

Volume Rejuvenation of the Facial Upper Third*

Edward D. Buckingham, MD¹ Robert Glasgold, MD² Theda Kontis, MD³ Stephen P. Smith, Jr., MD⁴
 Yalon Dolev, MDCM, FRCS(c)⁵ Rebecca Fitzgerald, MD⁶ Samuel M. Lam, MD, FACS⁷
 Edwin F. Williams, MD⁸ Taylor R. Pollei, MD⁸

¹ Director, Buckingham Center for Facial Plastic Surgery, Austin, Texas

² Department of Surgery, Rutgers University-Robert Wood Johnson Medical School, Piscataway, New Jersey

³ Johns Hopkins Medical Center, Baltimore, Maryland

⁴ Department of Otolaryngology, The Ohio State University, Columbus, Ohio

⁵ Department of Facial Plastic and Reconstructive Surgery, ENT Specialty Group, Westmount, Canada

⁶ Department of Dermatology, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, California

⁷ Willow Bend Wellness Center, Plano, Texas

⁸ Williams Center for Excellence, Latham, New York,

Facial Plast Surg 2015;31:43–54.

Address for correspondence Edward D. Buckingham, MD, Department of Facial Plastic Surgery, Buckingham Center for Facial Plastic Surgery, 2745 Bee Caves Road #101, Austin, TX 78746 (e-mail: edbuckin@yahoo.com).

Abstract

The next three articles in this issue take a unique approach to discussing volumetric restoration. Robert Glasgold has provided an assessment for each facial region and five different renowned authors (TK, SPS, RF, SML, and EFW) have been asked to speak on a particular volumetric product, of which they are considered an expert, as it applies to the different regions of the face. The articles are broken into the following: (1) upper third which corresponds to the upper eyelid, brow, temple, and forehead; (2) middle third which will cover lower eyelid, cheek, and perioral area; and (3) lower third which discusses the marionette, prejowl, and jawline. Our hope is that by placing differing opinions of experienced authors, organized by facial region together, the reader will have the opportunity to more readily compare the options. The contributing authors and their product area are as follows: Theda Kontis, MD—hyaluronic acid; Steve Smith, MD—calcium hydroxyl appetite; Rebecca Fitzgerald, MD—poly-L lactic acid; Sam Lam, MD—polymethyl methacrylate; and Edwin Williams, MD—Autologous Fat Transfer. If the author included general comments on the product, they are included in the article on the upper face only and are not repeated. Please note that other individuals may also have significantly assisted in the production of these articles, but those listed above are the senior authors.

Keywords

- ▶ volume restoration
- ▶ facial fillers
- ▶ autologous lipotransfer
- ▶ facial volumization
- ▶ autologous fat transfer
- ▶ orbital and brow rejuvenation

Volume Rejuvenation of the Upper Face: Robert Glasgold

Aesthetic Analysis

Upper face rejuvenation has traditionally focused on creating an “open” upper eyelid via blepharoplasty and brow lifting. Excessive removal of the upper lid fat and skin combined with

brow elevation exposes the bony orbital contours, creating an overly sculpted appearance; this result is often unnatural, and may even create a more aged appearance. If the goal is to have natural upper face rejuvenation, then an updated aesthetic must be established. There is no better way to define the aesthetic of a youthful upper lid and brow than by comparing ones current appearance to photos at a younger age. In doing so, the hallmarks of a youthful face and the changes indicative of aging can be identified.

* Please see the section titles in the article for all contributing authors. The different components of each article were assembled by Edward D. Buckingham and the editors of Thieme.

