

Upper Face: Clinical Anatomy and Regional Approaches with Injectable Fillers

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Injection of facial fillers has been increasing globally as new injectable products have been developed and new applications have been identified. The basis for successful filler injections is a thorough knowledge of anatomy and an understanding of the products to be injected. Knowledge of the applied anatomy can maximize

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Background: The use of facial fillers has been rapidly increased as the range of injectable products and indications continues to expand. Complications may arise from improper placement or technique. This article highlights the importance of anatomic knowledge when using injectable fillers in the face.

Methods: A detailed review of the clinical anatomy of the upper face is performed. Regional approaches are described using the applied anatomy to efficiently and safely augment the different subunits of the upper face.

Results: Key aspects of safe and successful injection of fillers in the upper face include a thorough knowledge of the location of fat compartments and neurovascular structures. Awareness of these structures enables the practitioner to maximize injections, while avoiding damage to important nerves and vessels.

Conclusion: A detailed knowledge of the anatomy and properties of the product is paramount to maximize the efficacy while minimizing the risk of complications. (*Plast. Reconstr. Surg.* 136: 204S, 2015.)

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the efficacy of injections and minimize the potential complications.

Applied Anatomy for Injectable Fillers: Upper Face and Temporal Region

Any practitioner who injects fillers should have a thorough knowledge of all soft tissue and skeletal structures, from superficial to deep. An understanding of the volume deficiencies and the lifting capacity of the various filler substances is essential. It is important for the injector to know where the important neurovascular structures are located, in order to avoid injury. Because of the unique periorbital anastomoses of the internal and external carotid vascular system, devastating complications after periorbital filler injections are possible. These anatomical danger zones should be known and avoided. This article will provide an in-depth discussion of the layered anatomy of the upper face and temples as it applies to filler injections.

The Temporal Fossa

The temporal fossa is bounded by the curved superior temporal line (anteriorly and superiorly), the frontal process of the zygomatic bone (anteroinferiorly), and the zygomatic arch (inferiorly). The fossa contains the superior aspect of the temporalis muscle and its layered fascia, the superficial temporal artery and vein, and the auriculotemporal nerve (V3). At the superior temporal line (the region of the conjoined tendon), the temple transitions to the forehead, and at the zygomatic arch inferiorly, the temple transitions to the midface.

The temporal hairline courses variably and obliquely through the temporal region. The anteroinferior region is non-hair bearing, and the superolateral region contains the temporal hair. The hair-bearing region is vascular, with thick skin and abundant subcutaneous tissue.

The anatomical layers of the temporal fossa from superficial to deep begin with the skin (layer I), the subcutaneous tissue (layer II), the superficial fascia (layer III), the loose areolar tissue (layer IV), and the deep temporal fascia (DTF) (layer V) (Fig. 1). The temporalis muscle, deep to the DTF, is designated layer VI (Fig. 2). The fascial layers of the temporal fossa have been identified by many names¹ (Table 1). Lack of precise nomenclature has caused confusion in the literature and added to misunderstanding of the anatomy in this region. As in all regions of the head and neck, both superficial and deep fascia exist, and these 2 fascial layers are separated by loose areolar tissue. The temporoparietal fascia (TPF),

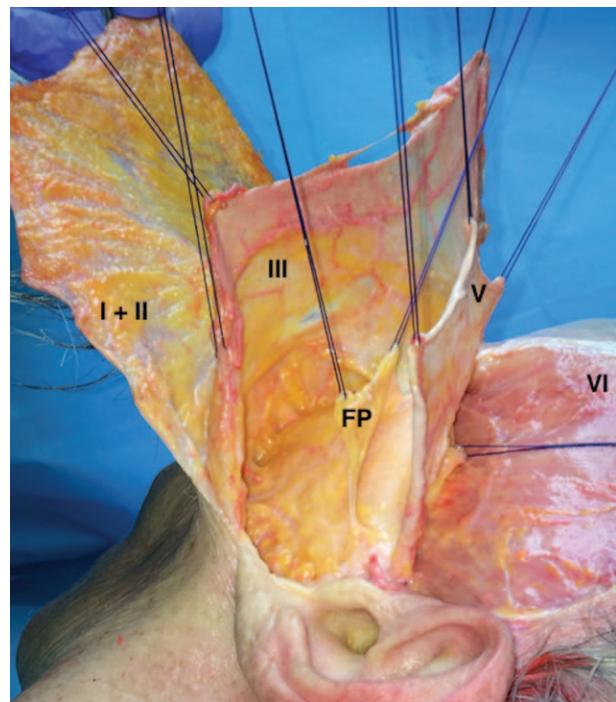


Fig. 1. Layers of the temple. I, skin; II, subcutaneous tissue; III, TPF (superficial temporal fascia); FP, temporal fat pad; V, DTF; VI, temporalis muscle.

also termed the superficial temporal fascia, lies just beneath the subcutaneous fat of the temporal region. It is a thin, pliable, and vascular layer that is tightly bound to the overlying skin. Dissection in the plane just superficial to the TPF layer contains and is supplied by the superficial temporal narrow-caliber vessel and is one of the terminal branches of the external carotid artery² (Fig. 3). It supplies the TPF and makes this a reliable tissue source for auricular and midface reconstruction.

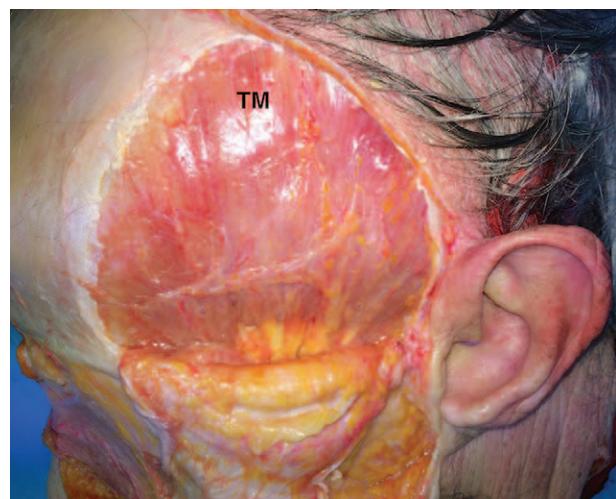


Fig. 2. Cadaver dissection after reflection of the DTF showing the temporalis muscle (TM).

Table 1. Layers of the Temporal Fossa

Accepted Nomenclature	Other Names Used
Skin (layer 1)	
Subcutaneous tissue (layer 2)	
TPF (layer 3)	Superficial temporal fascia
Loose areolar tissue (layer 4)	
DTF (layer 5)	
Superficial layer	
Deep layer	Intermediate fascia
Temporalis muscle (layer 6)	
Pericranium	
Temporal bone	

The TPF (layer III) is the superior extension of the superficial musculopaponeurotic system (SMAS) of the midface³ (Fig. 4). The SMAS of the midface is discontinuous at the level of the zygomatic arch, where it is contiguous with the TPF. At the superior temporal line, the TPF becomes continuous with the epicranial aponeurosis of the forehead.

