Facial Anatomy for Filler Injection

The Superficial Musculoaponeurotic System (SMAS) Is Not Just for Facelifting

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KEYWORDS

• Facial fat compartments • Superificial musculoaponeurotic system (SMAS) • Facial artery • Angular artery • Superficial temporal artery • Pre-zygomatic space • Deep lateral chin fat compartment • Osseocutaneous ligaments

KEY POINTS

- The prezygomatic space is a desirable target for deep augmentation of the lateral cheek.
- The deep medial cheek fat compartment and deep pyriform space can be used to soften the nasolabial fold and peripyriform shadow.
- Key landmarks and surface topography can be used to identify and potentially avoid the main trunk and associated branches of the facial artery as it traverses through the face.
- Injection into the deep medial chin fat compartment is a desirable target for chin augmentation with volume.
- The deep lateral chin fat compartment can be volumized to soften a prominent prejowl sulcus shadow.

INTRODUCTION

The Fear of Injections, is the Fear of Anatomy
—Adapted from Ian Taylor's 1982 quote
"The Fear of Surgery, is the Fear of Anatomy"

In the spirit of this facelift edition of *Clinics in Plastic Surgery*, this article journeys through facial anatomy for the injector with a specific emphasis on utilization of the superficial musculoaponeurotic system (SMAS) as a unique tool for the facial injector. The SMAS is a structure that is familiar to the facelift surgeon and induces a mental image that can be applied to injectable procedures throughout the face.

The role of volume augmentation with filler and/or fat has become increasingly important in facial aesthetic rejuvenation. Whether the surgeons themselves are performing the injections or extenders of the surgeon are performing the procedure, the tenants remain the same; strive for optimal results and avoid complications. The American Society of Aesthetic Plastic Surgeons statistics reported 722,394 injections in 2017 and this number continues to increase. There has been a 40% increase in injectables over the past 5 years.[1,2] Looking back even further, there has been a 312% increase in minimally invasive procedures from 2000 to 2017.[3]

In contrast with facelift surgery where the surgeon can directly visualize the structures being treated, facial injection is often a blind stick, leaving the injector to estimate depth and location based on surface topography and experience.

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Therefore, this inability for injectors to directly visualize anatomic targets is why anatomic accuracy is critical to avoid suboptimal outcomes.

The objective of this article is to illustrate the layered anatomy in each facial aesthetic subunit and demonstrate high yield pearls that can be used by the facelift surgeon when performing volumizing procedures. The overarching concept is depth. The face is a 3-dimensional structure with lymphatic, neurovascular, and ligament networks, all of which can come into play when performing injections.

To navigate facial depth in the face the author suggests thinking of the facial layers in each aesthetic subunit as the supra-SMAS and the sub-SMAS, thereby facilitating a comprehensive categorization of the fat compartments, potential spaces, ligaments, lymphatics, and neurovascular networks in 2 distinct planes. Particular emphasis will be given to the facial vasculature because vascular compromise is one of the most dreaded complications of facial injection. In the worst of instances, this complication can lead to skin necrosis and blindness.[4–8]

THE TANGO BETWEEN THE SUPERFICIAL MUSCULOAPONEUROTIC SYSTEM (SMAS) AND THE FACIAL VASCULATURE

Described by Mitz and Peyronie[9] in 1976, the SMAS has been a cornerstone of facial rejuvenation for decades. In the modern day this structure can now play an integral role in non-surgical volumization of the face. Joel Pessa[10] teaches that the SMAS is a vestigial remnant of the pan-facial muscles of lower primates and explains that the SMAS acts as a highway to traffic important structures (mainly vessels and motor nerves) around the face. In many regions of the face, the facial vasculature demonstrates an intimate relationship with the SMAS, particularly in the jawline, perioral, nasolabial fold, infrabrow, and temple regions.[11–16] Therefore, using these principles as a baseline the injector can navigate superficial and deep to the SMAS while potentially avoiding interactions with facial vasculature in the process.

A suggested analogy of this concept is the middle layer of a 2-tiered cake. The platter that the cake sits on is analogous to the facial skeleton. The middle layer of icing (ie, the SMAS) is the center point, with a layer of cake below it (ie, sub-SMAS, preperiosteal, deep fat, and potential spaces) and a layer of cake above it (ie, supra-SMAS, subcutaneous) and then topped with icing (ie, the skin; **Fig. 1**). Consider this analogy as we take a journey through key facial aesthetic subunits.

