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Facial Muscles and Artery Identified in Sectioned Images of Cadaver

Músculos y Arteria Facial Identificados en Imágenes Seccionadas de Cadáver

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SUMMARY: Facial muscles are clinically important and responsible for various functions of the face. However, it is difficult to grasp the complex anatomy of facial muscles using conventional methods, such as cadaver dissection. This study comprehensively explained the facial anatomy by utilizing a cadaver sectioned image and schematic drawing. The face was categorized into orbital, maxillary, upper oral, and lower oral regions. The spatial relationship between facial muscles was explained using cadaver sectioned images. The findings were correlated with schematic drawings for a better understanding. Minute facial muscles in each region were examined using sectioned images. The different muscle depths are explained in the schematic drawings. Additionally, the relationship between the facial muscles and facial artery was analyzed. The positional relationship between the muscles was expressed in different colors in the schematic drawings. Owing to the high resolution of the cadaver sectioned images, it was possible to understand the positional relationship of the fine facial muscles. Unlike in traditional cadaver dissection, it is not necessary to damage the outer structure to observe its inner structure. This study will help clinicians identify facial muscles and arterial structures.

KEY WORDS: Facial muscles; Facial artery; Cadaver sectioned images; Schematic drawings; Spatial relationship.

INTRODUCTION

Facial muscles are crucial for a wide range of functions such as facial expressions, speech, chewing, swallowing, breathing, and so on. The buccinator and orbicularis oris contract for a lip-curling expression and the corrugator supercilii contracts for a slightly angry expression. The facial muscles that perform these various functions have complex anatomical structures that are difficult to explain visually (Moore *et al*., 2018).

A thorough understanding of the facial muscle anatomy is crucial for plastic surgeons (Li *et al*., 2016). Ultrasound is commonly used to examine the facial muscles during procedures, such as dermal filler injections or other facial plastic surgeries (Volk *et al*., 2013; Rohrich, 2015; Pistoia *et al*., 2023). Additionally, magnetic resonance imaging (MRI) is frequently used to diagnose facial muscle diseases (Farrugia *et al*., 2007; Som *et al*., 2012). Therefore, to identify facial muscles accurately on medical images with low resolution and grayscale color, clinicians require a concrete understanding of facial anatomy.

However, the anatomy of facial muscles is difficult to grasp because of the following characteristics: First, the facial muscles are very small and thin compared to muscles such as the latissimus dorsi. This necessitates careful consideration by plastic surgeons to avoid damaging these delicate facial muscles during procedures such as double eyelid surgery (Kim *et al*., 2013).

Second, facial muscles are located at varying depths within the subcutaneous tissue. While the facial muscles originate from the facial bones and insert to the skin, their muscle bellies have different depths. Therefore, during botulinum toxin or dermal filler injections, varying facial muscle depths must be considered (Kosins *et al*., 2007; Jaspers *et al*., 2011).

Additionally, the facial artery passes between numerous facial muscle layers, creating a complex course and further emphasizing the need for consideration during the procedures.

Third, current methods have limitations in the study of facial muscles. In conventional cadaver dissection, superficial and minute facial muscles might be removed during skinning (Cotofana & Lachman, 2020). Furthermore,

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simultaneous examination of both deep and superficial muscles can be challenging. Most anatomy textbooks provide limited descriptions of differing muscle depths (Moore *et al*., 2018). More detailed and comprehensive anatomical data are required for advanced research on facial muscles.

As a solution, an actual cadaver head was serially sectioned to yield the sectioned images with high resolution and real colors. These sectioned cadaver images provided detailed observations of the facial muscles. Unlike conventional dissection methods, sectioned cadaver images allow simultaneous visualization of the deep and superficial facial muscles without damaging them.

In this study, most facial muscles, along with the facial artery, were identified in the sectioned images of a cadaver. The cadaver sectioned images were correlated with schematic drawings to elucidate the complex morphology of facial muscles. The findings of this study will contribute to the advancement of the knowledge of facial muscle anatomy, benefiting the field of plastic surgery

MATERIAL AND METHOD

Cadaver sectioned images were obtained as described in a previous study. A female cadaver was donated with approval from the donor and her family. The whole process for this study protocol was approved by the IRB (Institutional Review Board) (CR321181). The cadaver was scanned to obtain CTs, and then frozen at 70°C and embedded with gelatin solution; no embalming agent or dyes were injected. The frozen cadaver was sectioned horizontally using a milling machine. Sectioning was performed serially at 0.04 mm intervals. A CanonTM EOS 5DsR digital single-lens reflex camera and CanonTM EF 100 mm f/2.8L Macro IS USM Lens were utilized (resolution, 8,688 × 5,792 pixels) (Chung *et al*., 2019).

We analyzed which muscles were seen in several adjacent cadaver sectioned images and analyzed the movement of successive muscles up and down to analyze the thickness and depth of the muscles and their positional relationship with other muscles at a specific level. In addition to the muscles, the positional relationship with the muscles was analyzed after identifying red-looking facial blood vessels.

The face was divided into four parts to examine the muscles distributed in the orbital region, nasal region, upper region, and lower region, respectively, and all positional relationships were examined based on the anterior view. In addition, muscles near the nose, where many fine muscles are distributed, were examined in detail by forming a separate slide, and the driving direction of the facial artery that supplies blood flow to each facial muscle was examined based on a local view.

In addition, these muscles were displayed in cadaver sectioned images, and schematics were created in each area; the depth distribution of muscles was easily expressed by expressing different muscle colors, and the colors that were deeper and more superficial were easily expressed through scale bars. Through this change in muscle distribution at different locations within an area, the size and depth change according to the position of a specific muscle in the face, and the distribution changes according to the position of the muscle in the face.

The facial muscles and facial artery were drawn as schematics, which also delineated their spatial relationship. Adobe Illustrator (Adobe Systems, Inc., San Jose, CA) was used for schematics.