The TPF is separated from the underlying DTF by loose areolar tissue (layer IV). The loose areolar tissue thickens into a superior temporal septum, which is located at the temporal crest (also designated the superior temporal line), and an inferior temporal septum⁴ (Fig. 5). The inferior temporal septum separates the temporal region into a superior and an inferior compartment. The superior and inferior temporal septi fuse anteriorly near the tail of the brow.

The DTF, also termed the temporalis muscle fascia, is a thickened layer of connective tissue which covers the underlying temporalis muscle (Fig. 6). Traveling within the DTF are the middle

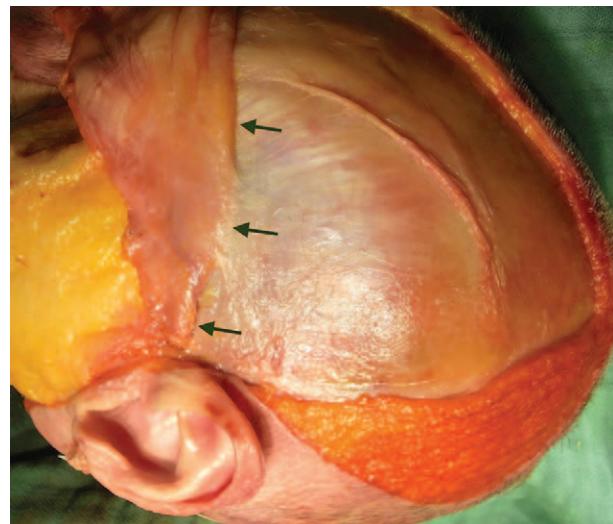


Fig. 4. Left-sided cadaver dissection depicting the continuity of the TPF of the temporal region with the SMAS of the midface.

temporal vessels, which along with the deep temporal artery and vein, supply the temporalis muscle. The DTF is a single layer in the superior portion of the temporal fossa. In the inferior temporal fossa, the DTF divides approximately 2–3 cm above the zygomatic arch. The DTF splits into 2 layers to envelope the temporal fat and then to ensheathe the zygomatic arch. The superficial layer of this DTF is termed the “intermediate” fascia.⁵

The fat compartments in the temporal fossa have confusing terminology (Table 2). The fat that is deep to the TPF and lies within the 2 layers of the DTF is often termed the “superficial” fat pad of the temple. This is a misnomer, as this fat layer is contiguous with the sub-orbicularis oculi

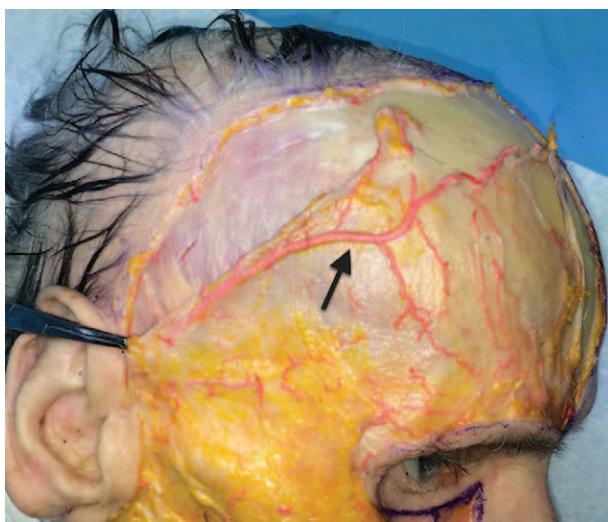


Fig. 3. Cadaver dissection after reflection of the skin and the subcutaneous tissue showing the TPF with the arrow pointing to the frontal branch of the superior temporal artery.

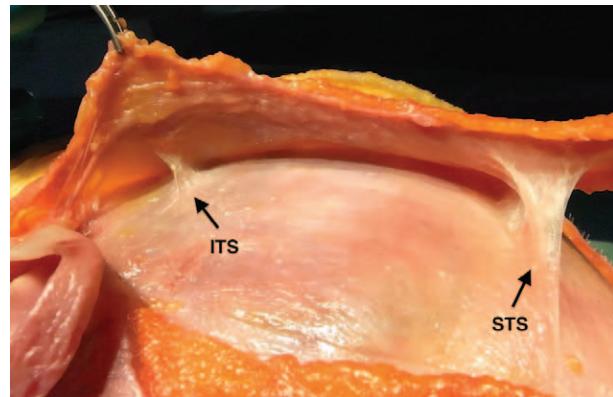


Fig. 5. Left-sided cadaver dissection showing the inferior temporal septum (ITS) and the superior temporal septum (STS). These septi join near the tail of the brow and connect the galea (level III) with the periosteum (level V).

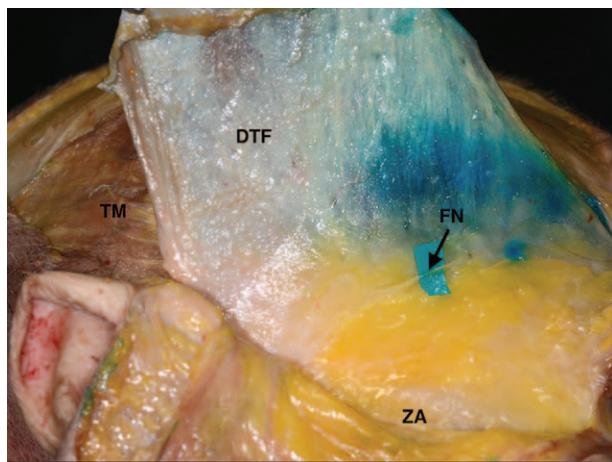


Fig. 6. Right-sided cadaver dissection with inferior reflection of the skin, subcutaneous tissue, and TPF. The DTF is shown elevated off the temporalis muscle (TM). The temporal branch of the facial nerve (FN) is shown with an arrow underling the TPF. The zygomatic arch (ZA) is shown at the inferior aspect of the photograph.

fat of the midface. This fat is, of course, deep fat. The fat enveloped by the DTF would therefore be more appropriately termed suprazygomatic fat of the temple. There is a deeper layer of fat of the temple which lies deep to the zygomatic arch and is continuous with the buccal fat of the midface. This fat could be termed the deep or retrozygomatic fat of the temple. (See Video, Supplemental Digital Content 1, which demonstrates the clinical anatomy of the upper face and temporal region, available in the “Related Videos” section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B449>.)

Filler Injection of the Temple

Augmentation of the deficient temporal fossa can be accomplished with surgical alloplasts, augmentation with autologous fat, or injection with a variety of “off-the-shelf” filling agents. Safe placement of a substance for temple augmentation is dependent on the agent used. The 3 potential planes for augmentation are as follows: (1) The immediate subcutaneous plane (superficial to

the TPF), (2) just deep to the TPF (between the superficial and deep fascia), and (3) deep to the temporalis muscle (see Video, Supplemental Digital Content 1, <http://links.lww.com/PRS/B449>).

The desirable plane for placement of injectable filler or implant is based on the augmentation material used. Hyaluronic acids (HAs) should be placed in either the subcutaneous plane or the plane between the superficial and DTF. Alloplast implants, such as expanded polytetrafluoroethylene, or injection of filler substances, such as poly-L-lactic acid, calcium hydroxylapatite, or hyaluronic acid gels (HAGs) with a high G', should be placed deep to the temporalis muscle to assure maximal soft-tissue coverage. This is especially true in the temple, where the temporalis muscle has a strong contraction. If these substances are placed within the temporalis muscle, migration or lumping of the particles can occur.