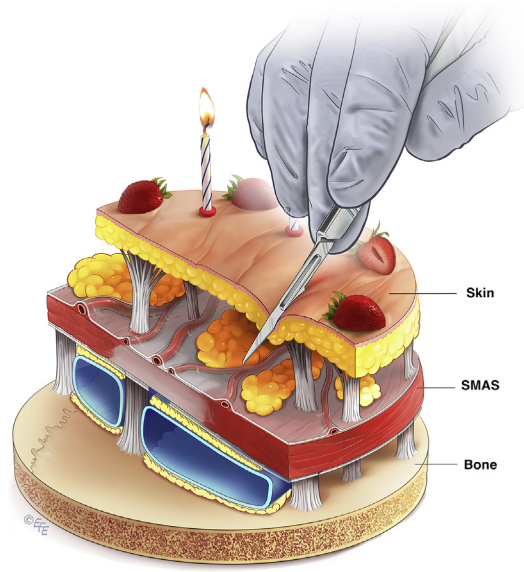

Fig. 1. Concept diagram for the layered anatomic arrangement in the face. Demonstrating the SMAS as a central layer with categorized structures deep and superficial containing fat compartments and potential spaces for target volumization. (*Courtesy of* Levent Efe, CMI, Melbourne, Australia.)

MIDFACE AND TEAR TROUGH

Sub-SMAS (Subsuperficial Musculoaponeurotic System)

The sub-SMAS midface has been a well described target for cheek volumization.[3,11,12] For the purposes of anatomic classification, the deep midface can be divided into upper and lower components partitioned by the zygomaticocutaneous ligaments. This imaginary division line has been termed the malar equator (**Fig. 2**).[11,13]

The lower sub-SMAS midface contains the deep medial cheek fat compartment and deep pyriform space. An additional potential space, the premaxillary space has been identified but has yet to be shown as a preferred target for cheek augmentation.[3,11–15]

The deep medial cheek fat compartment lies on the anterior maxilla and is divided into medial and lateral segments by the levator anguli oris muscle. Medial to this fat compartment lies the deep pyriform space. This space lies adjacent to the pyriform aperture. The angular artery has been described to traverse lateral and superficial to this space; however, vascular anatomy in this region can be variable (**Fig. 3**).[17]

The deep pyriform space and deep medial cheek fat compartments lie underneath the lip elevators, which are contained within the SMAS; therefore, clinical volumization of these targets helps to soften the nasolabial fold prominence

Fig. 2. Photograph of a model demonstrating the malar equator, a topographic landmark for the approximate location of the zygomaticocutaneous ligaments.

and peripyriform shadowing. Access to this space has been demonstrated through a variety of insertion points within a 1.5-cm area of the alar base (Fig. 4).[11,13–15]

The upper sub-SMAS midface contains the suborbiculairs oculi fat, preperiosteal fat, and the prezygomatic space. The preperiosteal fat pad is described as a thin fat pad residing on the surface of the zygoma. The suborbicularis oculi fat (SOOF), by definition, lies on the undersurface of the orbicularis muscle. A potential gliding space exists between these two fat compartments, termed the prezygomatic space. This space has been well-described as a target for cheek volume restoration. The prezygomatic space is bordered superiorly by the orbital retaining ligament and inferiorly by the zygomaticocutaneous ligaments. These ligaments coalesce medially at the tear trough ligament. Laterally, the space is bordered by the lateral orbital thickening. The far lateral extent of the zygomaticocutaneous ligaments is the main zygomatic ligament (Fig. 5). When using cannula, injectors will often feel a palpable and even audible pop as they traverse through the SMAS into the prezygomatic space. This is a confirmatory sign of safe passage into the sub-SMAS upper midface.[11]

Of note, the deep chain of facial lymphatics courses from the lower eyelid into the floor of the prezygomatic space before descending in the

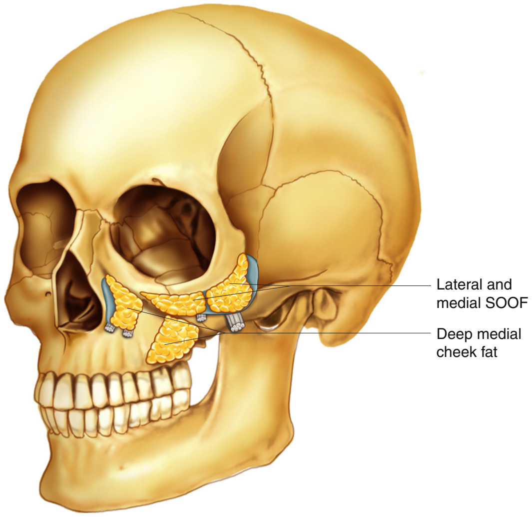

Fig. 3. The sub-SMAS structures of the anterior midface. The deep medial cheek fat compartment is divided into medial and lateral components by the levator anguli oris muscle. Adjacent to the pyriform aperture is the deep pyriform space. SOOF, suborbicularis oculi fat.