RESULTS

Schematic drawings were made to easily elucidate the complicated facial muscles. Schematic drawings of the orbital region, maxillary region, nasal region, upper oral region, lower oral region were made. To indicate the relative depth of each muscle, the muscles were drawn in four colors: pink, yellow, green, and purple. The four colors represent only the approximate depth of the muscles. For instance, both the auricularis anterior and levator labii superioris alaeque nasi are purple; however, their actual depths from the skin differ. The upper or lower levels of the horizontally sectioned images of the cadaver's face are indicated by blue lines in the schematics.

The Facial muscles of the orbital region are explained in a schematic drawing and cadaver sectioned images (Fig. 1). Above the orbit, the procerus, frontalis,and orbicularis oculi were observed at the same level. The frontalis was deeper than the procerus and their directions were similarly vertical. The orbicularis oculi covered the entire eye area, and the auricularis anterior is laterally distributed. The orbicularis oculi and auricularis anterior were at similar depths; therefore, they appeared connected. (Fig. 1A).

The frontalis was not observed in the upper part of the orbit, whereas the procerus was observed. Corrugator supercilii and depressor supercilii, small muscles near the eyebrows, were observed in the deeper layer. Corrugator supercilii had horizontal direction, while the depressor supercilii had vertical direction. The corrugator supercilii was lateral to the depressor supercilii (Fig. 1B).

In the lower part of the orbit, the procerus was not observed, whereas the transverse part of the nasalis covering the nose appeared. In addition, the levator labii superioris alaeque nasi, a long muscle distributed from the nasal bone to the nostrils and upper lip, was observed. This muscle is more superficial than the orbicularis oculi. The nasolacrimal duct was medial to the orbit (Fig. 1C).

Below the procerus, the transverse part of nasalis was observed. The lower part of the orbicularis oculi was lateral to the transverse part of nasalis. The levator labii superioris is observed deep in the orbicularis oculi. In addition, the levator labii superioris alaeque nasi, a thin and long muscle located medially to the levator labii superioris, was observed. The zygomaticus major, a muscle originating from the zygomatic bone, was also observed on the most lateral side. The zygomaticus minor was not visible at the same level, because its origin was inferior to that of the zygomaticus major (Fig. 2A).

The transverse part of nasalis surrounds the nose, and its lateral end extends deep to reach the maxilla. While the transverse part becomes narrow as it reaches the ala of nose, the alar part of nasalis thinly covers the region. Both the zygomaticus major and zygomaticus minor were observed collaterally (Fig. 2B).

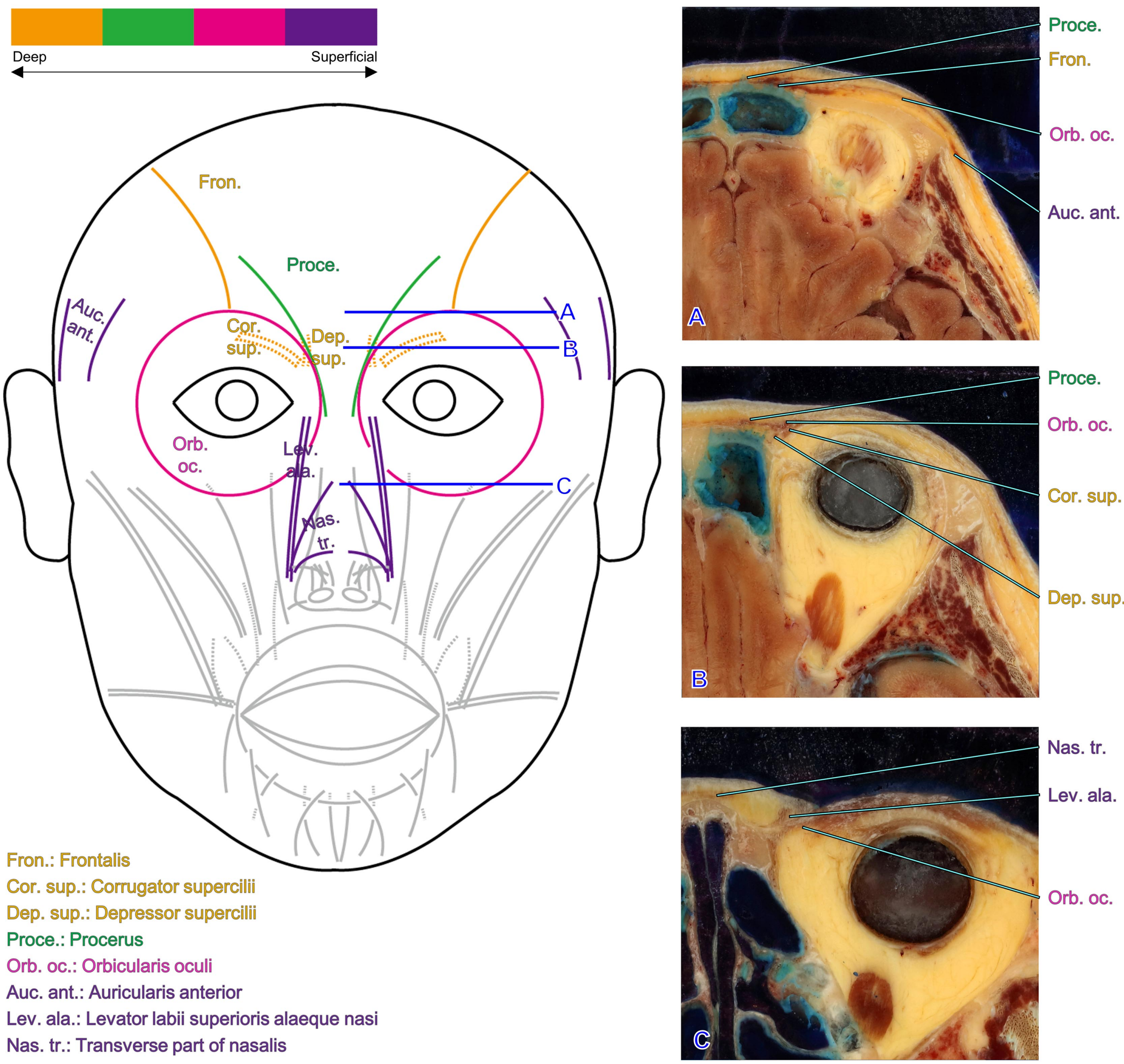

Fig. 1. Schematic drawing and cadaver sectioned images of orbital region.