Anatomy of the Forehead

The boundaries of the forehead are the frontal hairline (superiorly), the eyebrows and the nasal root (inferiorly), and the temples (laterally). In patients with hairline recession, the superior extent of the forehead is considered at the superior border of the paired frontalis muscles. The transition between the forehead and the temporal regions is the superior temporal lines or the anterosuperior extent of the temporalis muscles. In this region, the fascial planes fuse and are termed the conjoined tendons. The skull in the temporal fossa is concave, accommodating the temporalis muscle, while the shape of the forehead is convex.

The central forehead and scalp consist of 5 distinct layers identified by the mnemonic



Video Available Online

Video 1. Supplemental Digital Content 1, demonstrating the clinical anatomy of the upper face and temporal region, is available in the “Related Videos” section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B449>.

Table 2. Fat Compartments of the Temporal Fossa

Widely Used Names	More Appropriate Anatomical Terms
Subcutaneous fat	
Superficial temporal fat pad	Suprazygomatic temporal fat
Deep temporal fat pad	Retrozygomatic (deep) temporal fat (contiguous with buccal fat of the midface)

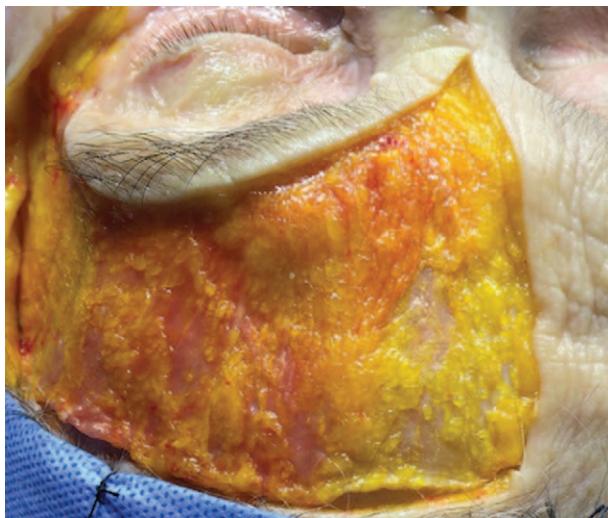


Fig. 7. Left-sided cadaver dissection with removal of the skin showing thick subcutaneous tissue, galea aponeurosis, and underling frontalis muscle.

SCALP (skin, connective tissue, aponeurosis, loose areolar connective tissue, and pericranium). The skin of the forehead and scalp is thick, averaging 2381 microns in thickness⁶ (Fig. 7). Only the epidermis overlying the mentum, approximately 2500 microns, is thicker. The thick and well-vascularized forehead skin contrasts sharply with the adjacent thin and delicate skin of the eyelid.

The galea aponeurosis, or epicranial aponeurosis, is the fibromuscular extension of the SMAS of temple and lower face (Fig. 8). The galea is a tendinous sheet connective tissue, which encircles the entire skull. The galea splits to envelop the

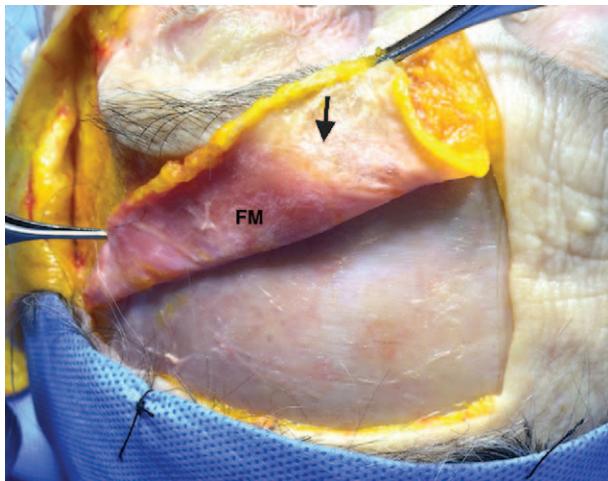


Fig. 8. Left-sided cadaver dissection with reflection of the galea aponeurosis (arrow) which envelopes the frontalis muscle (FM).

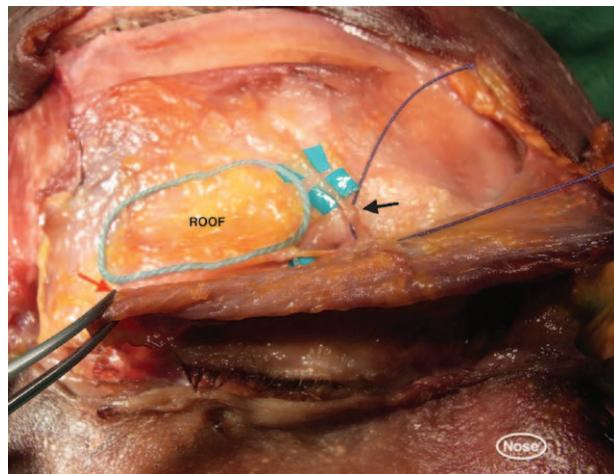


Fig. 9. Right-sided cadaver dissection with inferior reflection of the galea aponeurosis and frontalis muscle showing the retroorbicularis oculi fat (ROOF), the supraorbital neurovascular bundle (black arrow). Note that the ROOF is deep to the orbicularis oculi muscle (red arrow).

frontalis, the occipitalis, the procerus, and the periauricular muscles.

The loose areolar tissue of the forehead and scalp is an avascular layer connecting the overlying galea and the underlying pericranium.

Filler Injection of the Brow and Upper Eyelid

The retroorbicularis oculi fat is the deep fat compartment of the upper eyelid and brow. This fat gives shape to the brow and to the upper eyelid above the supratarsal fold.⁷ The fat pad lies deep to the orbicularis oculi muscle and the inferior extension of the galea aponeurosis and lies

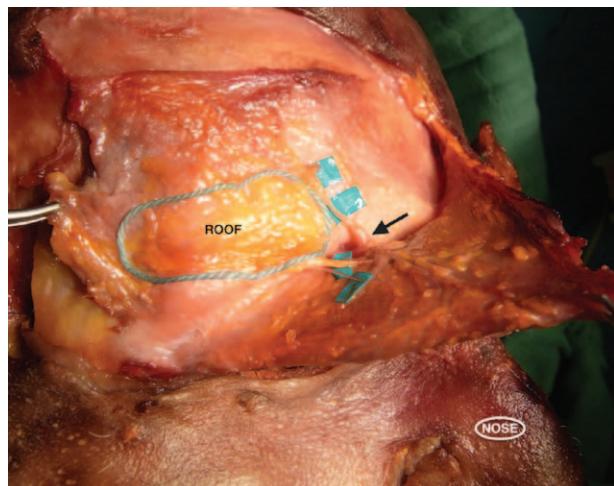


Fig. 10. Oblique photograph of the right side of the cadaver showing the retroorbicularis oculi fat and its relationship with the supraorbital neurovascular bundle (arrow).

superficial to the pericranium (Figs. 9 and 10). Loss of volume within this fat compartment contributes to deflation and descent of the tail of the brow and can create a deep sulcus of the upper eyelid.^{8,9}

Augmentation of the lateral brow and upper eyelid can enhance periorbital appearance. When the filling agent is placed deep to the tail of the brow, 3-dimensional brow correction including vertical lifting and horizontal brow projection is achieved. The filler should be placed lateral to the supraorbital neurovascular bundle (to avoid injury) and deep to the orbicularis oculi muscle (Fig. 11). If the supraorbital notch can be palpated, injection in the avascular subgaleal glide plane between the supraorbital and supratrochlear neurovascular bundles can be performed.

