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Parotid Gland Fascia Demonstrated by Novel Prepared GAX-Specimens with Innovative Contract Imaging and Fresh Frozen Cadavers Supporting Revised Morphology

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ABSTRACT

INTRODUCTION. The parotid gland (PG) is the largest salivary gland of the head and neck which is triangular shaped due to an inferior tail region. PG lies within 3D quadrangular parotid space sandwiched posterolaterally between the external and internal sides of the mandibular ramus creating a superficial and deep lobe connected by an isthmus. Contemporary anatomy texts/atlases consistently describe the investing layer of deep fascia forming the parotid fascia/capsule. Surgical literature provides controversy regarding the morphology of the parotid gland fascia (PGF). Study objective was to dissect, image and assess the PGF from novel GAX-specimens with innovative contrast and fresh frozen cadavers (FFC). METHODS. GAX-specimens (n=6, 12-sides) were MRI, CT-contrast and ultrasound scanned (GE Vscan Air) and dissected. FFC (n=18, 36-sides) were dissected to reveal PGF. RESULTS. Combined GAX-specimens and FFC sides (n=48) revealed anterolateral PGF as an extension of SMAS. The SMAS tissue was intimate with the anterolateral PG capsule. Facial surgeons often consider SMAS of facial subregions interconnected. The authors have conducted platysma dissection research recognizing a platysma-SMAS system within a common plane. Facial SMAS protected arteries and nerves creating grooves or partial tunnels and fused into nearby facial subregions. CONCLUSION. GAX-specimens demonstrated lifelike texture, colour, planes, orientation and decreased surgical dissection resistance of neck and facial structures with free movement for several months versus formalin-fixed cadavers. FFC provided similar experience with very limited ideal dissection time (days). This study suggests GAX-specimens provide lifelike dissection revealing SMAS being intimate with anterolateral PG capsule. Further GAX-specimen studies may improve PGF-capsule knowledge.

OBJECTIVE

Study objective was to dissect, image and assess the PGF from novel GAX-specimens with innovative contrast and fresh frozen cadavers (FFC).

INTRODUCTION

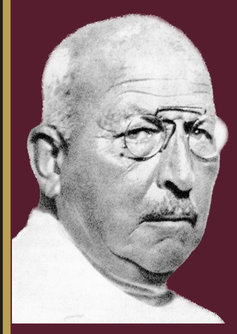

Figure 1: Germany surgeon, Dr. Erich Lexer, credited as a founder of cosmetic surgery.

The platysma is involved with less-than-ideal results from facial surgeries and is known to become less prominent with age leading to increased face and neck superficial structure redundancy. During the COVID-19 pandemic, the American Society of Plastic Surgeons (ASPS) reported over 230,000 rhytidectomies, attributed in part to the “Zoom Boom” phenomena. Dr. Erich Lexer, MD is suspected to have been one of the first surgeons to have performed these procedures, pre-dating 1910. Beyond cosmetics alone, multiple procedures, across a spectrum of surgical professions, involve raising subplatysmal flaps for the purpose of access to deeper structures and reconstruction. There is thus a need in medical education to be precise in our understanding of this delicate muscle. Preservation of its fibers can prove challenging for early dissectors, and many contemporary texts, including atlases, report attachments along the mandible, but the accompaning images tend not to match their written description (i.e., the superior attachment will be drawn past the mandibular borders). The aim of this project was to compare three cadaveric preparations, novel GAX, formalin fixed traditional embalmed cadavers and fresh frozen, and determine if each demonstrated a consistent set of facial attachments. Determining the extent of variability and comparing the consistent superior attachment to contemporary texts will serve to improve medical education, our understanding of the platysma regarding surgical procedures, and its function.

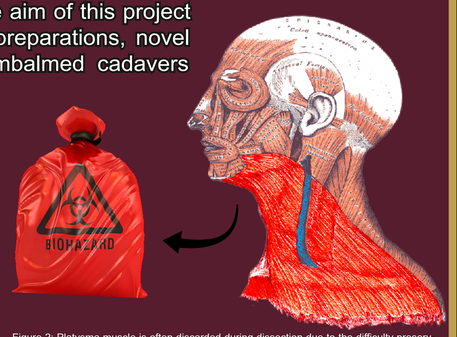

Figure 2: Platysma muscle is often discarded during dissection due to the difficulty preserving the tissue and perceived lack of clinical significance.

METHODS

GAX-specimens (n=6, 12 sides) were MRI, CT-contrast and ultrasound scanned (GE Vscan Air) and dissected. FFC (n=18, 36 sides) were dissected to reveal PGF.