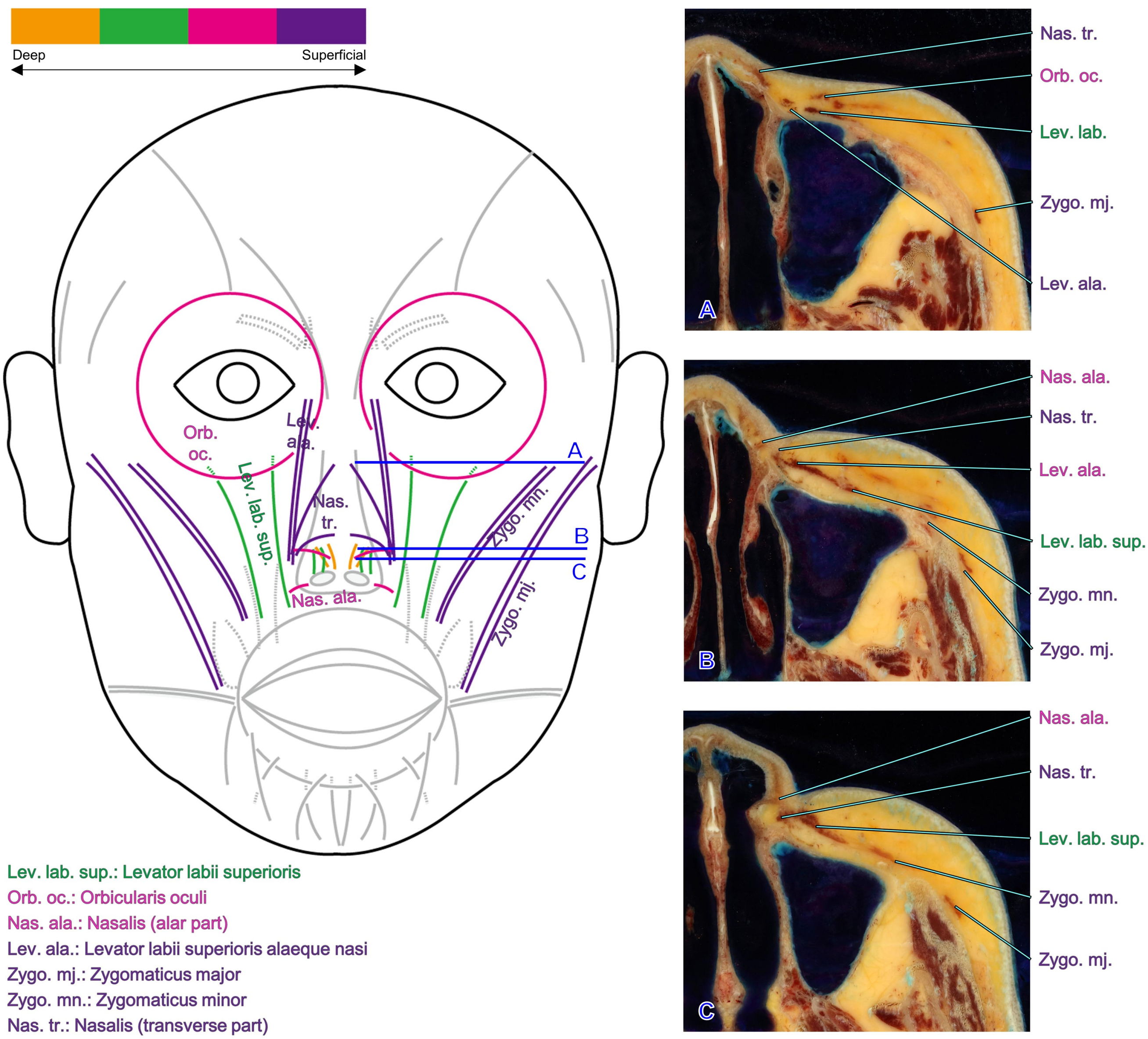

Fig. 2. Schematic drawing and cadaver sectioned images of maxillary region.

The levator labii superioris and zygomaticus minor are close to each other. The levator labii superioris is located close to the nose (Fig. 2C).

The small nose area contains complex small muscles: the compressor narium minor, dilator naris anterior, transverse part of nasalis, and the alar part of nasalis (Fig. 3).

In the sectioned image, the compressor narium minor was observed at the medial part of nasal tip, whereas the dilator naris minor was observed at the lateral part of nasal tip. The superior part of compressor narium minor was underneath the dilator naris anterior. The lateral portion of the alar part was located underneath the transverse part (Fig. 3A).

Among the muscles of the nose, the compressor narium minor and dilator naris anterior are relatively small at the nasal tip, and the transverse part of nasalis is relatively large at the side wall of the nose. The upper parts of the compressor narium minor and dilator naris anterior are covered by the transverse part of nasalis, while the lower part of the dilator naris anterior is covered by the alar part of nasalis (Fig. 3B).

The levator labii superioris alaeque nasi is long distributed and sticks to the side of the nose, so it can be seen at all levels. The maxillary origin of the transverse part of nasalis is even deep to the levator labii superioris alaeque nasi (Fig. 3C).