Augmentation of the superior sulcus of the upper eyelid can be accomplished with an injection just inferior to the supraorbital rim. Placement of HAG below the rim, deep to the orbicularis muscle, and superficial to the levator aponeurosis can provide volume into a skeletonized orbit, improving the appearance of the upper eyelid. It is important to avoid injury to the underlying septum orbitalis, upper eyelid fat pad, and levator mechanism of the upper eyelid. These structures should be deep and inferior to the area of injection.

Summary

Augmentation of the temple and periorbital region can provide significant enhancement of the upper facial appearance. To accomplish this,

a thorough knowledge of pertinent anatomy is required to maximize the efficiency of injection and to minimize the incidence of complications.

REGIONAL APPROACHES

Forehead

Nowell Solish, MD, FRCP; Toronto, Ontario, Canada

The shape and contour of the forehead is variable. Most consider an esthetically pleasing forehead to be round and smooth. Injectable fillers have become a much less invasive treatment option for reshaping of the forehead.

In my practice, I prefer to use HA fillers. They have the advantages of being moldable and reversible. I do not feel that any one product is superior over another. I would suggest using one that has the ability to aid in projection of the forehead. Typical examples for me include Volift, Voluma, or Perlane, but many others can be used.

Typically, the area to be injected is the mid forehead. At this level (mid forehead), the supraorbital and supratrochlear vessels have become more superficial. To decrease the risk of intravascular injection, the filler should be placed at the level of the periosteum. At this level, one is likely to be underneath the vessels. I am not sure how reliable aspiration is with a 30-gauge needle, but one can try to aspirate before injecting to help decrease the risk of being intravascular. I prefer to use a technique where I inject small boluses of approximately 0.2 mL of filler across the forehead. The boluses are placed like small tent poles in order to increase the projection of the forehead. I will gently mold the boluses to make sure that the contour looks even. Typical volumes for me are approximately 1 cc in total.

I use a syringe with a needle, I often transfer my HA in to insulin syringes for control, but this is a personal preference and is not necessary. I use the B-D syringes with a 30gauge needle, which is similar in diameter to most needles that are co-packed with the HA syringes. I do not dilute my filler. I have no data to prove if there is any disruption of the product through these syringes but clinically have not noticed any difference. Others prefer the use of a cannula in this area. I do not over inject this area, I use a profile view to judge my endpoint and inject to full correction. (See Video, Supplemental Digital Content 2, which demonstrates Dr. Solish's

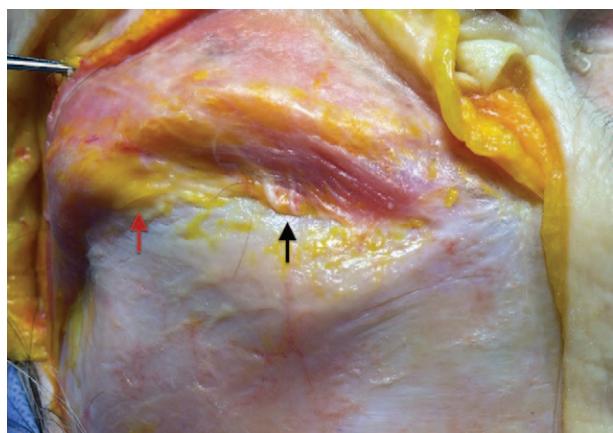
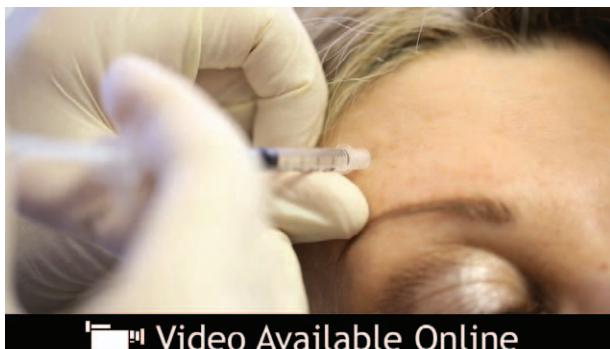


Fig. 11. Left-sided cadaver dissection shown in a subgaleal dissection plane with the *black arrow* pointing to the supraorbital nerve and the *red arrow* pointing to the retroorbicularis oculi fat pad. The safe zone for injection of autologous fat of fillers is lateral to the supraorbital neurovascular bundle.



Video Available Online

Video 2. Supplemental Digital Content 2, demonstrating Dr. Solish's personal technique for injecting HA fillers into the forehead, is available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B450>.

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**Jean Carruthers, MD, FRCSC,
FRC(OPTH), and Alastair Carruthers, MA,
BM, BCh, FRCPC, FRCP(Lon); Vancouver,
British Columbia, Canada**

Many middle-aged individuals develop a scalloped area in their mid forehead, which gives them the appearance of age and also being careworn. Because they usually have some moderate degree of associated brow ptosis, using neuromodulator to smooth out the horizontal forehead lines is not helpful as it drops their brows and makes them both look and feel angry.

Reflating the forehead with a diluted HA filler allows them to again present a smooth forehead, to lift their brows to express interest and compassion, and to reduce the etched appearance of the horizontal frontalis lines.

We deposit 2 cc of HA filler, diluted 100–150% with preserved saline (total volume now 4 cc) in 3 locations. One at each lateral brow at its junction with the temporal fusion line and in mid glabella between the supratrochlear vessels, we deposit about 1.3 cc of the diluted product into the subgaleal glide plane. We then massage the product using a thin gel lubricant (Cytotec) so that the forehead is smooth.

The technique requires the delivery of approximately 1.3 cc of the diluted HA filler at each injection portal using the anterograde injection technique. Most injectors use the retrograde technique where the needle or cannula is inserted, and injection occurs as the injecting module is

gently withdrawn. Used in this fashion, allows the injecting module the opportunity to inadvertently lacerate or penetrate a blood vessel.

In our anterograde technique, the needle or cannula tip is inserted into the subgaleal space, and then after safe aspiration, the product is gently deposited as the injecting module is moved forward. This adds to the safety profile because the bolus of HA being introduced is much softer than a tip of either a needle or a cannula.

The subsequent massage of the diluted product in the subgaleal plane avoids further needle insertion and also gives a smooth and soft youthful appearance to the forehead as it elevates the brow and reduces the severity of the etched horizontal forehead lines.

We always withdraw the plunger whether we are using a needle or a cannula—you can see in this video blood coming into the hub of the needle. At this point, it is necessary to remove the needle and reinsert, again withdrawing to be sure the needle tip is not intravascular.

