholic Kwandong University (IRB No. CKU-21-01-0403).

Competing interests The authors declare no competing interests.

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