Fig. 4. Port insertion for access to the deep anterior midface volumization targets.

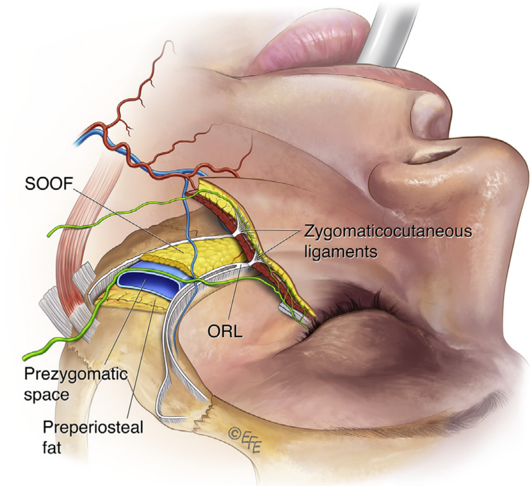

Fig. 5. The sub-SMAS structures of the lateral midface. The preperiosteal fat pad resides on the body of the zygoma. The suborbicularis oculi fat (SOOF) lies on the undersurface of the orbicularis oculi muscle. Between these 2 fat compartments is the prezygomatic space. Note the ligamentous boundaries of the space, the orbital retaining ligament and zygomaticocutaneous ligaments. The lymphatic and vascular networks are also displayed. (*Courtesy of* Levent Efe, CMI, Melbourne, Australia.)

lower midface.[18] The angular vasculature predominantly lies medial to the prezygomatic space and the tear trough ligament. A topographic marking 1.7 cm from midline and 1.3 cm inferior to the medial canthus has been described as an approximate location of the angular artery.[11,19] However, aberrant angular vessels have been described in up to 30% of cadaver samples. The course of this aberrant system is more lateral within the nasojugal groove. Topographically, this difference corresponds with a point 3.5 cm lateral from the midline, level with the supratip break and converging with the midpupillary line[19] (**Fig. 6**). The angular vein has been mapped 4.2 mm ($\pm$0.7) inferior to the infraorbital foramen coursing superomedially deep to the orbital leaf of the orbicularis oculi muscle.[3]

Supra-SMAS (Suprasuperficial Musculoaponeurotic System)

The supra-SMAS midface consists of superficial fat that is divided by vascularized septae creating distinct compartments. These compartments include the nasolabial, medial superficial, middle superficial, and lateral temporal cheek compartments[12] (**Fig. 7**). During cannula injection in the subcutaneous plane of the submalar hollow, resistance is often readily felt as the cannula traverses from one compartment to the next.[11] In the aging face, the depression that extends inferiorly from the tear tough into the cheek is titled the nasojugal groove and has been noted to result from volume shifts in the nasolabial and medial cheek fat compartments.[12]

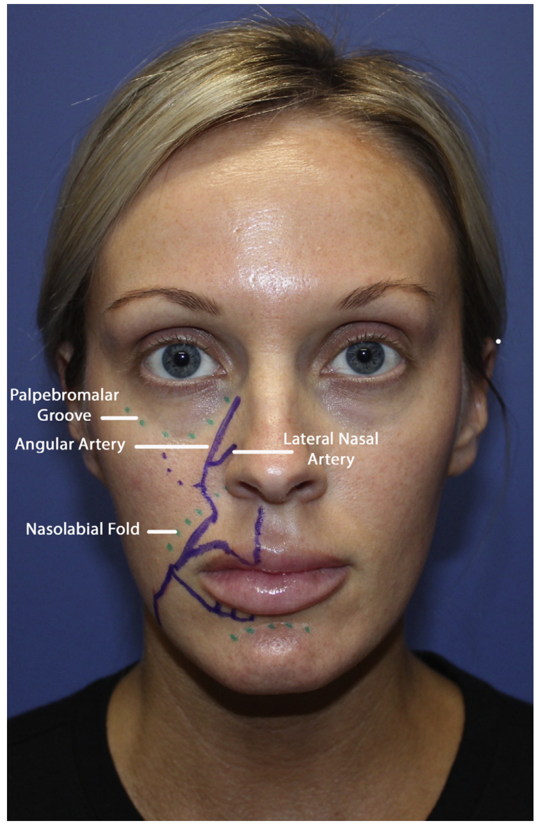

Fig. 6. Topographic markings for the commonly described facial and angular artery trajectories in the midface.

