An Anatomical Study of the Nasal Superficial Musculoaponeurotic System

Surgical Applications in Rhinoplasty

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Objective: To give a unifying description of nasal muscles and ligaments corresponding to anatomical and surgical findings such as the dermocartilaginous ligament described by Pintanguy in 2001.

Methods: In 30 fresh cadavers of white individuals, nasal dissections were performed, divided into 3 different approaches: from radix to nasal tip, from nasal tip to radix, and from midline to lateral. The anatomical and surgical planes of dissection were followed to isolate the nasal superficial musculoaponeurotic system (SMAS). Correlations between the nasal SMAS and the nasal framework were noticed. In 9 specimens, the left nasal wall was resected for histologic examination.

Results: The nasal SMAS consists of a unique layer, and it divides at the level of the nasal valve into deep and superficial layers. Each layer has medial and lateral components. The dermocartilaginous ligament corresponds to the deep medial expansion. Both the deep and the superficial medial expansions correspond to the lowering ligaments of the nasal tip; the cephalic rotation of the nasal tip is allowed by their cut. The histological examination showed that the deep lateral expansion is composed of fat.

Conclusions: This description of the nasal SMAS explains the relationship between the nasal muscles and ligaments, including the dermocartilaginous ligament described by Pitanguy. Furthermore, it is helpful to surgeons during rhinoplasty.

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Many articles have discussed the nasal muscles, which form the so-called nasal superficial musculoaponeurotic system (SMAS). The insertions and the functions of these muscles have been widely described,1-3 but, in our opinion, there is a lack of a united concept of muscles and ligaments of the nose. We demonstrate:

1. The existence of the nasal SMAS, an anatomical structure that unifies the different muscular and ligamental anatomical components overlying the bony and cartilaginous nasal framework;
2. That this anatomical structure is a continuous layer that extends from the glabellar region to the nostril margin;
3. That at the level of the internal nasal valve it is possible to identify a superficial and a deep nasal SMAS layer, each one with medial and lateral components.

Basing our opinion on many cadaver dissections performed during the senior author’s (Y.S.) surgical and anatomical career, we hypothesize that the nasal SMAS does exist and that the ligament described by Pitanguy4 in 2001 is part of this whole structure; in particular, it would be the deep medial expansion of the nasal SMAS. Anatomical explanations have a critical impact on surgical procedures because to obtain the best nasal tip definition and rotation, it is necessary to operate on the components of the nasal SMAS.5,6 From the methodological point of view, it is fundamental to perform the dissection of this area using the anatomical approach and not the surgical approach. In fact, the surgical approach causes the disruption of the anatomical nasal structures and makes the study and description of them impossible. Furthermore, dissection can be performed in different planes. Five distinct layers above the cartilaginous and bony nasal structure have been described7,8; we have found the same layers: the skin, the superficial areolar layer, the fibromuscular layer, the deep areolar layer, and the perichondral (periosteal) layer. The dissection can be performed in the subcutaneous, sub-SMAS, and subperichondral planes. The plane of the dissection influences the understanding of the links between the anatomical components of the nasal SMAS.
METHODS

This study was divided into (1) a cadaver dissection section and (2) a histologic analysis section using light microscopic examination of fresh nasal tissue excised from the nasal lateral wall of 9 specimens.

CADAVER DISSECTION

Detailed dissections were performed at the anatomy laboratory at the School of Medicine, University of Nice, Nice, France. For this study, 30 white fresh cadavers were examined. The dissections were performed in 3 different anatomical planes: the subcutaneous, the sub-SMAS, and the subperichondral. Three different approaches were used: the radix to nasal tip (cranial-caudal) approach, the nasal tip to radix (caudo-cranial) approach, and the midline to lateral approach.

1. In 10 specimens, the skin was incised in the midline. In 5 specimens, the subdermal dissection was performed on the right side of the specimens in the subdermal, proceeding from the midline laterally. In another 5 specimens, the same procedure was performed on the left side. The skin was then excised on this side, exposing the nasal SMAS. Next, the nasal SMAS was incised in the midline, allowing sub-SMAS dissection from the midline laterally. Eventually, a subperichondral dissection was performed. The opposite side in 9 specimens was left intact until the end of the procedure. Then the lateral wall of this untouched side was resected to perform the histologic examination. In 1 specimen, the sub-SMAS dissection of the left side was performed to show the correlation between the histologic and anatomical findings.