This technique allows for a natural look with preservation of expressive forehead movement. It lasts for 9–12 months. (See **Video, Supplemental Digital Content 3**, which demonstrates Drs. Jean and Alastair Carruthers' personal technique for reflating the forehead using diluted HA, available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B451>.)

Amir Moradi, MD; Vista, Calif.

Restylane is a transparent, viscous gel composed of HA biosynthesized by Streptococcus species of bacteria, chemically cross-linked with 1,4 butanediol diglycidyl ether, and suspended in physiologic buffer at pH = 7 and concentration of



Video Available Online

Video 3. Supplemental Digital Content 3, demonstrating Drs. Jean and Alastair Carruthers' personal technique for reflating the forehead using diluted HA, is available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B451>.

20 mg/mL Restylane is intended for mid-to-deep dermal implantation. One of the consequences of the aging process includes loss of volume in the face, due to loss of bone, collagen, and fat in the subcutaneous area. Restylane is approved by the US Food and Drug Administration for the correction of moderate-to-severe facial wrinkles and folds. Its texture is ideal for correction of forehead lines because of its small particle size and hydrophilic potentials as compared with other HAs.

The treatment site should be cleaned with a suitable antiseptic solution and a topical anesthetic ointment. Restylane is administered using a 30- to 32-gauge needle by injecting the material into the superficial dermis. (**See Video, Supplemental Digital Content 4**, which demonstrates Dr. Moradi's personal technique for injecting Restylane into the superficial dermis of the forehead, available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B452>.) Each injection site should be massaged to conform to the contour of the surrounding tissues.

The aesthetic endpoint should be the improvement of the lines. Care should be taken to not over correct. To ensure safety when injecting the forehead lines, all injections must be performed superficially in the mid to superficial dermis. This will decrease the possibility of intra-arterial injection. The main arterial supply to the forehead is through the supraorbital, supratrochlear, and superficial temporal artery. Small branches from these arteries enter the undersurface of the deep dermis radially and branch out into small caliber vessels; therefore, all injections must be performed superficial to this layer to avoid intra-arterial injections. The possibility and magnitude of skin necrosis is directly correlated to the location of the artery embolized (proximal vs distal) and the volume of the bolus injected. Proximal injection and larger volumes would cause embolization of a larger zone and lead to occlusion of end arterioles, which can make collateral circulation ineffective.

The complications can be catastrophic when a larger caliber artery is injected with high pressure or large lumen needle or cannula. In those cases, a retrograde displacement of the particles can enter the larger arteries, such as the internal maxillary artery, and subsequently cause a much larger necrotic effect and possibly blindness due to retinal artery occlusion. It is vital to keep the boluses under 0.02 cc and not to penetrate beyond the dermis.



Video Available Online

Video 4. Supplemental Digital Content 4, demonstrating Dr. Moradi's personal technique for injecting Restylane into the superficial dermis of the forehead, is available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B452>.

Safety considerations include using the correct volume to correct the deficiency. Expected adverse events can include bruising, swelling, bumps lasting for up to 7 days, and redness lasting 1–2 days. Unanticipated adverse events include bumps lasting longer than 7 days, redness as a sign of infection, skin necrosis, hyperpigmentation of the skin, irregularity at the skin surface, allergic reaction at injection site (itching, swelling, and redness), anaphylactic reaction (generalized rash, swelling, and shortness of breath), and a drop in blood pressure.

Temples

Arthur Swift, MD, CM, FRCS (C); Montreal, Quebec, Canada

Treatment of Temple Hollows (One Up, One Over).

Safe correction of overly scaphoid temporal hollows can be achieved only through a solid understanding of the injection anatomy of the region. The temporal crest or fusion line is an important forehead surface landmark that is most palpable at the eyebrow level. This delineates the temporal fossa that houses the temporalis muscle, a muscle of mastication. Unlike the gliding muscles of facial expression, the temporalis must generate significant pull on the mandible and so is firmly anchored high up to the temporal bone. The fan-like muscle is thin in its upper portion and thickens into a fibrotendinous muscle as it converges to insert onto the coronoid process of the mandible. The dense galea fascia of the forehead therefore continues laterally over the temporalis muscle as the DTF, an anatomical oddity of which the injection specialist can take advantage for dispersion of filler product with this technique.

The ramus frontalis branch of the superficial temporal artery traverses the fossa in the deep leaves of the superficial temporal fascia overlying the DTF on the muscle surface, anastomosing more commonly with the ipsilateral supratrochlear artery of the forehead. Superficial needle injection of filler in this region should be avoided, as inadvertent intravascular injection into this system of vessels can pass retrograde into the ophthalmic artery causing central retinal artery occlusion. The deep temporal arteries (anterior and posterior), branches of the second division of the internal maxillary artery, as well as the middle temporal artery, pass within the deep substance of the muscle, diminishing in diameter as they ascend the fossa. A superficial plexus of veins, if not apparent through the temporal skin, can be better visualized and marked once engorged by placing the head in a forward position.

Planned injection is a single puncture, vertically oriented down to bone, 1 cm up the temporal fusion line and 1 cm lateral, parallel to the supraorbital rim (one up, one over). (**See Video, Supplemental Digital Content 5**, which demonstrates Dr. Swift's personal "one up, one over" technique to treat signs of aging in the temple hollows, available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B453>.) Digital pressure confirms the absence of a pulse at the injection site, and any obvious veins are avoided. Aspiration prior to injection is suggested, although the absence of blood reflux is not a guarantee of extravascular location of the needle tip. Maintaining the tip of the needle on bone is crucial to avoiding inadvertent intravascular injection. This location, selected high up near the temporal crest

where the muscle fibers are sparse, remains relatively avascular in that any terminal branches of the more posterior deep temporal vessels are of no relative consequence to injection. Inadvertent piercing of a more superficial artery or vein will result in deposition of product deep to the vessel on bone and should limit adverse events to possible bruising in the area. Again, in this region of the fossa, it is mandatory to be close to the temporal fasciae lata (1 cm lateral), anterior (1 cm superior to the supraorbital rim), and absolutely deep (the needle must be touching bone) to deposit filler in this relatively avascular plane that is devoid of any significant vessels. Maintaining the needle on bone during the entire slow injection period is fundamental for a safe outcome.

Using a product of significant G' and cohesivity, a vertical tent pole will be created that traverses the thin fibers of the temporalis muscle in this region and then spreads between the DTF and muscle creating a canopy effect, filling the hollow. The product will spread circumferentially from the injection point, stopping at the fused fascia/bone interface of the tensor fasciae lata and supraorbital rim but continuing inferiorly, as intended, toward the zygomatic arch. Placement of an index finger posterior (behind) the injection point during injection will prevent the undesirable and irrelevant spread of product under the hair-bearing scalp. The author has found this technique to be the most economical, with typical volumes of HA filler ranging from 0.25 to 0.75 cc per temporal hollow. Withdrawal of the needle, which may have injured a deeper vessel (external sentinel vein), mandates gentle pressure for several minutes. This pressure is important in the absence of any obvious bleeding from the puncture site, in order to avoid delayed ecchymosis. Mild molding of product or gentle massage of the temple posttreatment is occasionally indicated.