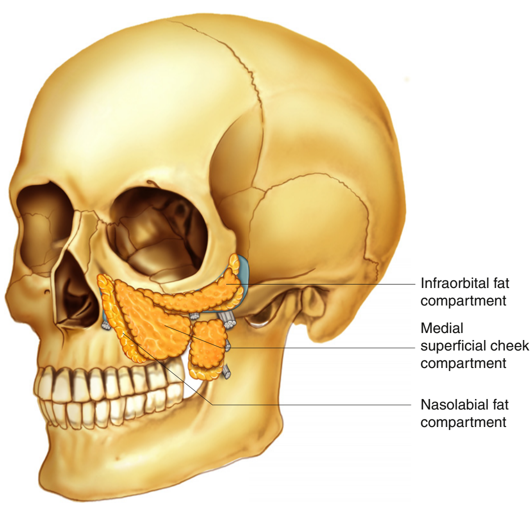

Fig. 7. The nasolabial, medial superficial, middle superficial, and lateral temporal cheek fat compartments.

The most superior superficial fat compartment in the midface is the infraorbital or malar fat compartment.[12] This compartment is straddled by the cutaneous insertions of the orbital retaining ligament (superiorly) and the zygomaticocutaneous ligaments (inferiorly). The superficial lateral chain of lymphatics course through this compartment. Iatrogenic malar mounds from filler injection have been documented in the literature and disruption of this lymphatic chain may be a contributing factor to this phenomenon.[11,13]

Based on the described anatomy, superficial volumization of the midface fat compartments in the submalar hollow can be a desirable technique to expand the cheek and overall facial proportions, however superficial volumization of the upper midface between the cutaneous insertions of the orbital retaining ligament and zygomaticocutaneous ligament should be approached with caution because there is the potential for lymphatic disruption in this plane.[11,13]

PERIORAL AND NASOLABIAL FOLD

Sub-SMAS (Subsuperficial Musculoaponeurotic System)

The facial artery ascends over the mandibular border coursing just lateral and often deep to the depressor anguli oris (ie, the sub-SMAS). It continues into the perioral region intimate with the modiolus complex giving off the inferior and superior labial vessels. In the majority of instances, these vessels remain deep to the orbicularis muscle (ie, the sub-SMAS) as they traverse medially. This path may traverse the supra-SMAS plane in the philtrum or central lower lip in a smaller percentage of people.[20–24] Owing to this principle, many lip injections are performed in the supra-SMAS plane in the upper lip, philtrum and lower lip. The idea behind this approach is to maximize the return on the investment of volume and topographic alteration while attempting to avoid vascular complications.[25] Authors have described potential spaces in the subvermillion (ie, supra-SMAS) of the upper and lower lip that can be readily accessed with cannulas for lip augmentation.[11,26]

The inferior labial artery comes off the facial artery within an area 2.4 cm from the oral commissure and 2.4 cm superior to the lower border of the mandible traversing submucosal to the midline. The path of the artery is variable; the main trunk can travel as low as the labiomental crease or has high as the vermillion cutaneous junction.[20,21] The superior labial artery is not always a bilateral structure. Studies have shown that up to 43% of subjects had 1 superior labial artery. The branching of the superior labial artery off of the facial artery is generally in a 1.5 cm^2 area from the oral commissure at a depth of approximately 3.5 mm. The artery will commonly traverse cephalic the white roll for the lateral two-thirds of the lip and then dive caudal to the white roll at the proximal third of the lip at a depth of 3 mm as it terminates in the median tubercle of the upper lip. From there, the artery gives off an ipsilateral philtral branch[22] (**Fig. 8**). The philtral branch is suborbicularis 75% of the time; however, data has shown that the artery can travel superficial to the muscle in 25% of studied specimens.[27]

The facial artery then ascends from the perioral region medial to the nasolabial fold and most commonly crosses the fold at an average depth of 5 mm at the junction of the middle and proximal third of the fold.[11,28] It is at this point where there often seems to be an intimate relationship of the angular artery and the SMAS (see **Fig. 8**). This relationship seems logical since the artery's path courses through the insertions of SMAS into the nasolabial fold.[29–32] The SMAS and the angular artery are often interlaced until the artery approaches the region of the alar crease where it most commonly traverses subcutaneous as it gives of the lateral nasal artery. It then courses in the alar facial groove to anastomose with the dorsal nasal artery.