2. In 10 specimens, subcutaneous and sub-SMAS dissections were performed using a cranial-caudal approach through the glabellar cutaneous incision; in another 10 specimens, the procedure was performed from the columella to radix. A transcolumellar incision and a rim incision were used, and subdermal dissection was performed. This anatomical approach differs from the surgical external rhinoplasty approach, which interrupts the subcutaneous layer that lies between the skin and the anterior border of the medial crura. This approach transcends the small arteries running in the columella before the sub-SMAS dissection is performed.

HISTOLOGIC ANALYSIS

Histologic examination of 9 specimens excised from the left lateral nasal wall (from the medial canthus to the nostril rim), including layers of this area, was performed. The tissues were immediately fixed in 10% formalin. After decalcification in 5% chlorhydric acid, the specimens were embedded in paraffin, and Masson trichrome stain was used. Microsections of the specimens were performed, then the sections were observed under light microscopy.

RESULTS

CADAVER DISSECTION

Incision in the Midline

Subdermal Dissection. A continuous musculo-aponeurotic layer, which connected the nasal muscles to the facial SMAS, was exposed. It covered the whole nose, from the radix to the nostril rim, and continued medially on the columella. At this level, it was superficial to the caudal border of the medial crura of the lower lateral carti-

Figure 1. Right lateral view. The superficial aspect of the nasal superficial musculoaponeurotic system: the nasal muscles (black arrow, the procerus; blue arrow, the levator labii alaeque nasi muscle and the orbicularis oculi muscle; red arrow, transverse nasalis muscle. All of these muscles are linked by the nasal aponeurosis.

Figure 2. Basal view of the superficial medial layer of the nasal superficial musculoaponeurotic system. This layer is penetrated by vascular elements lying immediately beneath the dermis (black arrow).
lage (LLC), and it met the depressor septi nasi muscle just anterior to the anterior nasal spine (Figure 1 and Figure 2).

The subcutaneous layer was easily undermined from the nasal SMAS layer. Only subcutaneous fat was noticed in this plane, and it was more abundant in the supra-nasal tip area, as presented in widely accepted anatomical and surgical descriptions.

Blunt dissection between the dermis and the musculo-aponeurotic layer was impossible in the area of the dilator nasi muscle, and it was necessary to use a sharp scalpel dissection to separate these anatomical structures. Fibers of the dilator naris muscle intermingle with the SMAS fibers at the level of the junction of these 2 structures.

Sub-SMAS Dissection. Incision of the nasal SMAS in the midline was performed in 10 specimens, and the nasal SMAS was undermined (in 5 specimens on the right side, in the other 5 on the left side) from the bony and cartilaginous framework. Then the nasal SMAS was reflected laterally (Figure 3, black arrow).

The nasal SMAS appears as a unique anatomical layer that is easily dissected (Figure 4). It seems to have an insertion, composed of yellowish tissue different from the reddish muscular layer, onto the nasal skeleton at the level of the internal nasal valve (Figure 3, red arrow). This different tissue seems to be another, deeper anatomical layer that connects the nasal SMAS to the internal nasal valve.

According to these anatomical observations, laterally, at the level of the internal nasal valve, the nasal SMAS seems to be composed of 2 layers:
1. A superficial layer that continues from the dorsal portion of the nasal SMAS, which is composed of the transverse nasalis muscle. This layer passes over the LLC, and it inserts into the skin of the alar margin. Here, it is very thin and difficult to dissect, and it may be called the superficial lateral layer (or supra-alar layer) of the nasal SMAS (Figure 3, blue arrow);
2. A deep yellowish layer that originates from the nasal SMAS at the level of the internal nasal valve and inserts into this valve. This layer may be called the deep lateral layer (or valve layer) of the nasal SMAS (Figure 3, red arrow).

According to these findings, laterally, the nasal SMAS seems also to be divided into a cranial portion that extends from the frontalis muscle to the internal nasal valve and can be easily dissected and a caudal portion that overlies the LLC and includes superficial and inconstant muscles surrounding the LLC. This part is very thin and difficult to dissect.