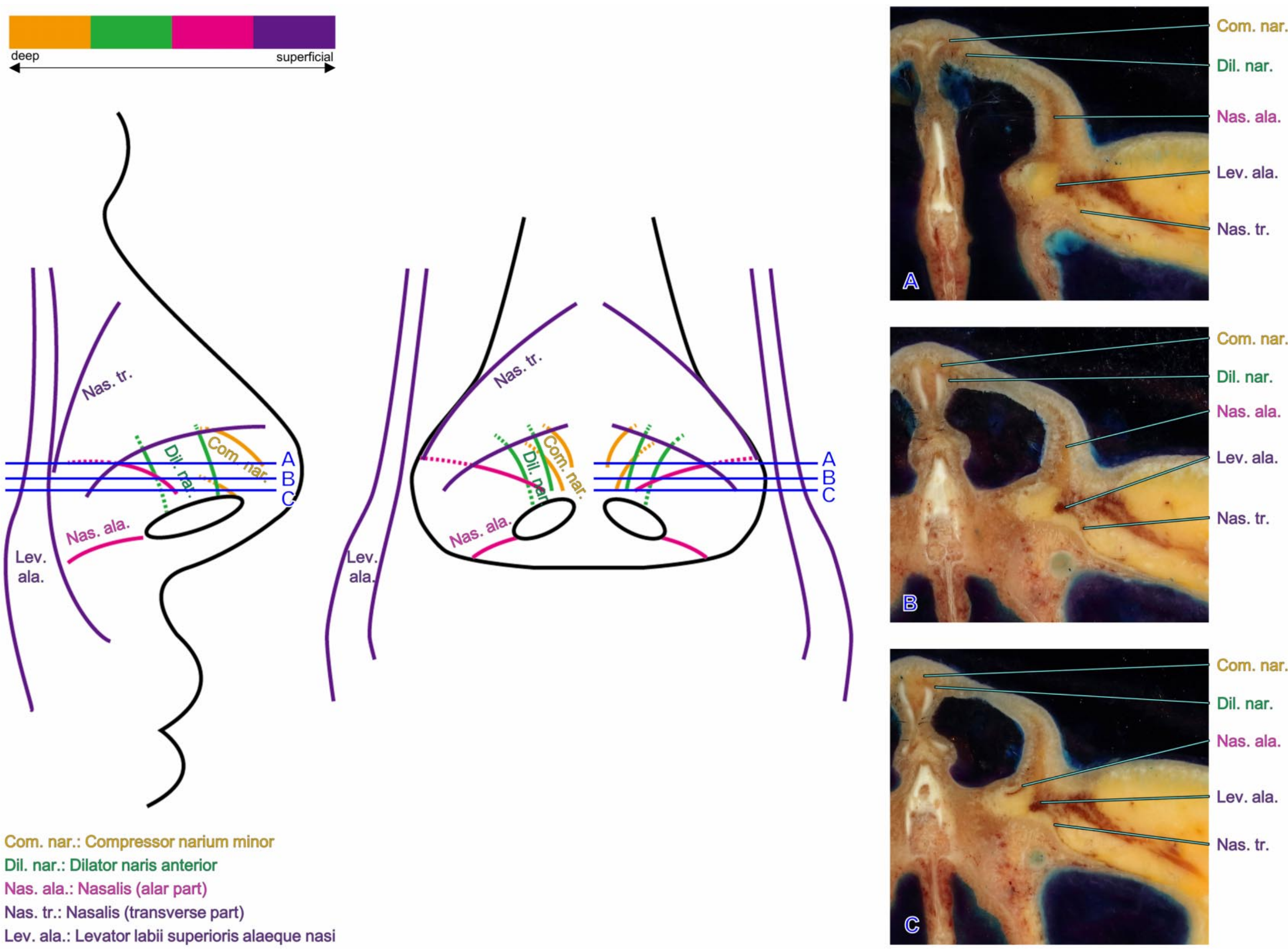

Fig. 3. Schematic drawing and cadaver sectioned images of nasal region.

At the lower part of the nose, the levator anguli oris was deeper than the nearby muscles. In addition, the inferior ends of the alar part of nasalis and levatorlabii superioris were visible. The inferior end of the zygomaticus minor was observed more medially than the superior end and was closer to the levator labii superioris. In contrast, the zygomaticus major was observed comparatively laterally at the same level (Fig. 4A).

Buccinators that are observed in very deep areas become thicker and are observed on the more superficial side. The nose was almost invisible from the contour of the face, and transverse part and alar part of nasalis, the muscle covering the nose, is not visible below the nose. The levator labii superioris was observed at the level where the orbicularis oris appeared, and the levator anguli oris was observed at the deeper part of the same level. Additionally, the orbicularis oris, a muscle that widely covers the mouth, begins to appear as the level at which the mouth appears on the face approaches (Fig. 4B).

The outline of the nose was not visible, but the outline of the mouth was visible. The buccinator is located deeper than the levator anguli oris. The inferior end of zygomaticus major was faintly observed on the medial side, whereas the zygomaticus minor was not observed. The superior part of orbicularis oris, which covers the mouth was widely observed (Fig. 4C).

The orbicularis oris, which covers the entire mouth area, clearly appears in the superficial part. While the levator anguli oris was on the upper side of angle of mouth (Fig. 4), the depressor anguli oris was on the lower side of angle of mouth. The risorius was in the horizontal direction at the angle of the lip. The buccinators merged with the other muscles at the angle of mouth (Fig. 5A).

Orbicularis oris was observed to cover a wider range than in (Fig. 5A). In addition, the depressor labii inferioris showed movement from the medial to the lateral side. In contrast, the driving direction of the depressor anguli oris