This vessel pattern is the reason several published resources suggest deep preperiosteal

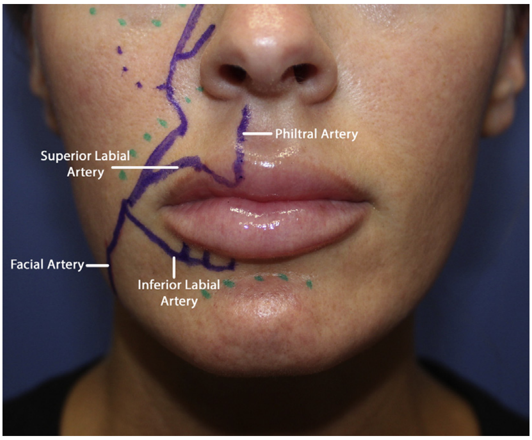

Fig. 8. Topographic markings for inferior labial, superior labial, and facial artery. Note the superior labial courses cephalic to the white roll for the lateral two-thirds of the ipsilateral upper lip and then traverses caudal to the white roll into the medial tubercle of the lip in the proximal third at an average depth of 3 mm. Then, a philtral artery branches vertical and superior toward the columella. The facial artery travels medial to the nasolabial fold and then crosses beneath the fold at the proximal third at an average depth of 5 mm.

injections on the bone in the anterior cheek and intradermal or immediate subdermal injection in the nasolabial fold. Additionally, studies recommend exercising caution in superficial injections in the peripyriform shadow because the depth of the angular artery at this level seems to be variable and less predictable.[16,33] To summarize, in the anterior cheek staying supra-SMAS in the nasolabial fold and sub-SMAS in the pyriform region are likely to be safe planes to help decrease the incidence of vascular injury (**Fig. 9**).

The main deep fat compartment of interest in the upper lip is the retro-orbicularis oris fat. As the name suggests, this compartment resides deep to the orbicularis oris muscle. It has been postulated that this fat compartment loses turgor with age and authors have postulated volumization of this compartment for perioral rejuvenation.[11]

Supra-SMAS (Suprasuperficial Musculoaponeurotic System)

Superficial fat compartments of the lip have been described; however, given the strong fibrous network between the perioral skin and the underlying musculature, this fat can be dispersed and vary in thickness, density, and demarcation. Three distinct boundaries define the subcutaneous boundaries of the perioral region: the nasolabial sulcus, the labiomental sulcus, and the submental sulcus. Volume augmentation in this region should be approached carefully and product selection is paramount, given the dynamic interplay of muscle and skin with animation.[3]

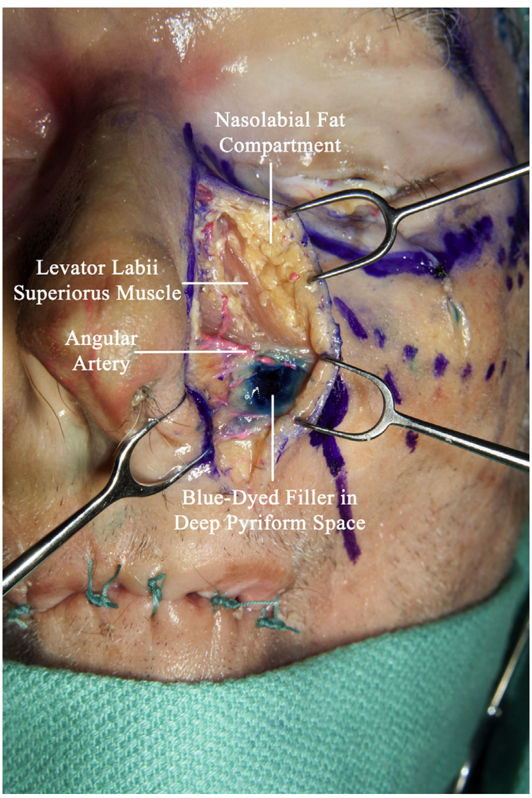

Fig. 9. Cadaveric dissection demonstrating blue dyed hyaluronic acid filler within the deep pyriform space and adjacent anatomic structures. Note the location and path of the latex injected angular artery vessels.