Figure 3. Upper nasal superficial musculoaponeurotic system (SMAS). The nasal SMAS before its division (black arrow); note its insertion into the internal nasal valve, which appears yellowish (red arrow). The medial superficial layer covers the lower lateral cartilage (blue arrow) and inserts on to the skin of the alar margin.

Figure 4. Deep aspect of nasal superficial musculoaponeurotic system (SMAS) after sub-SMAS dissection and separation of SMAS insertions at the level of the internal nasal valve (black arrow) and the margin of the nostril (red arrow).
In the same way, medially, at the level of the internal nasal valve, the nasal SMAS seems to divide into a superficial and a deep layer. The deep medial layer runs between the anterior septal angle and the interdomal ligament. It runs in the membranous septum, between the caudal border of the septum and the medial crura of the LLC, toward the anterior nasal spine (Figure 5 and Figure 6). This anatomical structure could correspond to the ligament described by Pitanguy.4 In fact, it is described as a medially located structure, originating in the fascia of the upper third of the nose, which extends down to the domal segment of the middle crus, merging below the inferoanterior portion of the septum.5

The superficial medial layer runs caudally superficial to the caudal border of the medial crura of the alar cartilages to reach and interconnect with some fibers of the depressor septi nasi muscle9 (Figure 7).

Subperichondral Dissection. On the right side of the same specimen, subperichondral dissection was performed after the subcutaneous and sub-SMAS dissections (Figure 8). The perichondrium (periosteum) was elevated and raised with 2 forceps. In this plane, the dissection stopped at the internal nasal valve according to the fusion of the perichondral tissue of the upper lateral cartilage (ULC) and the LLC. There was no evidence of any fibrous tissue running between the cranial margin of the LLC and the caudal margin of the ULC. In fact, the cartilages seemed to be almost continuous.

Cranio-Caudal Dissection

Sub-SMAS Dissection. Subdermal dissection followed by cutaneous excision of the nasal pyramids of 10 specimens was performed, so that complete exposure of the nasal SMAS was obtained. Then, the nasal SMAS was incised at the level of the radix of the nose and laterally toward the medial canthus. The sub-SMAS dissection was performed, and there was evidence that

1. Laterally the dissection could be performed in the same surgical plane up to the internal nasal valve.
2. Medially, the nasal SMAS was easily elevated up to the anterior septal angle without cutting any anatomical structure. At this point, it was not possible to reach the domes directly owing to the presence of vertical anatomical structures. Two planes became apparent: a deep plane and a superficial plane. The dissection in the deep plane was simply performed following the deep aspect of the nasal SMAS anterior to the septum, without cutting it. This dissection led directly to the nasal spine. To dissect toward the domes of the LLC, it was necessary to cut the naso SMAS layer that runs caudally to the anterior septal angle (what we consider the deep medial layer of the nasal SMAS).
The sub-SMAS nasal dissection through cranio-caudal approach shows that the nasal SMAS layer is divided at the level of the internal nasal valve into superficial and deep layers. These layers contain vessels.

Columellar Incision and Cranial Dissection. Ten nasal sub-SMAS dissections were performed using columellar and rim incisions. In 5 specimens, both the subcutaneous and the sub-SMAS dissections were performed to isolate the nasal SMAS layer. The cutaneous incision was placed in the labiocolumellar junction, and the dissection was performed in the subdermal plane over the LLC and cranially to the radix. The incision of the subcutaneous tissue between the dermis and the cartilages was performed just above the cartilaginous structures, as in the open approach. The dissection could be performed up to the anterior nasal septal angle where vertical fibrous bands were noticed, which passed immediately anterior to the anterior septal angle. As described in the previous subsection, 2 planes became apparent: a deep plane and a superficial plane. The dissection in the deep plane was performed following the layer that originates from the nasal SMAS, without cutting it. This dissection directly led to the nasal spine. The dissection in the superficial plane was possible only after cutting the layer as described (which also contains blood vessels), and it allowed us to reach the dorsum. Laterally at the level of the cranial border of the LLC, it was not possible to continue the dissection. To reach the radix, it was necessary to cut or to elevate the yellowish tissue, which inserted onto the internal nasal valve.

In another 5 specimens, only the sub-SMAS dissection in the deep areolar plane, superficial to the perichondral plane, was performed using the transcolumnellar incision. The same anatomical planes became apparent.