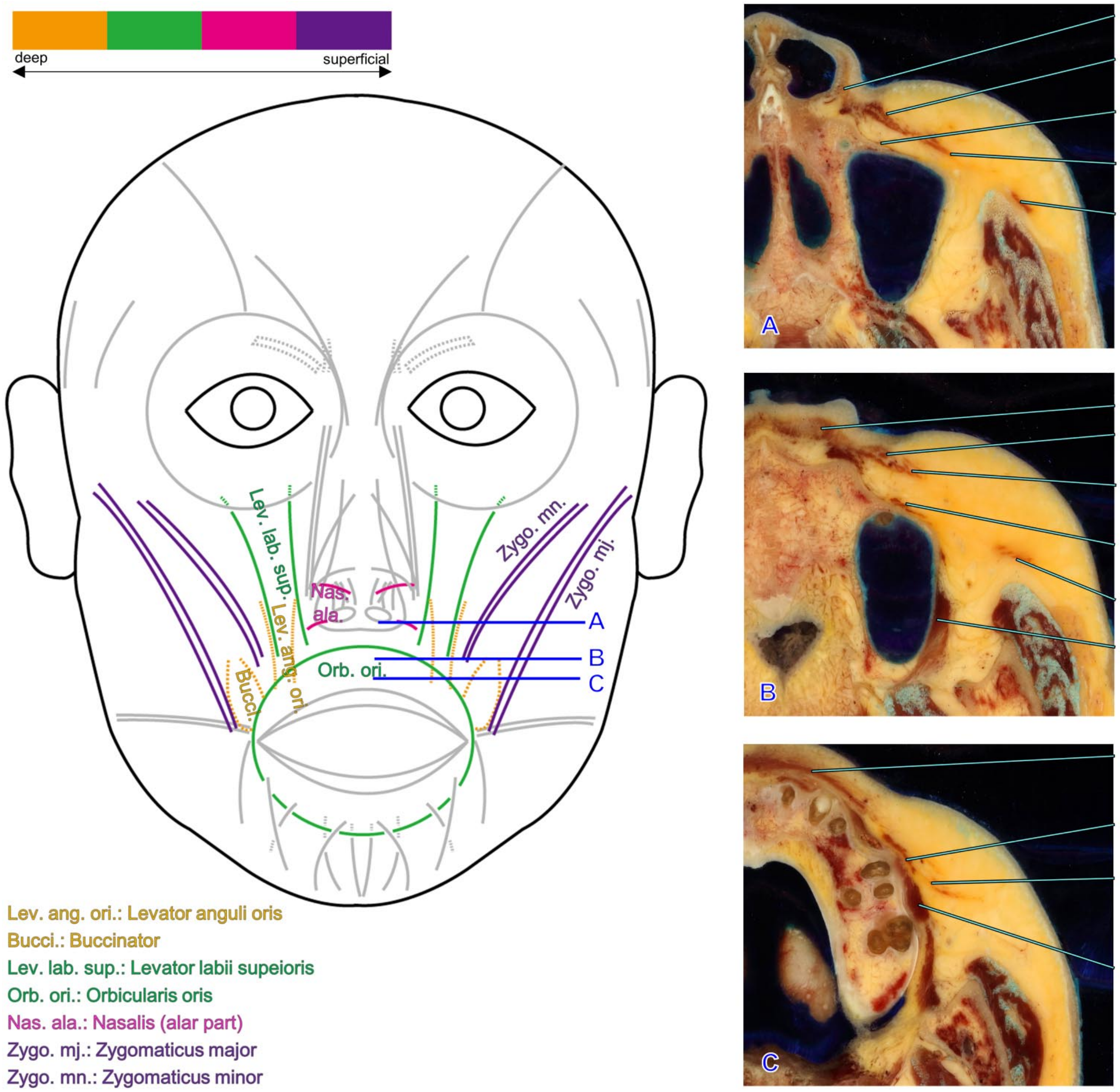

Fig. 4. Schematic drawing and cadaver sectioned images of upper oral region.

was from the lateral to the medial side, and the direction and angle differed from those of the depressor labii inferioris. The risorius, which was observed on the most lateral side, moved toward the medial side and resembled the tail of the depressor anguli oris (Fig. 5B).

As the teeth disappear in the cadaver sectioned image, the mentalis, the deepest and most medial muscle in the jaw, is observed, and the orbicularis oris, which widely covers the mouth was very blurry and difficult to distinguish. The bilateral mentalis and depressor anguli oris are V-shaped, whereas the bilateral depressor labii inferioris are l-shaped. In the overlap area, the mentalis was deeper than the orbicularis oris, whereas the depressor anguli oris and depressor labii inferioris were more superficial than the orbicularis oris. The bilateral mentalis are slightly V-shaped. The directions of the mentalis and the depressor anguli were almost vertical, while that of the depressor labii inferioris was more inclined (Fig. 5C).

In addition to the facial muscles, this study examined the facial arteries. Facial arteries are distributed between the facial muscles and play a vital role in blood supply. We investigated five muscles that are closely related to the facial artery: the risorius, buccinator, zygomaticus major, zygomaticus minor, and orbicularis oculi.

The facial artery passes beneath the risorius and is superficial to the buccinator. It sequentially passes underneath the zygomaticus major and zygomaticus minor.

The facial artery becomes the angular artery. Around the medial angle of the eye, the angular artery passes underneath the orbicularis oculi and anastomoses with the ophthalmic artery (Fig. 6).