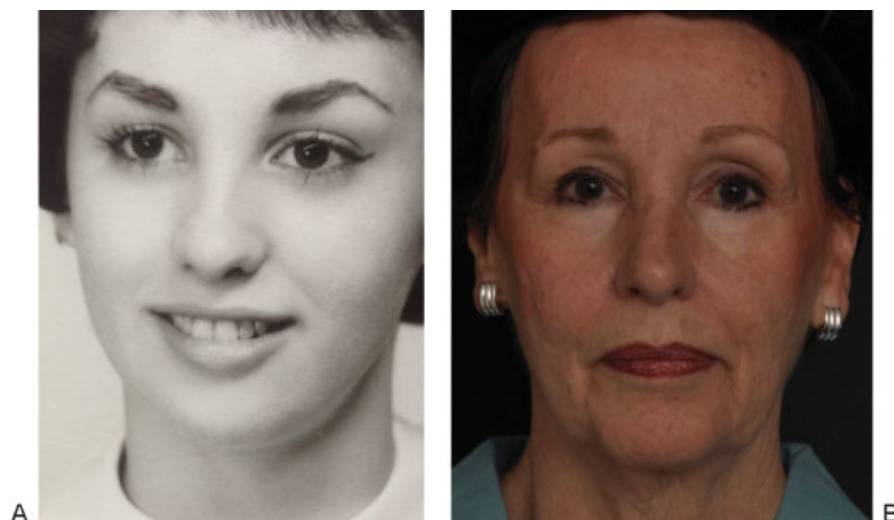


Fig. 1 (A) As a teenager this woman demonstrates the hallmarks of a youthful upper eyelid and temple. (B) The same woman in her 60s, demonstrating volume loss below the superior orbital rim and in the temporal fossa. (Reprinted with permission from Glasgold Group Plastic Surgery, 2014.)

The youthful upper face is defined by the following characteristics. A uniform fullness of the upper eyelid spans from the lid fold inferiorly to the brow superiorly. This creates a seamless transition from upper lid to brow, devoid of an intervening infrabrow shadow; analogous to the lack of inferior orbital rim shadow between lower lid and cheek in younger faces (►Fig. 1A).¹ Absent or slight concavity of the temporal fossa masking the skeletal margins (i.e., lateral

cephalic margin of the superior orbital rim, the superior margin of the zygoma, and the temporal line).

The degree of visible pretarsal skin is variable in a youthful upper eyelid. Most commonly, a minimal strip of pretarsal skin is visible between the upper lid fold superiorly and the lash line inferiorly (►Figs. 1A and 2). There exists a smaller subset of people who have a greater degree of pretarsal skin show and a more sculpted upper lid at a young age (►Fig. 3).

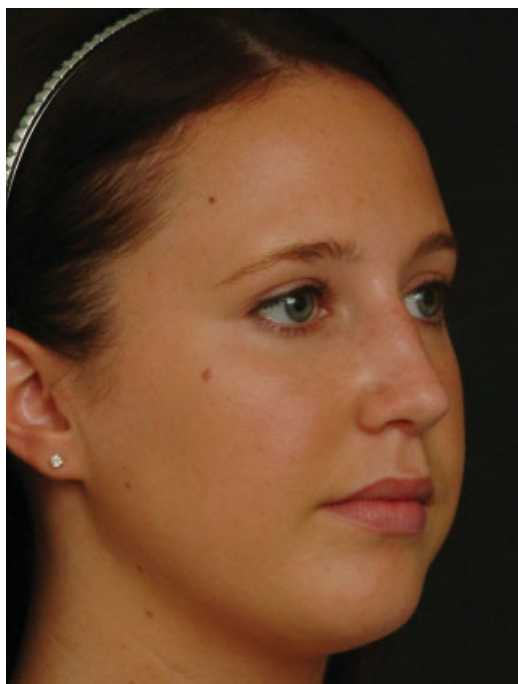


Fig. 2 A 20-year-old woman with more commonly seen youthful upper lid characterized by minimal pretarsal skin visibility and a full upper lid. (Reprinted with permission from Glasgold RA, Glasgold MJ, Lam SM. Periorbital fat grafting. In Massry G, Azzizadeh B, Murphy M, eds. Master Techniques in Blepharoplasty and Peri-orbital Rejuvenation. New York, NY: Springer; 2011.)