HISTOLOGIC ANALYSIS

The histologic examination (Figure 9) of the specimens of the left lateral nasal wall showed the presence of a fatty component between the ULC and the LLC. There was no evidence of any fibrous anatomical structure running between these 2 cartilaginous components. Only the perichondrium of the ULC seemed to be in continuity with that of the LLC.

CADAVER DISSECTION

The cadaver dissection showed the existence of a unique and continuous anatomical layer, the nasal SMAS, consisting of the nasal muscles. These muscles are the transverse nasalis muscle, the procerus, and the compressor naris major and minor. Regarding the levator labii alaeque nasi and the dilator nasi muscles, the discussion is still open, and our opinion is that these muscles connect the nasal SMAS to the facial SMAS. This whole structure overlies the nasal bony and cartilaginous framework and continues from the “frontal SMAS” that consists of the frontalis muscle in this area as a unique layer. At the level of the internal nasal valve, it seems to divide into a superficial layer and a deep layer. Each layer can be divided into medial and lateral expansion.

The superficial layer of the nasal SMAS passes superficially over the LLC: laterally, it inserts into the skin of the alar margins, and medially, it joins the depressor septi nasi muscle at the nasolabial angle (Figure 10).

The deep layer of the nasal SMAS runs deep to the superficial layer; laterally, it inserts into the internal nasal valve with a fatty component; medially, it passes immediately anterior to the anterior septal angle, and it runs posterior to the interdomal ligament of the alar cartilages. Thus, the in-
terdomal ligament separates the deep and the superficial medial expansions of the nasal SMAS. The dermocartilaginous ligament described by Pitanguy \(^4\) corresponds, in our opinion, to the deep medial expansion. There is no evidence of any fibrous structure originating from the dermis and crossing the nasal SMAS. Basing our statements on anatomical and surgical observations, the section of the medial deep expansion of the nasal SMAS determines nasal tip rotation and improvement in nasal tip definition. The same result was described by Pitanguy \(^4\) when the interruption of the dermocartilaginous ligament was performed. It is important to stress the fact that Pitanguy et al\(^10\) asserted that the dermocartilaginous ligament was predominantly observed in patients with platyrrhine and bulbous noses; on the contrary, in our study, only specimens of white individuals were examined. Furthermore, Pitanguy \(^4\) hypothesized that the fibers of the dermocartilaginous ligament could represent the vestigial remnants of, or an evolutionary link to, the transverse nasalis muscle. Our results also suggest a close relationship between these 2 anatomical structures.

Clinical observations and routine surgical practice show that from a surgical point of view, these anatomical findings may have an impact on surgical procedures, but this statement needs to be better assessed by objective measurements, which will be provided in further studies. Both the deep and the superficial medial layers of the nasal SMAS may be considered to be the lowering ligaments of the nasal tip. Surgical section of these anatomical structures is performed routinely during the external rhinoplasty approach, and clinical evidence shows nasal tip rotation after section of these ligaments.

**HISTOLOGIC ANALYSIS**

The histologic examination (Figure 9) of the lateral nasal wall showed that the portion of the nasal SMAS that lies over the ULC (transverse nasalis muscle) is in continuity, at the level of the nasal valve, with a fatty component that corresponds to the yellowish expansion noted during the cadaver dissections. There was no evidence of any fibrous structures between the ULC and LLC, and only the perichondrium joining ULC to LLC was noticed.

**CONCLUSIONS**

In this study, we have demonstrated that it is possible and reliable to propose a unique and complete anatomical vision of the nasal SMAS. The nasal SMAS continues from the frontalis muscle, which may be called the frontal SMAS, and at the level of the internal nasal valve it divides into a deep and a superficial layer; each layer consists of lateral and medial layers. This unified vision of the nasal SMAS may explain the connections between all the muscular and ligamentous components that were previously described by other authors. It seems to correspond to anatomical findings observed during surgical procedures, such as fatty expansions onto the internal nasal valve and vertical fibrous bands caudal to the anterior septal angle (**Figure 11**).

The dermocartilaginous ligament described by Pitanguy \(^4\) corresponds, in our opinion, to the deep me-
dial layer of the nasal SMAS. The resection of this anatomical structure determines the same change to the nasal tip and supra–nasal tip area of the nose as described by Pitanguy."4

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REFERENCES


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