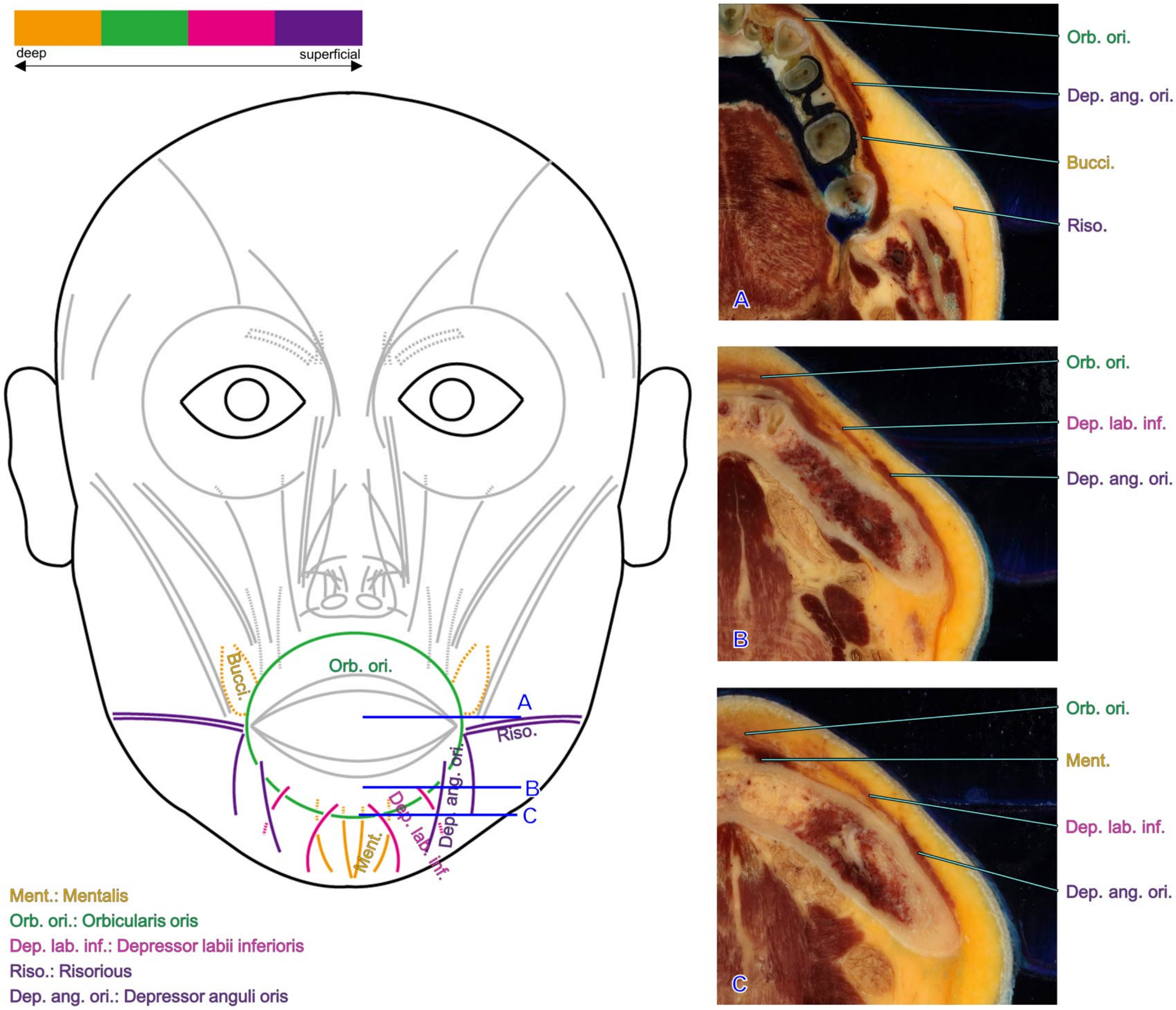

Fig. 5. Schematic drawing and cadaver sectioned images of lower oral region.

DISCUSSION

The sectioned images in this study possessed high resolution and real color, allowing a detailed observation of minute facial muscles. For instance, the corrugator supercilii, depressor supercilii, and nasal muscles were clearly visible (Zide, 1985; Park *et al*., 2003). Different facial muscle depths were identified on the horizontally sectioned images. For instance, when examining the orbicularis oculi and corrugator supercilii around the eye, the corrugator supercilii was located deeper than the orbicularis oculi. There were instances in which one portion of the muscle was superficial and the other was deep, such as the transverse part of nasalis. (Fig. 2) (Trévidic *et al*., 2015). This complex location relationship could be clearly identified in the sectioned images.

The combination of the cadaver sectioned images and the schematic drawings are effective in elucidating the complex anatomy of the facial muscles and artery. Although the sectioned images show the fine muscles and artery of actual cadaver, the schematics can easily explain the complicated anatomical relationships. Surgeons can use similar schematics to enhance their understanding of the anatomical structures during practice and study (Kearns, 2019).