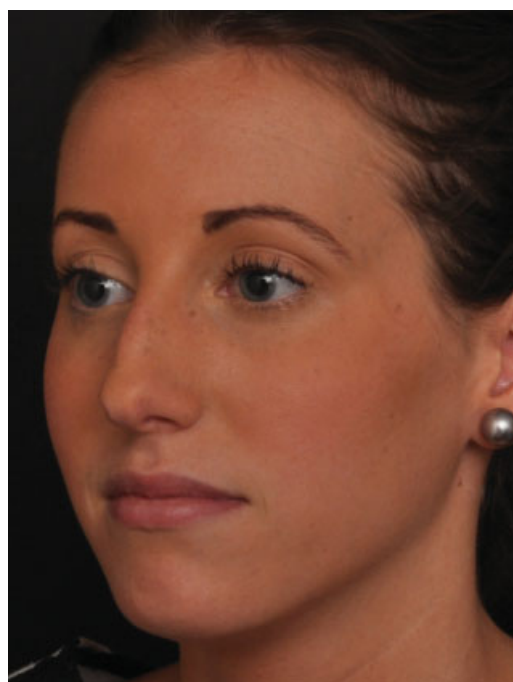


Fig. 3 A 21-year-old woman demonstrating the less commonly seen youthful sculpted upper eyelid characterized by a larger span of visible pretarsal skin show and a more sculpted upper lid. (Reprinted with permission from Glasgold RA, Glasgold MJ, Gerth DJ. Upper eyelid volumization with hyaluronic acid. In Hartstein M, Massry G, Holds J, eds. Pearls and Pitfalls of Cosmetic Oculoplastic Surgery, 2nd ed. New York, NY: Springer; 2015.)

This exception is important to note as a natural result is best accomplished when one's youthful upper lid appearance as a guide is used.

Advancing age accounts for specific areas of volume loss in the upper face. Volume loss in the superior orbital rim and upper lid creates infraorbital hollowing manifesting as a deep shadow under the orbital rim. The upper lid often appears deflated and the lid fold no longer flows seamlessly up to the brow. Volume loss is most significant above the medial upper eyelid where there is a greater degree of bone resorption.^{2,3} As the bony medial rim elevates it retracts the medial upper lid fold superiorly, and increases exposure of medial pretarsal skin (►Figs. 4A and 1B). Temporal volume loss creates a progressive concavity and shadowing in the temporal fossa. This volume loss exposes the temporal margin of the superolateral orbital rim and superior margin of the zygoma eliminating the softer less shadowed appearance typical of a youthful face.

I purposely do not define the appearance of a youthful upper face by the height of the brow. The purported "ideal" brow position is classically defined relative to the bony superior orbital rim.⁴ In a youthful face the superior orbital rim is generally not visible due to upper lid volume (►Figs. 1A and 2). Aging is associated with soft tissue volume loss, exposing the superior orbital rim, and increasing infraorbital shadowing (►Fig. 1B). Studies have suggested that age-related bone loss of the superomedial orbital rim elevates the position of the medial bony orbital rim.^{2,3} In this light, a more natural rejuvenation strategy should restore the volume deficiency below the brow, and not elevate the brow to the higher position of the bony orbital rim (►Fig. 4A, B).

My focus here is on addressing the volume changes in the upper face. Tissue redundancy and descent is not to be dismissed. Upper lid hooding often needs to be addressed, but a rejuvenation strategy that overlooks the importance of volume will fail to achieve a natural youthful appearance. In the remainder of this article each contributing author will

review their preferred techniques and materials for upper face volume rejuvenation.