Table 1: Literature Review of Contemporary Anatomy Texts

Text	Yr	Ed	Author	Superior Attachment(s)
Gross Anatomy Board Review Series	2005	5th	Kyung W. Chung	"Mandible; skin and muscles over mandible and angle of the mouth."
Last's Anatomy Regional and Applied	2006	11th	Chummy S. Sinnatamby	"Some fibers continue on to the face, blending with the muscles of facial expression. [Platysma]... converge bowe towards the midline just beneath the chin."
Moore Clinically Oriented Anatomy	2014	7th	Keith L. Moore Arthur F. Dalley Anne M.R. Agur	"Inferior border of mandible, skin, and subcutaneous tissues of lower face" "...descending from the angle of the mandible..."
Clinical Anatomy	2004	7th	Richard S. Snell	"It passes upward into the neck and is inserted into the lower margin of the body of the mandible; some of the posterior fibers enter the face and blend with the muscle at the angle of the mouth. Below the chin, some of the anterior fibers interlace with the muscle fibers of the opposite side."
Clemente Anatomy: A Regional Atlas of the Human Body	1997	4th	Carmine D. Clemente	"...extends from the angle of the mouth and chin downward across the clavicle..." "[platysma]...insert[s] within the superficial fascia."
Gray's Anatomy for Students	2010	2nd	Richard L. Drake A. Wayne Vogl Adam W.M. Mitchell	"...ascends through the neck to the mandible. At this point, the more medial fibers insert to the mandible, whereas the lateral fibers join with muscles around the mouth."
Netter's Atlas of Human Anatomy	2019	7th	Frank H. Netter, MD	"Mandible, oral muscles."
A Textbook of Human Anatomy	2008	6th	T.S. Ranganathan	No note of any attachments.

Table 1: Literature review of eight contemporary anatomy textbooks with the quoted language used to describe the superior attachment of the platysma muscle.

SUMMARY

Literature search revealed majority of texts revealing facial attachment just above the inferior mandible border (IMB). Combined GAX-specimens and FFC (n=48) all revealed a more proximal attachment ascending anteriorly to at least the modiolus (48/48) and frequently zygomaticus minor (32/48) and posteriorly to the buccinator muscle level (38/48) and commonly to zygomaticus major (35/48) and occasionally orbicularis oculi (4/4). TEC were more difficult to dissect and assess proximal attachment as they were more dehydrated with an average age of 83. TEC (22/30) revealed platysma reaching over the IMB to the modiolus, occassionally to more superior structures (see Table 2).

Figure 3: Female Caucasian GAX specimen displaying the anteromedial and posterolateral platysmal boundaries ascending to modiolus (white arrows). Ascending fibers toward buccinator muscle (black arrow). SMAS reflected medially over orbicularis oris muscles (green arrowheads).

Figure 4: Reference image of formalin fixed traditional embalmed cadaver platysma dissection, boundaries ascending toward mandible (green arrows).

Point of Superior Attachment of Platysma by Preparation

Preparation	Modiolus	Buccinator & Parotid Fascia	Zygomaticus Major	Zygomaticus Minor	Inferior Border of Orbicularis Oculi
Novel GAX-specimens (n=6, 12 sides)	n=12 sides	n=12 sides	n=10 sides	n=6 sides	n=2 sides
Fresh frozen (FFC) (n=14, 28 sides)*	n=28 sides	n=24 sides	n=24 sides	n=23 sides	n=3 sides
Traditional embalmed, formalin fixed (TEC) (n=15, 30 sides)	n=22 sides	n=8 sides	n=5 sides	n=3 sides	n=0 sides

*n=36 originally; 8 (4 right & 4 left sides) fresh frozen cadavers met exclusion criteria; final n=28

Table 2: Post-dissection frequency analysis of platysma facial attachments by preparation type.

SUMMARY CONTINUED

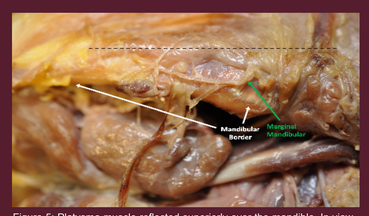

Figure 5: Platysma muscle reflected superiorly over the mandible. In view, submandibular gland, marginal mandibular nerve, lymph nodes and tracts.