JAWLINE AND CHIN

Sub-SMAS (Subsuperficial Musculoaponeurotic System)

The sub-SMAS jawline contains the deep medial and lateral chin compartments as well as the mandibular osteocutaneous retaining ligament (MOCL) and platysma mandibular ligament (PML). Similar to the midface, these ligaments can act as boundaries of injection when performing volume correction of the prejowl sulcus.[11]

The PML is located approximately 5 cm distal to the gonial angle and acts as a fulcrum of stability for the platysma as it contracts over the jawline. The PML is analogous to the zygomaticocutaneous ligaments in that it possesses a hammock-like effect to help prevent injected volume to descend below the jawline into the neck. Additionally, the PML is analogous to the orbital retaining ligament owing to its stabilizing function on the platysma muscle (**Fig. 10**).[34]

The MOCL resides 5.6 cm distal to the gonial angle and 1 cm above the mandibular border. The

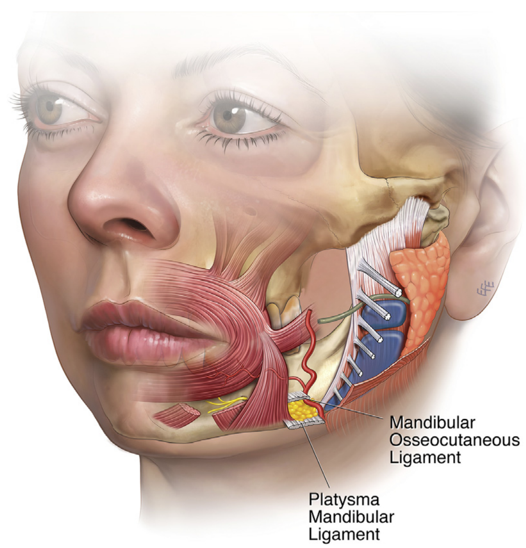

Fig. 10. Pertinent sub-SMAS anatomy of the jawline. The mandibular osseocutaneous ligament, PML, deep medial, and deep lateral chin fat compartments. (*Courtesy of* Levent Efe, CMI, Melbourne, Australia.)

ligament has been described as spanning 3.6 mm in width and interdigitates with the depressor anguli oris muscle. Therefore, the MOCL contributes to the lower marionette fold and is a transition point between the anterior jowl and marionettes.[34]

The deep chin fat contains medial and lateral compartments. The medial compartment lies on the mentum deep to the mentalis muscle and functions as a suitable target for deep chin augmentation. The deep lateral chin fat compartment lies deep to the depressor anguli oris muscle, facilitating muscle glide and has been described as a key injection target for volume correction of the prejowl sulcus (see **Fig. 10**).[11,12]

Several approaches to the prejowl have been described. The author's preferred approach is through a paramedian port via cannula injecting cephalic to the PML and caudal to the MOCL to volumize the deep lateral chin fat compartment. For injectors who prefer a more direct approach with a sharp needle, be mindful of the facial artery, which ascends over the jawline through the antigonial notch, delivering vessels within or along the undersurface of the depressor anguli oris muscle and then continuing cephalic to give off the inferior labial artery[11] (see **Fig. 10**; **Fig. 11**).

Supra-SMAS (Suprasuperficial Musculoaponeurotic System)

The supra-SMAS jawline contains the superior and inferior jowl compartments which are separated from the submandibular compartment by the cutaneous insertion of the PML. With aging, repeated gliding of the platysma over the mandible results in counter-clockwise shift of the compartments around the ligaments with gradual inferior descent. This leads to the commonly described stigmata of lower facial aging.[3,35,36]

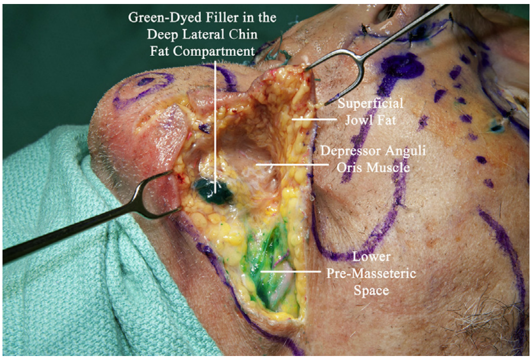

Fig. 11. Cadaveric dissection demonstrating green dyed hyaluronic acid filler deep lateral chin fat compartment. Note the relationship of the superficial jowl fat, depressor anguli oris and the facial artery branches relative to this sub-SMAS injection target.