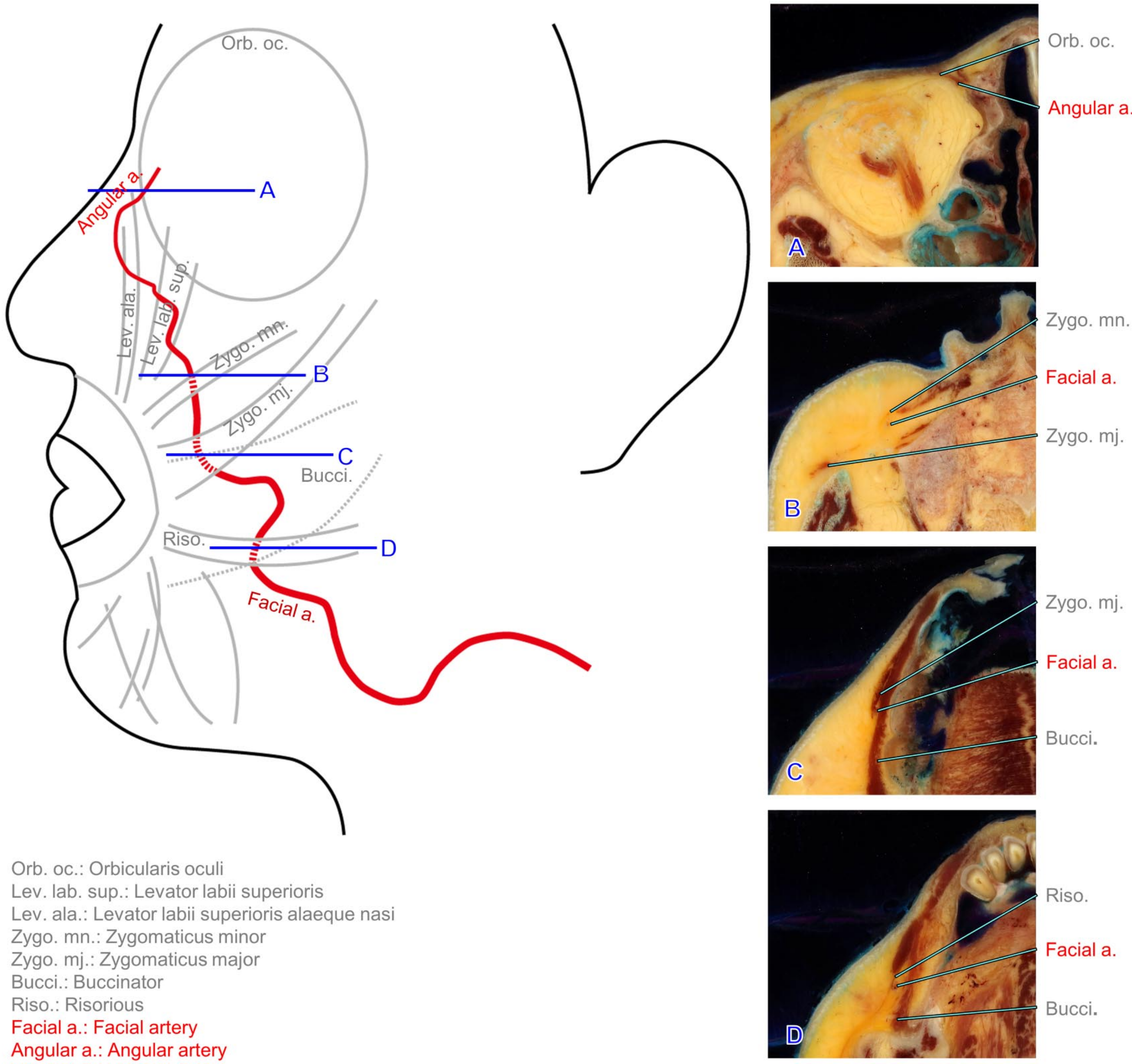

Fig. 6. Schematic drawing and cadaver sectioned images of facial artery.

Our study addresses the limitations of the existing anatomy books. These books often make it challenging to distinguish the varying depths of facial muscles at a glance. In contrast, the relationship between the facial muscles was examined based on sectioned images of the face, and schematic drawings were constructed based on the research results. Unlike existing anatomy books, the schematic drawings of this study show the relative depths of the muscles in several colors, which is helpful for a holistic understanding of facial muscle anatomy (Noel, 2015). Furthermore, the cadaver sectioned images can complement the limitations of conventional cadaver dissection. To observe the deep layers of the muscle in cadavers, it is necessary to remove the superficial layers of the muscle, leading to the loss of the facial muscles' original positions (Pessa *et al*., 1998). Consequently, research on the facial muscles using conventional cadaver dissection is often limited and lacks detailed information. In contrast, the sectioned images in this study showed the original positions of the facial muscles without removing the superficial muscles to elucidate their spatial relationships.

The sectioned images of facial muscles can significantly improve the understanding of medical imaging techniques, such as ultrasound and MRI. It is very difficult to accurately grasp detailed location relationships in medical images. However, our sectioned images with their real color representations offer valuable assistance in interpreting these medical images with grayscale colors, providing a clearer understanding of the detailed location relationships (Farrugia *et al*., 2007; Volk *et al*., 2013; Pistoia *et al*., 2023).

The comprehensive facial muscle anatomy presented in this study can be helpful to plastic surgeons. For example, the nasal region is frequently operated upon by complicated nasal muscles. The sectioned images and schematics offer a clear understanding of the positional relationships between these muscles (Bruintjes *et al*., 1998) This enhanced understanding can aid plastic surgeons in performing these procedures with greater precision and confidence.

When administering botulinum toxin or dermal filler injections, avoiding the facial artery is essential. The facial artery passes between facial muscle layers at various depths. The artery passes underneath the four muscles (zygomaticus major, zygomaticus minor, risorius, and orbicularis oculi), as shown in the sectioned images and schematics (Mangano & Mangano, 2012; de Maio *et al*., 2017). Ultrasonography is commonly used for guidance in cases where botulinum toxin injections are administered. By referencing our study, surgeons can achieve greater accuracy in their procedures, ensuring a safer and more effective approach to injections while avoiding potential complications related to the facial artery (Wu *et al*., 2022).

For the treatment of chronic migraine, botulinum toxin is injected into facial muscles such as the corrugated supercilii, procerus, and frontalis, and the positional relationship between each facial muscle must be accurately understood. This study analyzed the positional relationship between the forehead and muscles in the eye area (Dodick *et al*., 2004).

However, this study had several limitations. Because the sectioned images were obtained from a single female cadaver, they did not reflect the characteristics of various demographics. In addition, the schematics may have oversimplified the details compared to the actual cadaver photographs.

However, future studies should address several limitations. The anatomical structures labeled in the cadaver-sectioned images can be segmented to make 3-dimensional (3D) model. Constructing a 3D model based on the positional relationship of the facial muscles discussed in previous studies will contribute to the digital anatomy of facial muscles. The cadaver sectioned images used in this study were made of a 3D volume model and thinly peeled to show the facial muscles (Kwon *et al*., 2016). In addition, based on our research, we can create a 3d volume model that can be reconstructed to yield oblique planes according to user needs. Furthermore, the facial nerves innervating the muscles and trigeminal nerves should be addressed in future studies (Kim *et al*., 2022).

CONCLUSION

Hopefully, the results of this study will be of great help for the diagnosis and surgery of various clinical situations involving the facial muscles. Determining the surgical site in the face based on this study would certainly be useful. Our study can be used as a foundation in several areas in which facial muscles are used. Additionally, it will be particularly helpful in plastic surgery and radiology.

WON, J. W.; LEE, S. H. & CHUNG, B. S. Músculos y arteria facial identificados en imágenes seccionadas de cadáver. *Int. J. Morphol., 43(3)*:914-923, 2025.

RESUMEN: Los músculos faciales son importantes clínicamente y además responsables de diversas funciones faciales. Sin embargo, es difícil comprender la compleja anatomía de los músculos faciales mediante métodos convencionales, como la disección de cadáveres. Este estudio explicó exhaustivamente la anatomía facial utilizando una imagen seccionada de cadáver y un dibujo esquemático. El rostro se clasificó en las regiones orbitaria, maxilar, oral superior e inferior. La relación espacial entre los músculos faciales se explicó mediante imágenes seccionadas de cadáveres. Los hallazgos se correlacionaron con los dibujos esquemáticos para una mejor comprensión. Se examinaron los músculos faciales diminutos de cada región mediante imágenes seccionadas. Las diferentes profundidades musculares se explican en los dibujos esquemáticos. Además, se analizó la relación entre los músculos faciales y la arteria facial. La relación posicional entre los músculos se expresó en diferentes colores en los dibujos esquemáticos. Gracias a la alta resolución de las imágenes de cortes cadavéricos, fue posible comprender la relación posicional de los músculos faciales finos. A diferencia de la disección tradicional de cadáveres, no es necesario dañar la estructura externa para observar su estructura interna. Este estudio ayudará a los médicos a identificar los músculos faciales y las estructuras arteriales.