Hyaluronic Acid Rejuvenation—Upper Face: Theda C. Kontis

Glabella

The old adage, neurotoxins for the upper face, and fillers for the lower face has changed over the years. Occasionally, neurotoxin alone may not provide adequate treatment for very deep glabellar creases. Hyaluronic acid (HA) is probably the only filler I would consider using to treat refractory glabellar lines. The terminal vessels of the internal carotid artery, the supraorbital and supratrochlear arteries exit the foramina in the glabellar region. Occlusion of these vessels can cause necrosis of the overlying forehead skin or cause retrograde embolization of the central retinal artery and subsequent blindness. Recent literature documents the occurrence of vascular occlusion and blindness with the injection of HA in this region.⁵

Injectors should keep these concerns in mind when injecting the glabella, but if performed with care, filling glabellar creases can be quite gratifying. The key to glabellar rhytid injections is to maintain a superficial placement. My technique is to inject in the superficial to mid-dermis and to massage the area to prevent lumpiness. Occasionally I will treat with botulinum toxin type A (BoNTA) first and have the patient return 2 weeks later to determine if the rhytid(s) could be further effaced with filler. The combination of filler and neurotoxin in the glabella often produces longer lasting improvement than treatment with either modality alone (see ►Fig. 5). Usually a linear threading technique is used with retrograde injection and only approximately 0.1 mL of filler typically is required.

The occasional patient may refuse BoNTA treatment of any kind; such patients may allow filler treatment to their glabellar creases as an alternative. Bruising in the glabellar



Fig. 4 (A) Volume loss of the superior orbital rim retracts the medial upper lid skin. (B) Upper lid rejuvenation accomplished through blepharoplasty and fat transfer below the superior orbital rim. Restoring orbital rim volume repositions the medial lid fold to its appropriate elevation and masks the appearance of the bony orbital rim. (Reprinted with permission from Glasgold Group Plastic Surgery, 2011.)

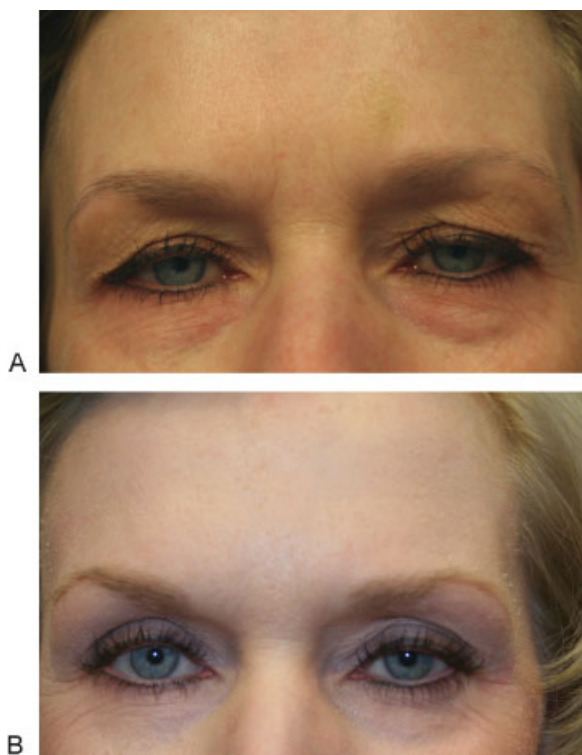


Fig. 5 Before (A) and 10 months after (B) injection of the glabella with hyaluronic acid (HA). The patient has persistent glabellar lines after neurotoxin injection. HA was used to completely efface the glabellar lines. (The upper lid ptosis seen in this patient is functional, and not a complication of neurotoxin injection.)

region is rare and the results of HA injection may last 6 to 9 months, or more. If lumpiness or irregularities are noted, these can be massaged postinjection to improve the contour.

Temple

Loss of volume in the temples is an early sign of aging but also occurs in patients with low body fat. As patients become more aware of the changes of the face with aging, more are requesting augmentation of the temples. It is not unusual for female patients to wear their hair in a way to cover their sunken temples and skeletonized bony rim. In those who are unaware that the area can be filled, the physician can point out that their depressed temples can be augmented with filler.

HA is ideal filler for this region because it is soft and pliable and can be massaged to create a convex contour of the region. Filler can be injected deep in the preperiosteal plane, or subcutaneously and massaged to smoothen out any palpable or visualized irregularities. Large veins and arteries are in this region, so bruising is a risk. Inadvertent vascular injection can be prevented by performing a reflux maneuver on the syringe while injecting.

