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Anatomical Concepts of the SMAS

Mr Dalvi Humzah and cosmetic and dermatology nurse practitioner Anna Baker detail the anatomical significance of the superficial musculo-aponeurotic system

Abstract

The anatomy and significance of the superficial musculo-aponeurotic system (SMAS) is well described, with cadaveric studies continuing to emerge to further enhance clinical awareness. Whilst the context of this plane is acknowledged in the surgical literature, this layer represents important boundaries to the non-surgical clinician, at defined anatomical regions. This paper captures the salient anatomical descriptions and considerations, and summarises some of the key findings from current literature.

Introduction

The third anatomical layer of the face forms one continuous plane, encompassing each facial region, although for descriptive purposes, different names are given to certain parts, often according to the superficial muscle contained within the anatomical region.[1] It is named the galea over the scalp, the superficial temporal fascia over the temple, (nomenclature describing the temporal fascia is inconsistent within the literature),[2] the orbicularis fascia in the periorbital region, the superficial musculo-aponeurotic system (SMAS) over the mid and lower face, and platysma in the neck.[3,4] Whilst the focus of this paper is to explore the anatomy, it is key to understand its context and characteristics in different anatomical regions, to ensure treatments are performed appropriately and safely.

SMAS background

The innovative and renowned plastic surgeon, Mr Tord Skoog (1915-1977), introduced pivotal changes in surgical face lifting techniques, spurning a shift in thinking by questioning the underlying change in the 'loose' appearance of skin seen in ageing, as well as laxity, believing that the reason lay in the fibrous support layer beneath the skin. At the time this was known as the superficial fascia and was deemed a radical concept when first presented in 1969.[5] Two years later, a defining article appeared in *Plastic and Reconstructive Surgery*, co-authored by French surgeons, Mr Vladimir Mitz and Mr Martine Peyronie, in which a new name was introduced for Skoog's superficial fascia – the 'superficial musculo-aponeurotic system,' commonly known by the acronym SMAS. This changed aesthetic plastic surgery indefinitely.[3]
Facial ligaments were later described by plastic surgeon, Mr David Furnas in 1989, who observed a stronger adherence of the superficial fascia, to the outer surface of the SMAS than in other areas. Through systematic cadaver dissection, Mr Furnas was able to describe a new element of facial anatomy.[6]

Anatomical context

It is important to appreciate the basic five-layer structure of the superficial soft tissues over the facial skeleton, to understand the contextual relevance of the SMAS. This 'layer' concept is well established historically, and consistently described within the literature:[3,7,8]

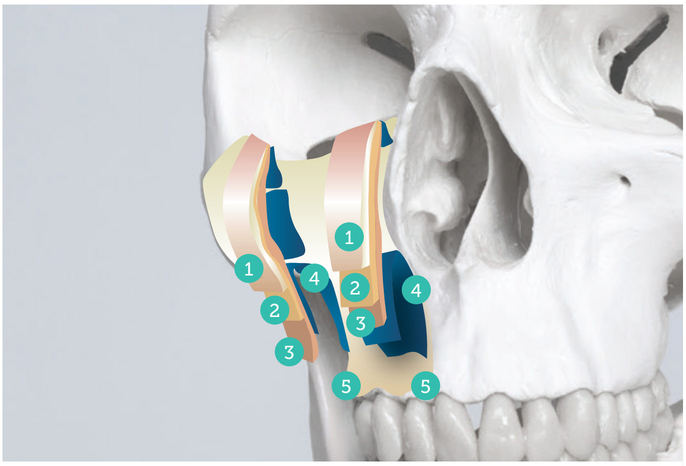

Figure 1: SMAS Layers 1-5. Image shows the anatomy over the skeleton and bony cavities.[20]