TEMPLE

Sub-SMAS (Subsuperficial Musculoaponeurotic System)

The temple remains a controversial topic in the current realm of facial injections. To date, the question remains as to what is the best plane to inject. Certain authors target deep on the bone, others target superficial fat and, in some instances, intermediate targets are discussed.[11,37] A chronic issue with temple anatomy is that there are several different names for the same structure. Studies have attempted to simplify this.[38,39]

The etiology of the temple hollow has been well-studied and research shows that the anterior–inferior trough is the deepest part of the temporal fossa. In youth, this trough is camouflaged by bulky soft tissue; however, as the face ages, thinning of this soft tissue exposes the temple hollow, creating an aesthetic deformity.[40]

The deepest layer of fat in the temple is the temporal extension of the buccal fat pad (aka the deep temporal fat pad), which lies deep to the deep temporal fascia. Wedged between the 2 layers of deep temporal fascia is the intermediate temporal fat pad. Interestingly, the bulk of this quadrangular fat pad is focused in the anterior–inferior trough and studies show a volume loss with age in this compartment is a key component of aging the temple hollow. The intermediate temporal fat pad receives its

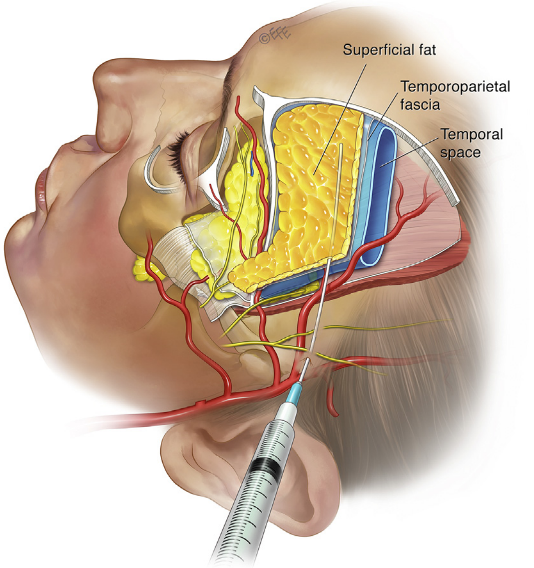

Fig. 12. Pertinent anatomy of the temple. Note the fat compartments of the temple and associated fascial layers along with the demonstration of the superficial temporal artery coursing within the temporoparietal fascia (ie, SMAS). (*Courtesy of* Levent Efe, CMI, Melbourne, Australia.)

vascular supply from the maxillary artery system (**Fig. 12**).

A potential space lies between the deep temporal fascia and the superficial temporal fascia titled the upper temporal space. This space is bordered superiorly by the superior temporal septum (STS) and inferiorly by the inferior temporal septum. A commonly described method of deep temporal augmentation is the use of an intersection point 1 cm superior along the STS and then 1 cm posterior to the STS with an injection directly on bone. Others have suggested adjusting this marking to 1.5 cm superior along the STS and 1.5 posterior to the STS[37] (**Fig. 13**).

Supra-SMAS (Suprasuperficial Musculoaponeurotic System)

The superficial temporal fascia is the SMAS equivalent in the temporal region. The superficial temporal artery travels within this fascia and often communicates with the orbital vascular system up to 70% of the time. This relationship between the superficial temporal artery and orbital vasculature is very important for each injector to understand as this has implications in vascular occlusions that can lead to blindness. The superficial temporal (subcutaneous) fat pad lies superficial to the superficial temporal fascia and is a common target for temporal volumization in the subcutaneous plane (see **Fig. 13**).

ORBIT

Periorbital injection is a hot topic in the current literature. As the specialty of plastic surgery transitions from a volume reduction era to the volume retention era in upper blepharoplasty the desire and necessity of infrabrow volumization is increasing.[41] However, detailed depictions of the periorbital vascularity are sparse. Actually, one can travel back to 1986 and credit Barry Zide and Glenn Jelks[42] with providing one of the first descriptions of tributaries stemming from the supraorbital and supratrochlear vessels. These tributaries can possess direct connections between the central retinal artery, the forehead and temple vasculature.