Superficial treatment of temporal hollows is also possible with the use of a lower G' product through a blunt cannula, preferably in a direction perpendicular to the superficial temporal arterial branches. Sharp needle penetration into the deeper portion of the temporal fossa above the zygomatic arch is strictly contraindicated, due to the presence of the branches of the second portion of the internal maxillary artery, the embolization of which has led to necrosis of the ipsilateral palate.

The aesthetic goal of temple fill in the female is to maintain a flat or slightly concave or convex curvature to the temple region. Obvious convexity signifies large muscle mass and is a masculinizing



Video Available Online

Video 5. Supplemental Digital Content 5, demonstrating Dr. Swift's personal "one up, one over" technique to treat signs of aging in the temple hollows, is available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B453>.

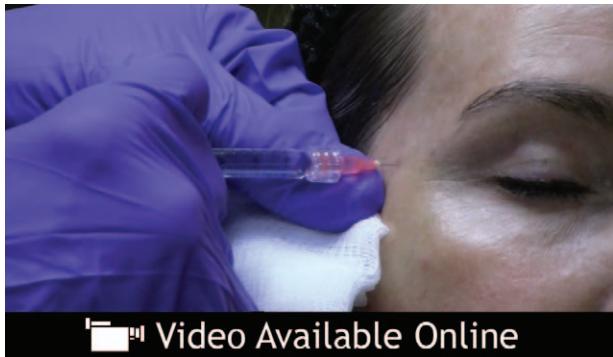
feature which must be avoided. An upward and outward elevation of the tail of the eyebrow is commonly noted posttreatment and will often persist for several months. Patient satisfaction with the technique is noted to be high, as rather than “disappearing around the corner” and falling into the hollow of the temple, the beautiful aspect of the tail of the brow is now visible when looking in the mirror on the anteroposterior view.

Amir Moradi, MD; Vista, Calif.

Restylane is approved by the US Food and Drug Administration for the correction of moderate-to-severe facial wrinkles and folds. Its texture is ideal for temporal fossa volumization because of its small particle size and hydrophilic potentials.

The treatment site should be cleaned with a suitable antiseptic solution and a topical anesthetic ointment. Restylane is administered using a 30-gauge needle by injecting the material into the subcutaneous tissue. To minimize trauma, the needle should be inserted perpendicular to the skin. Once passed through the dermis, the angle can be changed to 45 degrees so that the Restylane can be placed in the subdermal space at the level of the superficial temporal fascia. Each injection site should be massaged to conform to the contour of the surrounding tissues. A touch-up can be administered 4 weeks after the initial treatment.

The aesthetic endpoint should be a correction of the volume deficit in the temporal fossa and a more youthful appearance for the patient. (**See Video, Supplemental Digital Content 6**, which demonstrates Dr. Moradi’s personal technique for temporal fossa volumization using Restylane, available in the “Related Videos” section of the full-text article on PRSJournal.com or, for Ovid



■ Video Available Online

Video 6. Supplemental Digital Content 6, demonstrating Dr. Moradi’s personal technique for temporal fossa volumization using Restylane, is available in the “Related Videos” section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B454>.

users, at <http://links.lww.com/PRS/B454>.) Care should be taken to not over correct.

The vascular supply to the temple is through 3 branches of external carotid artery: superficial temporal, middle temporal, and deep temporal arteries. The superficial temporal artery is encased in the superficial temporal fascia, which first travels superiorly above the tragus and then turns horizontal toward the midline. The deep temporal artery lies in the DTF over the periosteum at the depth of the temporal fossa and middle temporal artery, a proximal branch of the superficial temporal artery supplies the mid musculofascial zone. Deeper injections beyond the subcutaneous layer place these arteries at risk. The deep temporal artery is a branch of internal maxillary artery. Retrograde injection of this artery can lead to catastrophic complications beyond skin necrosis, such as blindness.

We prefer the use of a 29- to 30-gauge needle based on the precision when intersecting multiple small aliquots of 0.01–0.02 cc. We believe that the superficial injections allow more precise and direct correction of the subcutaneous volume loss.

Safety considerations include using the correct volume to correct the deficiency. Expected adverse events can include bruising, swelling, bumps lasting for up to 7 days, and redness lasting 1–2 days.

Unanticipated adverse events include bumps lasting longer than 7 days, redness as a sign of infection, skin necrosis, hyperpigmentation of the skin, irregularity at the skin surface, allergic reaction at injection site (itching, swelling, and redness), anaphylactic reaction (generalized rash, swelling, and shortness of breath), and a drop in blood pressure.

Brows

Guy G. Massry, MD; Beverly Hills, Calif.

HAG can be used to lift the temporal brow¹⁰ and fill primary or secondary (postsurgical) upper eyelid hollows.^{11,12} The author has found fewer contour issues, blue color changes, and hydrophilic reactions in the upper periorbita as compared with its lower counterpart. This has allowed a slightly more aggressive approach to injection as more “room for error” may exist with eyebrow/upper eyelid injections. This upper/lower eyelid discrepancy may be explained by assessing how HAG fillers clinically behave in these distinct locations. Recently, anatomic cadaveric studies of Juvederm injected deeply to the eyebrow and infraorbital hollows have shown very different

patterns of migration of the gel after treatment. In the lower eyelid/cheek interface, the gel tends to spread from deep to superficial and is present in multiple planes, while below the eyebrow it stays deep, suggested to be impeded by fibrous septa within the brow fat pad.^{13,14} This may explain, in part, why edema, color, and contour changes are less frequently encountered in this site.

Volumetric expansion of the subbrow tissue is the principal behind filler-induced brow lifting. The author initially noted this potential years ago prior to injecting filler by observing the same effect when injecting local anesthetic during brow lifting surgery. This has also been shown in the office setting.¹⁵ As with infraorbital hollow HAG filler injections, the skin is prepped, regional nerve blocks (lacrimal/supraorbital) are given, and a cannula entry port is created just lateral to the outer brow. A 25-gauge 1½-inch cannula is advanced parallel to the supraorbital rim just above bone to an appropriate distance assessed clinically (typically to the hub of the cannula). As shown in the accompanying video, after initial resistance from connective tissue elements (a pop is felt when penetrated), the cannula moves freely in this plane without resistance. (See Video, **Supplemental Digital Content 7**, which demonstrates Dr. Massry's personal technique for using HAG filling for the brows, available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B455>.) The gel is injected in a retrograde fashion after aspiration on the plunger. Lifting the brow with the noninjecting hand elevates the subbrow tissue above the orbital rim which more directly and precisely expands this plane. The author has found this, in combination with massage of the gel

over the backstop of the frontal bone, an elegant way to improve contour and the overall result in general.¹² Typically, 0.5–1 cc of filler is sufficient as more than subtle changes can look artificial. Restylane is preferred here as its biophysical characteristics promote a 3-dimensional lift.