Layer 1: Skin
Layer 2: Subcutaneous tissue, including the fibrous retinacular cutis
Layer 3: Frontalis (upper face), SMAS (mid-face), platysma (lower face and neck)
Layer 4: Together these outer three layers form a composite anatomical unit, which is fixed in areas through ligaments in the sub-SMAS.
Layer 5: Investing layer of deep fascia on the muscles of mastication or the periosteum, where the skeleton may not be concealed by these muscles. Variations within the five-layer composition over the face and different aspects of the cheek, are described within the surgical literature.[8] Most of the variations of the basic five-layer soft tissue composition occurs over the orbit and oral regions, whereby the soft tissues continue beyond the skeletal apertures to form the eyelids, central cheek and the lips.[9]

Within the cheek, separating the lateral from the anterior cheek is the vertically-situated line of masseteric retaining ligaments near the medial border of masseter.[10] Consistent with the arrangement over the orbit, the superficial layers pass medially to this boundary to overlie the deeper soft tissues of the central cheek as well as the buccal fat.[11]
The region-specific anatomy of the SMAS is described in the forehead, parotid, zygomatic, and infraorbital regions, as well as the nasolabial fold, and the lower lip.[12] The SMAS forms one continuous, organised fibrous envelope, comprising collagen fibres, elastic fibres, fat cells and muscle fibre, and connects the facial muscles with the dermis.[1] The subcutaneous fat of the body is segmented from the muscle compartment by an investing layer of fascia encasing all muscles of the body.[13]
In the face, the muscles have connections to the skin in order to enable the mimetic activity of facial animation to take place. Muscles of facial expression are distinctly different from skeletal muscles beneath the deep fascia, as they are situated within the superficial fascia and move the soft tissues for which they are part of.[3] All

muscles of facial expression have either their entire or the majority of their components within Layer 3 of the face, predominantly located over and around the orbital and oral cavities.[7] Within Layer 3, the facial muscles have a layered configuration, with the broad, flat muscles forming the superficial layer that covers the anterior aspect of the face. The frontalis covers the upper, orbicularis oculi, the middle and lower thirds, as well as the platysma.[14] The muscles within this layer have minimal direct attachment to the bone, stabilised to the skeleton at their periphery.

Facial retaining ligaments are an area of anatomy which are gaining increasing interest and recognition in the context of ageing and aesthetic corrective treatments. In relation to the SMAS layer, the zygomatic ligament is one of the major ligaments supporting the facial soft tissues, but develops negligible laxity between its origin and connection to the SMAS.[15] Conversely, other ligaments, such as the masseteric ligaments below the oral commissure, significantly weaken and stretch with age.[6] Aesthetically, this may manifest as a dimple or pocket, with which overlying soft tissues anchor and appear to fold over, and may contribute to the worsening appearance of the jowl.

Current literature

A number of pivotal anatomical studies are emerging, which are deepening understanding of the anatomy of fascia in the face. Of particular interest to aesthetic practitioners are the recent findings of Pessa[9] who undertook a detailed literature review and clinical dissection to explore the concept of bilaminar SMAS fusion zones, suggesting that the boundaries of these zones equip the clinician with valuable, practical information. The authors illustrate this concept in context of the course of branches of the facial nerve travelling as deeply as possible until reaching the edges of the muscles which they innervate, where at this point they transition from the deep to the superficial fascia.

Pessa suggests that to minimise the risk of injury, nerves transition as close to muscle as possible, for example, the buccal branch of the facial nerve can be injured at the superior border of the zygomaticus major muscle, which is described as a transition point along a SMAS fusion zone within this study. Furthermore, Pessa proposes that the frontal branch of the facial nerve is most often injured at the inferior border of the frontalis muscles (along a temporal SMAS fusion zone), with injury to the marginal mandibular nerve and zygomatic branch occurring in the same manner. Based upon these clinical findings, Pessa argues that if a clinician is aware of the location of the SMAS fusion zones, the course of the facial nerve branches, from the deep to the superficial fascia, could potentially be anticipated and thus, avoided during cosmetic procedures.[9]