Common volumes used in the temples can range from 0.5 to 1 mL per side, depending on the amount of volume loss. The results may last up to a year, or more. Injection of the area should also be extended into the hairline to smoothen out the transition between the scalp and temporal region. Generally a fanning technique is used when the injection is subcutaneous.

Alternately, if a large volume is required, product may be placed preperiosteally using the depot technique and massaged to soften the contours.

Lateral Brow

Although not a commonly injected area for filler, occasionally HA may be used on the lateral bony orbital rim to provide volume to a skeletonized orbital rim and to produce a slight lateral brow elevation.

In this region, the 0.1 to 0.2 mL of HA is placed in the subcutaneous plane by a linear threading technique and massaged to reduce lumpiness and irregularities. Injection can also be placed preperiosteally using the depot technique. Care must be taken in this area to ensure symmetry. Bruising may occur after injection, but is not common.

Medial Superior Orbital Rim

The medial aspect of the superior orbital rim can hollow with aging, or may become skeletonized after overzealous removal of the central upper lid fat pad during blepharoplasty. This hollowing is often referred to as the “A-frame” deformity. HA is the safest material to place in this region because of its qualities of softness, pliability, and reversibility if vascular injury occurs.

HA is placed either in the subcutaneous tissue or preperiosteally by a linear threading technique. The supraorbital and supratrochlear arteries are at risk for injury with injecting in this region. Some advocate the use of a cannula for injection when treating the superior orbital rim. The cannula is inserted from lateral to medial along the rim in a subcutaneous plane and HA is injected in a retrograde fashion to fill in the supraorbital hollow. As with other HA injections, it is massaged into place after injection. This area is generally undercorrected so as to prevent heaviness or hooding of the brow.

Calcium Hydroxyl Appetite Upper Face: Yalon Dolev and Steve Smith

Background

Radiesse is a synthetic volumizing injectable filler (Merz Aesthetics, Inc., San Mateo, CA). It is composed of smooth calcium hydroxylapatite (CaHA) microspheres (diameter of 25–45 μm) suspended in a gel carrier consisting of sodium carboxymethyl cellulose, glycerin, and high purity water. By volume, Radiesse is composed of 30% CaHA and 70% carrier gel. It is available in 1.5 and 0.8 mL syringes.

It is currently specifically approved by the U. S. Food and Drug Administration (FDA) for subdermal implantation for the correction of moderate to severe facial wrinkles and folds. It is also approved for the restoration and/or correction of the signs of facial fat loss (lipoatrophy) in people with human immunodeficiency virus.^{5,6}

Properties

Molecular Structure and Biocompatibility

The molecular structure of CaHA is $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$. It is the mineral component of bone and teeth. As such, it is extremely

biocompatible and causes minimal inflammatory response, foreign body response, or giant cell reaction. Furthermore, the compound is nontoxic as are its degradation products, calcium, and phosphate.⁷ Degradation takes place via macrophage-mediated phagocytosis as would be the case for native bone.⁷⁻⁹ The carboxymethyl cellulose carrier gel has a long history of safety and has been used as a vehicle for the delivery of multiple other injectable materials. It offers a 1:1 correction of volumetric defects. This avoids the need to under- or overcorrect as is required with other soft-tissue fillers.⁸ The carrier gel is degraded over a 3 to 6 month period and replaced by collagen at the same rate as its degradation helping to maintain the volumization effect despite the loss of the carrier gel.^{8,10} This contributes to its longevity and may even confer a degree of semipermanence.