TECs that are formalin fixed tend to be dehydrated and more tightly adhered, making identification and incisions along surgical planes more difficult. Despite this, we were consistently able to determine platysma attachment in these specimens at least to the modiolus (n=22/30). FFC and novel-GAX specimens offer a unique dissecting experience wherein tissues maintain their structural integrity and compliance. As a result, tracing platysma muscle fiber orientation along the fascial planes, the superificial musculoaponeurotic system (SMAS), and into muscles of facial expression is more precise (see Table 2). The added benefits of novel-GAX preparation lie in the exceptional hydration, color, texture, and tone, and the elasticity of the tissues. In our series of dissections with novel-GAX specimens, we were more readily able to preserve neurovascular supply, including fine lymph nodes and their corresponding tracts (see Images 3, 5, 6, and 7). Our data suggests the modiolus is most likely a consistent superior facial attachment, and likely it is fairly commonplace to have continuity of lateral fibers into the parotid sheath and buccinator muscle. We recognize the platysma as an integrated superficial facial and neck structure with the SMAS, and thus, muscles of facial expression. Given the inconsistencies between anatomy texts and images (see Tables 1-2), there is an opportunity for improvement in the depicition and medical education of this delicate, clinically important muscle. Further investigation into the neurovascular and connective tissue intricacies related to the platysma are an area in which we are investigating for further study.

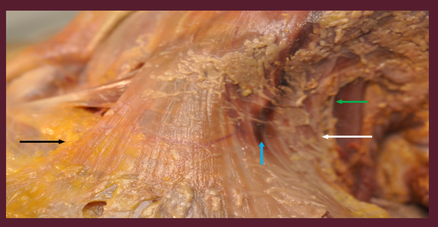

Figure 6: GAX specimen with posterolateral platysmal boundary (white arrow). Anteromedial border ascending to modiolus (black arrow). External jugular vein (blue arrow). Cervical nerve (green arrow). Note tone, texture, and hydration status of tissue.

Literature Review of Contemporary Anatomy Atlases

Atlas	Yr	Ed	Author	Superior Attachment(s)
Lippincott, Williams & Wilkins Atlas of Anatomy	2009	Latin	Patrick W. Tank Thomas R. Gest	Multiple illustrated views, though all depict the lateral fibers integrating into buccal fat pad or along mandibular border. None clearly show attachment to modiolus.
Grant's Atlas of Anatomy	2009	12th	Anne M. R. Agur Arthur F. Dalley	Several of the figures have cut away or reflected the platysma, so attachment sites are unclear. Further illustrations note an attachment to the modiolus on anterior view, and continuity with the Buccinator muscle.
Clemente Anatomy: A Regional Atlas of the Human Body	1997	4th	Carmine D. Clemente	Lateral fibers shown to overly parotid sheath, insert at modiolus and depressor anguli oris muscle in multiple images. No ancillary fibers more superior.
Gray's Atlas of Anatomy	2008	1st	Richard L. Drake A. Wayne Vogl Adam W.M. Mitchell Richard M. Tibbitts Paul E. Richardson	Lateral fibers continuous with parotid and masseteric fascias and medial fibers track towards modiolus via the Risorius muscle.
Netter's Atlas of Human Anatomy	2019	7th	Frank H. Netter, MD	Drawn with fibers inserting along border of mandible, integrating with parotid sheath. Medial fibers are shown to attach to buccinator, though they do not show a distinct connection to the modiolus
Thieme Atlas of Anatomy	2008	1st	Anne M. Gilroy Brian R. MacPherson Lawrence M. Ross	Depicted as attaching to lateral depressor anguli oris, without ancillary fibers attaching to modiolus, buccinator, or parotid sheath.
Sobotta Atlas of Human Anatomy	2001	13th	Johannes Sobotta	Several sites of attachment are drawn, with lateral fibers integrating with Risorius muscle on path to modiolus, medial attachment to depressor anguli oris, and inferior fibers tracking to mandibular border.
Color Atlas of Anatomy: A Photographic Study of the Human Body	2006	6th	J. W. Rohen C. Yokochi E. Lütjen-Drecoll	Cadaveric image displays medial fibers attaching to border of the mandible and unlabeled fibers tracking past Risorius towards Zygomaticus major and Buccinator muscles. Accompanying illustration shows attachments at modiolus, Risorius muscle, and mandibular border.

Table 3: Detailed descriptions of the platysma muscle attachments by pictoral representation depicted in eight contemporary anatomy atlases.

Figure 7: African-American male GAX specimen demonstrating lateral platysmal fiber orientation.

CONCLUSION

Assessing platysma dissections from three types of donor cadaver preparations demonstrated GAX and FFC have superior quality tissue, enabling delicate dissections versus TEC, and significantly revealed obvious proximal attachments, and thus deserving further recognition in contemporary texts and atlases.

ACKNOWLEDGEMENTS

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Others available upon request.