PALABRAS CLAVE: Músculos faciales; Arteria facial; Imágenes de cortes cadavéricos; Dibujos esquemáticos; Relación espacial.

REFERENCES

Bruintjes, T. D.; Van Olphen, A. F.; Hillen, B. & Huizing, E. H. A functional anatomic study of the relationship of the nasal cartilages and muscles to the nasal valve area. *Laryngoscope, 108(7)*:1025-32, 1998.

Chung, B. S.; Han, M.; Har, D. & Park, J. S. Advanced sectioned images of a cadaver head with voxel size of 0.04 mm. *J. Korean Med. Sci., 34(34)*:e218, 2019.

Cotofana, S. & Lachman, N. The superficial face dissection as an example for integrating clinical approaches, authentic learning, and changing perspectives in anatomy dissection. *Anat. Sci. Educ., 13(1)*:117-21, 2020.

de Maio, M.; DeBoulle, K.; Braz, A. & Rohrich, R. J. Facial assessment and injection guide for Botulinum toxin and injectable hyaluronic acid fillers. *Plast. Reconstr. Surg., 140(2)*:265e-276e, 2017.

Dodick, D.; Blumenfeld, A. & Silberstein, S. D. Botulinum neurotoxin for the treatment of migraine and other primary headache disorders. *Clin. Dermatol., 22(1)*:76-81, 2004.

Farrugia, M. E.; Bydder, G. M.; Francis, J. M. & Robson, M. D. Magnetic resonance imaging of facial muscles. *Clin. Radiol., 62(11)*:1078-86, 2007.

Jaspers, G. W. C.; Pijpe, J.; Jansma, J. The use of botulinum toxin type A in cosmetic facial procedures. *Int. J. Oral Maxillofac. Surg., 40(2)*:127-33, 2011.

Kearns, C. Is drawing a valuable skill in surgical practice? 100 surgeons weigh in. *J. Visual Comm. Med., 42(1)*:4-14, 2019.

Kim, C. Y.; Park, J. S. & Chung, B. S. Identification of cranial nerve ganglia using sectioned images and three-dimensional models of a cadaver. *Korean J. Pain, 35(3)*:250-60, 2022.

Kim, H. S.; Hwang, K.; Kim, C. K. & Kim, K. K. Double-eyelid surgery using septoaponeurosis junctional thickening results in dynamic fold in asians. *Plast. Reconstr. Surg. Glob. Open, 1(2)*:1-9, 2013

Kosins, A. M.; Hurvitz, K. A.; Evans, G. R. & Wirth, G. A. Facial paralysis for the plastic surgeon. *Can. J. Plast. Surg., 15(2)*:77-82, 2007.

Kwon, K.; Shin, H. K.; Shin, B. S. & Park, J. S. Serially peeled images of the curved surface of the face based on cross-sectional images for use in plastic surgery. *J. Plast. Reconstr. Aesthet. Surg., 69(5)*:727-9, 2016.

Li, Y.; Yang, X. & Li, D. The application of three-dimensional surface imaging system in plastic and reconstructive surgery. *Ann. Plast. Surg., 77 Suppl. 1*:S76-83, 2016.

Mangano, A. & Mangano, A. Current strategies in the treatment of gummy smile using Botulinum toxin type A. *Plast. Reconstr. Surg., 129(6)*:1015e, 2012.

Moore, K. L.; Dalley, A. F. & Agur, A. M. R. *Clinically Oriented Anatomy.* 8th ed. Amsterdam, Wolters Kluwer, 2018.

Noel, G. Rapid prototyping: an educational extension of anatomy coloring textbooks. *J. Hum. Anat. Physiol., 1*:4, 2015.

Park, J. I.; Hoagland, T. M. & Park, M. S. Anatomy of the corrugator supercilii muscle. *Arch. Facial Plast. Surg., 5(5)*:412-5, 2003.

Pessa, J. E.; Zadoo, V. P.; Adrian, E. K. J.; Yuan, C. H.; Aydelotte, J. & Garza, J. R. Variability of the midfacial muscles: analysis of 50 hemifacial cadaver dissections. *Plast. Reconstr. Surg., 102(6)*:1888-93, 1998.

Pistoia, F.; Picasso, R.; Zaottini, F.; Sanguinetti, S.; Caprioli, S.; Tovt, L.; Pansecchi, M. & Martinoli, C. High resolution ultrasound of facial muscles: sonoanatomy, scanning technique, and pathological cases. *J. Ultrasound Med., 42(3)*:547-57, 2023.

Rohrich, R. J. The "soft-tissue fillers and neuromodulators: international and multidisciplinary perspectives" supplement. *Plast. Reconstr. Surg., 136(5 Suppl.)*:1S-3S, 2015.

Som, P. M.; NG, S. A.; Stuchen, C.; Tang, C. Y.; Lawson, W. & Laitman, J. T. The MR imaging identification of the facial muscles and the subcutaneous musculoaponeurotic system. *Neurographics, 2(1)*:35-43, 2012

Trévidic, P.; Sykes, J. & Criollo-Lamilla, G. Anatomy of the lower face and botulinum toxin injections. *Plast. Reconstr. Surg., 136(5 Suppl.)*:84S-91S, 2015.

Volk, G. F.; Wystub, N.; Pohlmann, M.; Finkensieper, M.; Chalmers, H. J. & Guntinas Lichius, O. Quantitative ultrasonography of facial muscles. *Muscle Nerve, 47(6)*:878-83, 2013.

Wu, W. T.; Chang, K. V.; Chang, H. C.; Chen, L. R.; Kuan, C. H.; Kao, J. T.; Wei, L. Y.; Chen, Y. J.; Han, D. S. & Özçakar, L. Ultrasound imaging of the facial muscles and relevance with botulinum toxin injections: a pictorial essay and narrative review. *Toxins (Basel), 14(2)*:101, 2022.

Zide, B. M. Nasal anatomy: the muscles and tip sensation. *Aesthet. Plast. Surg., 9(3)*:193-6, 1985.

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