Kang *et al.*[16] describe findings from their cadaveric study comprising 40 hemi-faces (unembalmed tissue) to analyse if the superficial fascia (Layer 3) was bilayered at specific anatomical regions. The authors reported that the superficial fascia, (including the SMAS and the superficial temporal fascia), comprised two layers from the temporal area to the lower face, with the SMAS consisting of a superficial layer and a deep layer, separated by areolar tissue. Equally, these findings demonstrated that the temporal branch of the superficial temporal artery ran within the superficial temporal fascia, with the frontal branch entering and extending to the superficial component of the deep temporal fascia, approximately 2-4cm lateral to the eyebrow. The authors state that the platysma was not continuous with the superficial layer of the SMAS, and describe the remnant portion of the orbicularis oculi, zygomaticus major and minor, and the platysma as being invested by the deep layer of the SMAS. Furthermore, they were able to demonstrate that the SMAS was separable into two layers, and that the deep layer covered the levator labii superioris and levator anguli oris, but propose that these two structures (the deep SMAS and deep fascia), represent the same layer, which is coplanar with the platysma. Kang *et al.* demonstrate findings to conclude that the superficial facial fascia comprises two layers throughout the face, temple, and forehead.[16]

Non-surgical considerations

Optimal outcomes for non-surgical interventions can be obtained by ensuring treatment protocols are aligned to the anatomical and temporal changes of ageing. With the description of the SMAS, surgical techniques were developed to reposition the SMAS and overlying tissues and, hence, offer 'SMAS-Lift Procedures'. The limited SMAS lift approach, has been modified and extended. Currently the modified technique is popularised as the S-lift or mini-SMAS technique; they address the lateral part of the face but not the central area.[17]

The surgical procedures had a potential downside – as the dissections proceed medially to correct the mid-face changes, there is a danger of facial nerve damage as the branches of the facial nerve transition from Layer Four/Five into Layer Two through the SMAS.[7] The other problem was that these SMAS elevation procedures often left patients with facial disproportion and the 'windswept' look as many surgeons excised the redundant SMAS.[18] The issue here is that the volumetric changes in the face due to ageing were not addressed. This has led to techniques of reusing the redundant SMAS with methods such as imbrication and foldover procedures (autologous volumisation), ultimately leading to the 'deep plane' approach of dissection under SMAS, which was popularised by Sam Hamra.[18]

An important outcome of this was the understanding of the SMAS, its relation to the facial ligaments and the underlying facial sub-SMAS spaces. To get optimal results, three things need to be addressed:

1. SMAS tightening
2. Facial ligament retightening to reposition the SMAS
3. Revolumisation of the facial disproportion

When this is looked at in the context of non-surgical interventions, there are possible combinations that allow us to address these concepts.

Targeting the SMAS

It has been shown that using a diathermy directly on the SMAS causes areas of thermal damage and contraction of SMAS.[19] It is now possible to use focused ultrasound energy to target the SMAS under visualisation to produce contraction of the SMAS. The targeted thermal energy causes the SMAS to contract and repeated application will result in tightening of this area.[19] It is important to deliver the energy directly into the SMAS and not into the superficial subcutaneous tissues or into the deeper areas as the treatment will compromise deeper structures. Some improvement is often seen when using deeper or superficial settings, which may be the result of thermal energy indirectly working on the facial ligaments.[20]

Other energy delivery such as radiofrequency will also indirectly work on these areas but lack the specific focus to directly target

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the SMAS. The lack of a focused target results in a lack of longevity and repeated treatments are required for maintenance. Being able to target the SMAS and cause contraction of this particular layer results in an improvement of the overlying skin tone by fascial retightening.[20]

Facial ligament retightening

The true facial ligaments run from the deep layers of the face (periosteum) to the cutaneous tissues and due to stretching, laxity of the SMAS and resorption of bone, this allows the overlying skin to droop, bulge and wrinkle. The analogy used by Mendelson is to imagine a room under SMAS: the walls being the ligaments, forming columns running from the deep layers through the SMAS to attach to the superficial layers. The floor being Layer Five and the roof being the SMAS (Layer Three).[5,7,8,11,23]