When addressing upper eyelid hollows, especially after previous overresected blepharoplasty (A-frame deformity), the "lift, inject, massage" technique described above is especially useful.¹² In the author's experience, these combined maneuvers are more reliable and require less product than attempting to fill the eyelid hollow or "black hole" directly. After fill and "massage on bone," when the lid returns to its native position, the contoured and smooth dispersion of the HAG imparts a very natural appearance (Fig. 12). A half cc of filler is often a good starting point in this scenario. As a general rule, avoid injecting the eyelid proper (below the rim) to prevent an inadvertent alteration in lid position and function.^{12,15}

Finally, the author recently described a normal age-related depression at the nasal eyebrow/eyelid transition, which has been called the "orbitoglabellar groove" related to its adjacent anatomic structures.¹⁶ This periorbital hollow is continuous with the nasojugal groove (tear trough) at the lower lid/cheek interface. Like in the infraorbital area, this depression can be effaced with small amounts of 0.3–0.5 cc of filler. In this location, the author injects mid-depth (to avoid supraorbital vascular bundle) with adjunctive massage over the rim for contour. This is the one area of the eyebrow/eyelid complex in which the author prefers Belotero as it is softer and less viscous.

Val Lambros, MD, FACS; Newport Beach, Calif.

Eye movement tracking shows that when people interact, the brows and periorbital areas are among the most observed part of the face, along with the mouth and perioral areas. These are the most expressive parts of the face; a large amount of meaning can be compressed into a small geography; hence, small alterations in these areas can make large differences in the perceived facial information transmitted and received. Experience shows that filling the brow and upper lids can improve the look of the eyes and periorbital area considerably. Here, a technique of filling the brow is described using HA fillers (Fig. 13).

Traditional blepharoplasty techniques, being surgical, have relied on the things that surgery does best, removing skin and fat. Although there is a long history of successful patient treatments



■ Video Available Online

Video 7. Supplemental Digital Content 7, demonstrating Dr. Massry's personal technique for using HAG filling for the brows, is available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B455>.

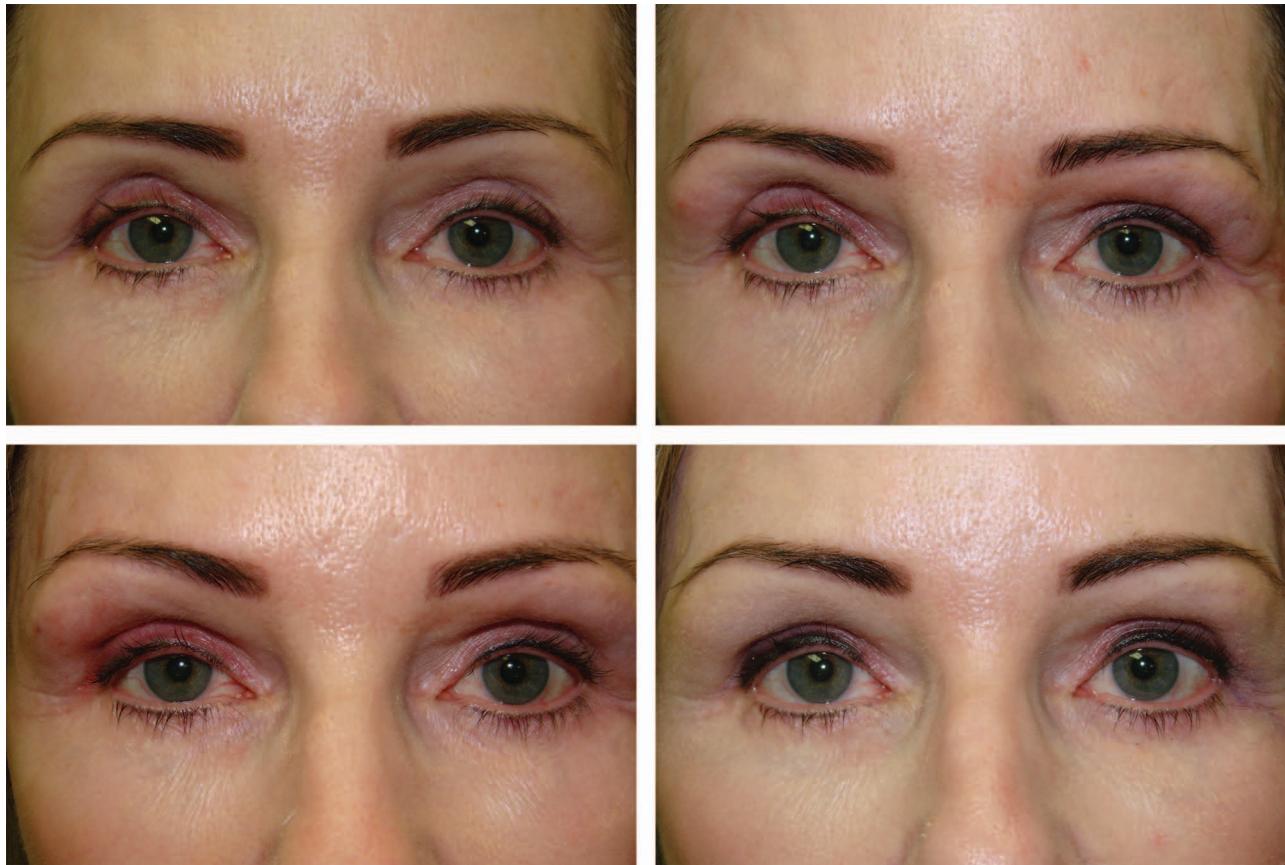


Fig. 12. (Above, left) Post-upper blepharoplasty appearance of a woman with hollowed upper lids. (Above, right) Immediately after fill with Restylane via “lift, inject, massage” technique on left. (Below, left) Immediately after fill with Restylane via “lift, inject, massage” technique on right. (Below, right) Final result at 6 weeks.

Lambros

doing traditional blepharoplasties, the procedure has its limitations. Being essentially a subtractive procedure, the eyelids are defatted, the upper lids become more hollow and defined and the bony orbit becomes visible. The answer is clearly to fill the orbit, but how?

At this time, injected fat is commonly used but has some problems with reliability, overgrowth, and irregularities that are difficult to correct.

For these reasons, we prefer the use of HA fillers particularly in the brow. I think that it is a finer brush than fat ... one has more control over the final contour than fat provides and can easily be reversed. The duration of injected HAs in the brow, as well as the temple and lower lid, is at least 2 years in my experience and a duration of 3–4 years is not uncommon.

Technique.

Although it might be idiosyncratic, I use local anesthesia before all HA injection, not just for the numbing effect but for vasoconstriction—there are large vessels in the superior orbit and it

would seem to be safer to vasoconstrict them to avoid arterial embolization. In addition, patients do not intuitively understand the idea of filling the face; it is a visual concept and needs to be shown visually. I precede every brow injection with a “local preview” in which about 1–2 cc of local anesthetic with epinephrine is injected into the brow to demonstrate the intended result. This is difficult to do without some experience, and the tendency is to make a blobby overfill of the upper lid which is not at all helpful. Small strings of local are placed and then massaged into position. It takes a few minutes per eye. The patient is then shown the result and can make his or her own decision about whether he or she likes it. Patients like this process as it gives them control over the result; it is like trying on clothes before buying them. The location of the product placement is in the subQ of the brow, deep to the orbicularis oculi but not on the periosteum where the large vessels can be found. The injection remains at or superior to the superior orbital

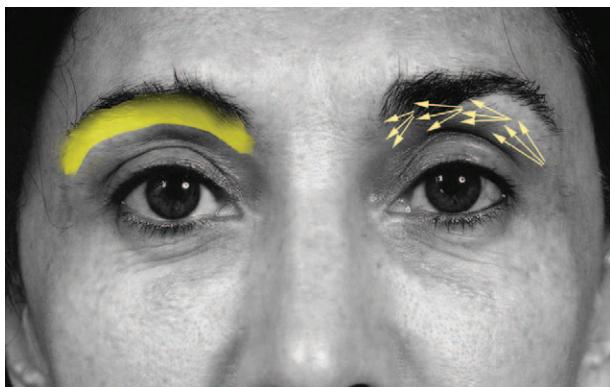


Fig. 13. On the patient's right is shown the approximate area of a brow injection. Note that it does not go inferior to the superior orbital rim. It is modified according to the patient's anatomy. On the patient's left is the pattern of injection. A 1/2-inch 30-gauge needle is used with tiny amounts of filler injected per stroke. The injection is made at a middle depth, below the orbicularis muscle but not adjacent to skin or periosteum.

rim. The upper lid itself is filled by the expansion of the brow soft tissues.