Some authors have suggested that Radiesse can serve as a scaffold for the ingrowth of bone. Although this is true for macroporous CaHA molecules, there is no evidence that microporous Radiesse behaves as such when injected into the soft tissues. Although the literature is conflicting, it may induce new bone formation when injected subperiosteally and perhaps even supraperiosteally.^{7,9,11,12} Despite this possible potential for osteoconductivity, new bone formation does not confer increased volumization over time since the deposition of bone occurs at the same rate as the degradation of the product.⁷

Rheology

Different soft-tissue fillers have a specific viscosity and elasticity. Complex viscosity (η^*) relates to how a substance flows from the needle and within the tissues. Elastic modulus (G') determines how well it will withstand deformation within the tissues. Radiesse has a specific complex viscosity and elastic modulus that confers onto it certain advantages over others. In comparison, it has the highest η^* and G' . This makes it a great volumizing agent because its high viscosity allows it to remain at the injection site and its high elastic modulus allows it to withstand deformation of surrounding muscles and therefore provide the greatest lifting/volumizing capacity per volume of injected filler.¹³

Safety

As mentioned earlier, the carboxymethyl cellulose carrier gel making up 70% of the product has a long history of safety. It has been extensively used in medical devices and is classified by the FDA as "generally recognized as safe."¹⁴

Data about Radiesse is also positive. Adverse effects reported in the original safety study submitted to the FDA for approval showed only minimal local adverse effects at 6 and 12 months in a split-face comparison of Radiesse versus collagen in 117 subjects. These included ecchymosis, erythema, edema, and pain at the injection site. One report of granuloma formation resolved spontaneously. Although systemic adverse events were reported during the study period, they were not related to the product.¹⁵ A follow-up study sponsored by Merz Aesthetics, Inc. looking at long-term adverse events at 2 and 3 years in that same group of patients found none at either interval period.¹⁶ Other large independent studies have repeated these findings.^{17,18}

A recent study looking at the safety of Radiesse in Fitzpatrick IV-VI skin types showed no incidence of dyspigmentation, hypertrophic scarring, or keloid formation.¹⁹

Longevity

Radiesse is not considered a permanent soft-tissue filler but it does have significant longevity when compared with other nonpermanent volumizing agents. Studies regarding its use in urinary stress incontinence have shown its presence at the site of injection 7 years after treatment.²⁰ Long-term studies on its use in vocal fold augmentation have also shown good longevity with clinical benefit lasting on an average 18.6 months with a range of 8 to 36 months.²¹ Although it has been seen on radiological imaging as far as 7 years after treatment,⁸ it likely has a much shorter clinical effect. In this author's experience, patients usually see effects of Radiesse lasting between 12 and 18 months at which point they will often return for additional treatments. Other authors have reported similar results depending on the site of injection with deeper injections having greater longevity.^{22,23} Histological studies in human subjects have demonstrated *de novo* collagen production (types 1 and 3) at the site of the injection present at 6 months. It is likely that it persists beyond that.^{8,24} Canine models have shown neocollagenesis beyond 70 weeks.²⁵ This neocollagenesis contributes to its long duration of effect.

Imaging Properties

CaHA is radiopaque and is therefore visible on conventional radiologic imaging and computed tomography (CT) scans. Previous studies have shown 100% visibility on CT and varying degrees of visibility on conventional radiologic imaging depending on the location of injection.²⁶ It is also visible on FDG-positron emission tomography scans and has been implicated in case reports of false positive reporting of malignancy.²⁷ For this reason, patients should be notified that they should make radiologists aware of previous treatment with Radiesse.

Preparation

As previously discussed, Radiesse comes in 0.8 and 1.5 mL syringes.⁶ Unlike other soft-tissue fillers, there is no formulation with local anesthetic. Because injection of the product can be quite uncomfortable, the manufacturer recommends mixing the product with 2% lidocaine using an available kit. Around 0.2 mL of 2% lidocaine is drawn into the provided 3-mL syringe and attached to the 1.5-mL Radiesse syringe using the Luer-lock connector. The product is then injected back and forth between syringes. This back and forth motion should be repeated 10 times until the mixture appears homogenous.⁶ This lidocaine mixture was found to be safe and to significantly reduce pain and discomfort related to the injection.²⁸ Furthermore, a detailed study looking at different ratios of lidocaine mixed with Radiesse demonstrated no adverse effects on the products inherent properties. To the contrary, the slightly decreased viscosity owing to the addition of lidocaine allowed for better malleability of the product.²⁹ A 27 G needle is then used to inject the product. Larger gauge needles are not recommended because the high

viscosity of the product will not allow continuous flow through the needle and may cause jamming and imprecise injection.