The first such space described by Mendelson was the prezygomatic space over the cheek, and being able to treat the cheek using dermal filler in this area gives a natural and anatomically-based outcome. Using an appropriate procedure to enter this prezygomatic space (with a cannula) will allow the injection of an appropriate product amount into this space and for a safe treatment.[22] This is of particular importance as the 'ceiling' of the prezygomatic space is composed of the suborbicularis oculi fat or 'SOOF'. This structure is implicated in the aetiology of malar oedema and, as such, should not be injected into directly. Filling the prezygomatic space achieves two things. Firstly, it inflates the 'room' and tightens the retaining ligaments – this transmits the tightening and lifting to the superficial parts of the ligament pulling the skin and tightening the overlying SMAS. Secondly, it also provides further lifting to the superficial tissues as it corrects the underlying deep tissue loss (see below).[15,21,23]

Revolumising facial disproportion

Ageing of the facial skeleton results in loss of bony support in areas of the face.[24] Going back to the room analogy, as the bony support reduces, (the floor/foundations deteriorate) this results in a collapse of the overlying structures causing the overlying cutaneous and subcutaneous tissues to droop and wrinkle. The ability to correct and augment the area within the room provides a firm foundation for the overlying SMAS, which lifts and repositions the subcutaneous fat pads. The 'triple area' procedure is a suitable technique, but beyond the scope of this article. It aims to address the mid-face and tear trough area. In youth, in the area where the alar meets the cheek, there is a fullness created by the underlying maxillary bone and the deep medial cheek fat pad. With age, there is bone resorption and loss of the deep medial cheek fat pad from this compartment, which has been termed 'Ristow's Space'.[21] Being able to strategically inject into this space results in mid-facial rejuvenation and allows an indirect approach to treating the tear trough.[21] This injection technique introduces either dermal filler or fat transplants into this facial space to reshape the overlying maxillary fullness in facial rejuvenation. Use of an appropriate product (with g high G') will allow correction of the drooping and will provide fullness by transmitting the tissue turgor through the overlying SMAS. These procedures allow for an indirect and direct approach to treating the SMAS through non-surgical cosmetic interventions. Techniques using superficial placement of dermal fillers are based on superficial revolumisation and do not address the SMAS–associated changes.

Conclusion

It is widely accepted that the safest and most effective treatment outcomes arise, in part, from a thorough and detailed facial analysis, which include an appreciation of the facial anatomical planes, to ensure product is placed appropriately and safely to yield the desired result. The continual emergence of new anatomical concepts reaffirms the importance of maintaining an accurate and critical awareness of published literature, as studies increasingly move away from formalin specimens and larger cohort numbers, to reflect more pivotal conclusions as methodology becomes more robust.