I prefer a 30-gauge 1/2-inch needle, though a cannula may be used as well. I start from laterally and place 3 injections per needle stick in a fanning pattern and proceed to inject across the brow. There are on the average 5 needle sticks across the brow; thus, there are an average 15 passes with occasional single injection points where needed in the brow. (**See Video, Supplemental Digital Content 8**, which describes Dr. Lambros personal technique of filling the brow using HA, available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B456>.)

The most common volume of product used per side is 0.5 cc, which can always be supplemented



Video 8. Supplemental Digital Content 8, describing Dr. Lambros personal technique of filling the brow using HA, is available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B456>.

later if necessary. The injected volume per pass is very small, about 0.02–0.03 cc per pass.

Bruising is always a possibility and the patients are given ice on leaving.

Complications.

Besides bruising, complications have been low with this procedure. There have been occasional irregularities which have been improved by adding more product. I have seen no vascular incidents as the area is vasoconstricted and the plane of injection is superior to the supraorbital arteries. Because of the "local preview," the patients have seen and approved the results of the procedure—like trying on clothes before they buy them—there are remarkably few complaints afterward. The orbital rim and globe should be palpated before undertaking any injections here; in some patients, there is no space between the globe and the orbital rim and these patients are at risk for a globe injury if the injection is made too deep.

B. Kent Remington, MD, FRCP; Calgary, Alberta, Canada

"Beauti-Phi-ed Eyebrows."

Eyebrow restoration and shaping without surgery is a form of biomimicry—trying to mimic what the patient's eyebrows looked like say 10 years ago. Neuromodulators in a synergistic role with appropriate HA filler can effectively re-create the shape and structure of the eyebrow and re-establish the peak of the brow in the phi position that is mathematically correct and pleasing to the aesthetic eye. The interplay of agonist and antagonist muscles, as modified with the application of neuromodulators, determines not only the degree of eyebrow expression but also the position of eyebrows in the resting state through static muscle tension. Choosing the best HA filler and the right technique re-creates the support and strut work of the static eyebrow. It is important for all aesthetic injectors to fully understand the different characteristics of HA fillers. These characteristics include their cohesivity, viscosity, elasticity, plasticity, lift ability, and each fillers complex rheology.

Aesthetic eyebrow restoration and shaping with injectables begins with a detailed understanding of the soft tissue, including the periorbital musculature, the skeletal anatomy, and the importance of the golden ratio of each face. The technique is based on factors that include detailed attention to individual animation, appropriate dosing of neuromodulator, volume of HA filler, and where to use cannulas versus needles. Each side of the face is siblings, not twins. This universal concept is often most apparent in the eyebrow

position—vertical and horizontal. The goal in eyebrow restoration and shaping is re-creating balance, harmony, and a pleasing proportion as perfect symmetry does not exist.

In the ideal feminine eyebrow, the head of the brow and the tail of the brow are parallel. The medial head of the brow should be lined up with the inner canthus and the nasal ala. The “peak” of the brow in women for the ideal phi should be lined up with a line drawn from the ala of the nose and just lateral to the pupil.

Youthful feminine relationship for the eyebrow, the radix, and the dorsum of nose is a curvilinear line.

Step 1: A critical part of the first step is the detailed approach to baseline with pretreatment photographs. It is important and instructive to have the patients bring in high-resolution photographs in their twenties. These past photographs are used to evaluate previous harmony symmetry and eyebrow balance and shape. Combined with this step inject your neuromodulator of choice. The eyebrow shaping with the neuromodulator can be done the same day as fillers or days in advance—do not forget the influence of the superior and lateral orbicularis oculi on the shape of the eyebrow.

Step 2: Carefully reflate and contour the radix, glabella zone, and the head of the brow with a G1 HA filler. I often transfer the fillers like Voluma, Perlane, or Emervel Classic into BD II insulin syringes that are 0.3 mL size and a 8 mm length and 31-gauge needle. With this mini setup, it is filled for comfort to about 0.2 mL and I inject right in the preperiosteal zone in an anterograde fashion. Molding with cool ultrasound gel is an important part of the brow restoration project.

Step 3: To reflate and contour the brow, the 25-gauge 1/2-inch trocar site is lateral at the tail of the brow. Measure with the 27-gauge 37-mm cannula right to the head of the brow where I have already injected with my mini syringes. Inject with Voluma, Volift, Perlane, Restylane, or Emervel Classic just preperiosteal both retrograde and anterograde tapered medial to lateral with less lateral and more where I have predetermined the peak to be. The noninjectors “smart hand” is a must for reflating and contouring brows. Injection of HA at the supraorbital crest will force the eyebrow up if the brow is above the promontory. Injection of HA at the supraorbital crest will force the eyebrow down if the brow is at or below the promontory.

Step 4: In this patient, I also reflat and contoured the “A Frame” using a 27-gauge 37-mm cannula—I prefer the 3 French brands Magic-needle—Derma-Sculpt or TSKs. My technique is



Video Available Online

Video 9. Supplemental Digital Content 9, demonstrating Dr. Remington's personal technique for brow beautification, is available in the “Related Videos” section of the full-text article on PRSJJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B457>.

to inject through the same lateral eyebrow trocar site or in some patients inject a new place just inferior to this site. (**See Video, Supplemental Digital Content 9**, which demonstrates Dr. Remington's personal technique for brow beautification, available in the “Related Videos” section of the full-text article on PRSJJournal.com or, for Ovid users, at <http://links.lww.com/PRS/B457>.) Like all zones, this area has a sweet spot that is just preperiosteal and gently push all the way to the zone just above the medial canthus and inject mostly retrograde. I prefer Restylane Silk—in Canada, we call it Restylane Fine Lines and I have used this for 16 years with great confidence.

Blending and molding with cool ultrasound gel is an essential part of the restoration project—both the eyebrow and the “a frame.”

Step 5: Reflate and contour the deflated zone that is predictably found 1 cm below the temporal fusion line and 1 cm above the upper orbital rim. I use the BD II minis 31-gauge 8-mm needle setup with Voluma in an anterograde fashion lifting the tail of the brow back and up with the “smart hand” at the same time as I inject.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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