Indications and Specific Injection Sites

Although only officially approved by the FDA for subdermal implantation for the correction of moderate to severe facial wrinkles and folds, and for the restoration and/or correction of the signs of facial fat loss (lipoatrophy) in people with human immunodeficiency virus, it has been used extensively as a soft-tissue filler in the face. As with any other soft-tissue filler, the injector must have a thorough understanding of the bony, soft tissue, and neurovascular anatomy in the areas being injected to avoid needless complications.

Upper Face—Glabellar Lines

Although this author does not prefer soft-tissue fillers for the glabellar region, this off-label indication is being included for completeness. Although, this is beyond the scope of this article, instead, the author prefers the initial treatment of glabellar rhytids with neurotoxins in an effort to efface dynamic and even static rhytids over time. When this method is unsuccessful or for very deep rhytids not amenable to neurotoxins, soft-tissue fillers including Radiesse can be considered.

First, the area is cleansed with alcohol. Then, 0.1 to 0.2 mL of Radiesse is delivered to each side in the immediate subdermal plane in a threading fashion. It can then be molded to avoid nodules. Great care must be taken to inject it in an immediate subdermal plane to avoid embolizing the supra-trochlear and supraorbital vessels, and avoiding the devastating possibility of skin necrosis.

Upper Face—Temporal Fossa

The temporal fossa is a common site for early fat loss in the aging face. In this author's experience, it is infrequently the primary area of concern for patients and often only appreciated by them once it is brought to their attention. Its volumization however, can have a profound impact on youthfulness and therefore should not be overlooked. The use of Radiesse in this region is well documented but considered off-label.

The technique involves the injection of Radiesse in a suprapariosteal plane. First, the area should be cleansed with alcohol and the area of volume loss should be marked. This author prefers the use of a white eyebrow pencil. A small bolus (0.5 mL) of 1% lidocaine with epinephrine should then be deposited in the center of the temporal hollow to provide anesthesia. Although mixing lidocaine with Radiesse (as described above) will decrease discomfort, the injection of aliquots of Radiesse into this plane will still cause significant discomfort without first anesthetizing the area.

Once anesthesia has been provided, 0.5 to 1 mL of Radiesse should be administered to each temple divided into aliquots. The plane of injection is suprapariosteal starting in the center of the temporal depression and then extending circumferentially from there until a subjective effacement of the hollow has been accomplished. The area should then be massaged to avoid nodule formation and to ensure a natural appearance. Injection

into the suprapariosteal plane helps to avoid the temporal vessels and possible vascular compromise and necrosis. Vascular compromise can either be due to embolization or compression of vessels. To avoid compression, this author advocates working up to a result over several sessions as opposed to injecting larger amounts in a single session.

The youthful temple should be minimally convex and continuous with the contour of the zygomatic arch. The lateral orbital rim should not be visible and the entire lateral eyebrow should be visible from the frontal view.³⁰

Poly-L-Lactic Acid, Upper Face: Rebecca Fitzgerald

Poly-L-lactic acid (PLLA) is a synthetic polymer derived from lactic acid that is both biocompatible and biodegradable. The mechanism of action of PLLA begins with a subclinical inflammatory tissue response following implantation, followed by encapsulation of the particles and subsequent fibroplasia. This fibroplasia volumizes the tissues and produces the desired cosmetic result. This mechanism of action enables the product to gradually and progressively restore "a little volume all over" yielding the sort of subtle and natural-looking results desired by many patients. Importantly, it also has critical clinical implications that determine the manner in which the product can be used to obtain predictable and reproducible results. Therefore, two simple yet critical components of methodology unique to this product—product reconstitution and placement—are worth mention here. (The common denominator of both is an even distribution of product.) As experience has been gained with this product and technical issues have evolved we have seen that the majority of adverse events seen with early use (papules and nodules, especially around the eyes or lips), stemmed from suboptimal product reconstitution or placement. Current recommendations are a dilution of > 5 mL (most experienced practitioners recommend a 9 mL dilution) and a hydration time of at least > 2 hours (most experienced practitioners recommend > 24 hours). Product should never be placed high in the dermis as superficial placement may lead to visible fibroplasia. Additionally placement in or through active muscles particularly around the eye or lip leads to localized overcorrection and nodules (representing product trapped in muscle fibers).^{31–33}