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REFERENCES

1. Gossain A.K., Yousif N.J., Madiedo G., Larson D.L., Matloub H.S., Sanger J.R., 'Surgical anatomy of the SMAS: a reinvestigation', *Plast Reconstr Surg* 92 (1993), pp.1254-1263.
2. Baker A, 'Temporal fossa anatomy: a review of the literature and safe planes of augmentation', *Journal of Aesthetic Nursing* 4(9) (2015), pp.372-379.
3. Mitz V, Peyronie M., 'The superficial musculo aponeurotic system (SMAS) in the parotid and cheek area', *Plast Reconstr Surg* (1976), pp.58:80.
4. Stuzin J.M., Baker T.J., Gordon H.L., 'The relationship of the superficial and deep facial fascias: relevance to rhytidectomy and aging', *Plast Reconstr Surg* 89 (3) (1992), pp.441-449.
5. Mendelson B, *In Your Face: The hidden history of plastic surgery and why looks matter,* Hardie Grant Books, 2013.
6. Furnas D.W., 'The retaining ligaments of the cheek', *Plast Reconstr Surg,* (1) (1989), pp.11-16.
7. Mendelson B.C., Jacobson S.R., 'Surgical anatomy of the mid-cheek; facial layers, spaces and mid-cheek segments', *Clin Plast Surg,* 35 (2008), pp.395-404.
8. Mendelson B., Wong C.H., 'Commentary on: SMAS Fusion Zones Determine the Subfacial and Subcutaneous Anatomy of the Human Face: Fascial Spaces, Fat Compartments, and Models of Facial Aging', *Aesthetic Surgery Journal,* 36(5) (2016), pp.529-532.
9. Pessa J.E., 'SMAS Fusion Zones Determine the Subfascial and Subcutaneous Anatomy of the Human Face: Fascial Spaces, Fat Compartments, and Models of Facial Aging', *Aesthetic Surgery Journal,* 36(5) (2016) pp.515-526.
10. Thaller S.R., Kim S., Patterson H., Wildman M., Daniller A., 'The submuscular aponeurotic system (SMAS): a histologic and comparative anatomy evaluation', *Plast Reconstr Surg,* (1990).
11. Mendelson B.C., Muzzaffar A.R., Adams W.P. Jr., 'Surgical anatomy of the midcheek and malar mounds', *Plast Reconstr Surg,* 110 (3) (2002), pp.885-896.
12. Ghassemi A., Prescher A., Riediger D., Axer H., 'Anatomy of the SMAS Revisited', *Aesthetic Plastic Surgery,* 27 (2003), pp.258-264.
13. Har-Shai Y., Bodner S.R., Egozy-Golan D., Lindenbaum E.S., Ben-Izhak O., Mitz V., Hirshowitz B., 'Mechanical properties and microstructure of the superficial musculoaponeurotic system', *Plast Reconstr Surg,* 98 (1996), pp.59-70.
14. Matros E., Garcia J.A., Yaremchuk M.J., 'Changes in eyebrow position and shape with ageing', 124(4) (2009), pp.1296-1301.
15. Humzah D., Baker A, 'Mid-face Rejuvenation', *Aesthetics Journal,* 3(5), (2016).
16. Kang H.G., Youn K.H., Kim I.B., Nam Y.S., 'Bilayered Structure of the Superficial Facial Fascia', *Aesthetic Surgery Journal,* DOI: 10.1093/asj/sjx001 (2017).
17. Tonnard Patrick, Verpaele Alexis, Monstrey Stan *et al.*, 'Minimal Access Cranial Suspension Lift: A Modified S-Lift', *Plast Reconstr Surg,* (2002).
18. Lemmon, M.L. , Hamra S.T (1980) Skog rhytidectomy: A 5-year experience with 577 patients. Plastic and Reconstructive Surgery 65(3) :283-297
19. Pritzker R.N., Hamilton H.K., Dover J.S., 'Comparison of different technologies for noninvasive skin tightening', *J Cosmet Dermatol,* 13(4) (2014) pp.315-323
20. Fabi S.G, 'Noninvasive skin tightening: focus on new ultrasound techniques', *Clin Cosmet Investig Dermatol,* 2015, 5(8) pp.47-52.
21. Rohrich R., Pessa J.E., Ristow B., (2008) The Youthful cheek and the deep medial fat compartment. Plastic & Reconstructive Surgery 121(6):2107-2112.
22. Van Loghem J.A.J., Humzah D., Kerscher M, 'Cannula Versus Sharp Needle for Placement of Soft Tissue Fillers: An Observational Cadaver Study', *Aesthetic Surgery Journal,* 2016.
23. Mendelson B & Chin-Ho W, 'Anatomy of the Ageing Face', *Aesthetic Surgery of the Face,* 2013, p.83.
24. Shaw R.B., Katzel E.B., Koltz P.F., Yaremchuk M.J., Kahn D.M., Langstein H.N., (2011) Ageing of the facial skeleton: aesthetic implications and rejuvenation strategies. Plastic and Reconstructive Surgery 127(1): 374 -384