Anecdotally, many skilled surgeons demonstrate beautiful results from infrabrow injection. However, the question remains: What is the key to these surgeons avoiding vascular problems? A common port site is the lateral tail of the brow. The vessel that is in closest proximity to this port site is the supraorbital vasculature. In cadaveric dissection on a limited sample there appears to be an intimate relationship of the supraorbital tributary and the orbicularis muscle (**Figs. 14** and **15**). The SMAS envelopes the orbicularis on its anterior and posterior surface.[11] As is seen in other parts of the face, the vessels tend to run in and around this posterior lamella of SMAS. Therefore, the common description of hugging the orbital rim on the bone during infrabrow injection places the injection in a sub-SMAS plane and conceivably in a plane that may decrease the incidence of vascular injury. This is an important pearl considering the possible adverse sequelae of vascular compromise in this region (ie, blindness). However, more anatomic and clinical data is needed regarding the efficacy and safety of infrabrow volumization.

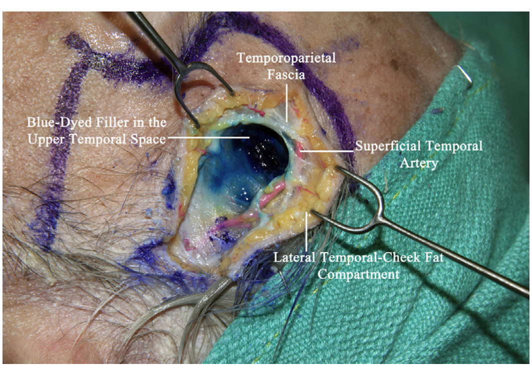

Fig. 13. Cadaveric dissection demonstrating blue dyed hyaluronic acid filler within the upper temporal space and adjacent anatomic structures. Note the location of the superficial temporal artery traveling within the temporoparietal fascia (ie, SMAS).

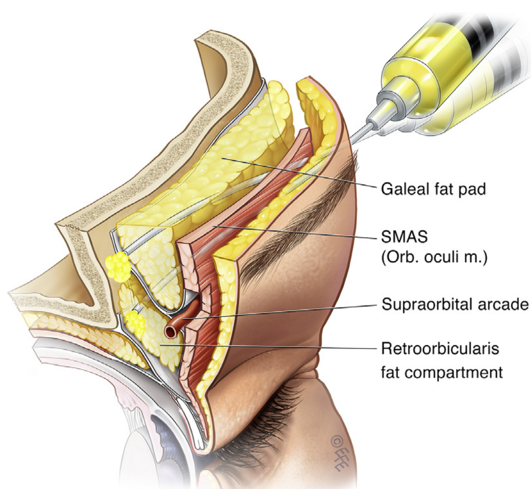

Fig. 14. The relationship of the SMAS, supraorbital arcade, retro-orbicularis fat compartment and galeal fat pad. (*Courtesy of* Levent Efe, CMI, Melbourne, Australia.)

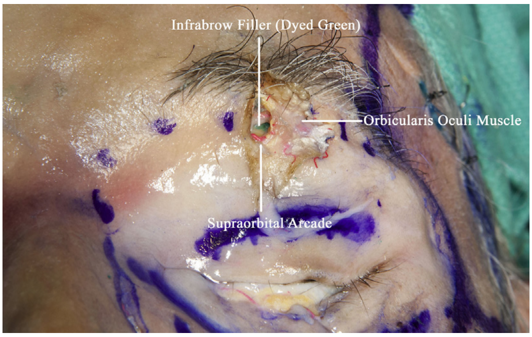

Fig. 15. Cadaveric dissection demonstrating green dyed hyaluronic acid filler within the retro orbicularis oculi fat compartment and adjacent anatomic structures. Note the location of the latex injected supraorbital vessel arcade running with the SMAS on the undersurface of the orbicularis oculi muscle.

SUMMARY

Facial volumization with filler and/or fat can serve as a finishing touch to compliment surgical repositioning of aging soft tissue. The depth of injection and anatomic awareness are paramount to help avoid vascular, lymphatic and other undesirable sequalae. Each aesthetic subunit can be approached in a systematic fashion to target sub-SMAS or supra-SMAS structures including fat compartments and potential spaces. This method can help the injector to obtain safe, accurate and aesthetically pleasing facial volume correction.

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