The amount of product used at one session is determined solely and completely by the amount of surface area to be treated at that session using approximately 0.1 to 0.3 mL/cm² when using a subcutaneous fanning or cross-hatch technique or 0.3 to 0.5 mL/cm² to place suprapariosteal depots followed by vigorous massage. The final volumetric correction is determined by the number of treatment sessions. This means that although a large face with severe lipoatrophy may require up to three vials per session in three or more sessions, a younger or fuller face may require only one vial per session in one or two sessions.^{31–33}

As we gain experience with all injectable fillers we now realize that very empty faces or those with a very

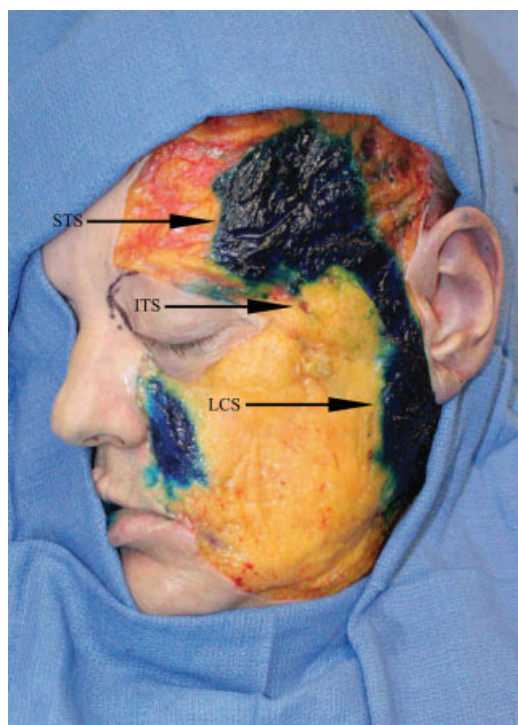


Fig. 6 The lateral temporal cheek compartment is the most lateral of the superficial cheek compartments and connects the temporal fat to the cervical subcutaneous fat. Replacement of volume near the temporal crest reduces shadowing and skeletonization in this area while replacement behind the hairline serves to re-ovalize a "peanut-shaped" head. ITS, inferior temporal septum; LCS, lateral cheek septum; STS superior temporal septum. (Reprinted with permission from Rohrich RJ, Pessa JE. *Plast Reconstr Surg* 2007;119(7):2219–2227; discussion 2228–2231.)

elastotic outer skin envelope may be challenging to volumize, requiring a substantial amount of product and work to achieve a desirable result. This is an issue of patient selection, not product selection. It should be expected in these patients and discussed before treatment to avoid unnecessary frustration for both the patient and the physician.

Volume Rejuvenation in the Upper Face

Areas to avoid: The glabella, the medial superior orbital rim, and the forehead are at risk of nodule formation due to trapping of product within these active muscle fibers. These areas have been treated successfully in a subgaleal location by experienced practitioners; however I do not routinely recommend PLLA in this location.³⁴

Areas to treat: Temples and lateral superior orbital rim. Note the amount of fat up to the temporal crest as well as behind the hairline in the cadaveric dissection used to demonstrate the borders of the temporal and lateral cheek fat pad in **Fig. 6**. Replacement of volume near the temporal crest reduces shadowing and skeletonization in this area while replacement behind the hairline serves to re-ovalize a "peanut-shaped" head (**Figs. 7 and 8**).

It is commonplace to use a 25 G 1.5-in needle inserted deeply to the underlying bone in the temple avoiding the vasculature (most veins are visible, and the temporal artery

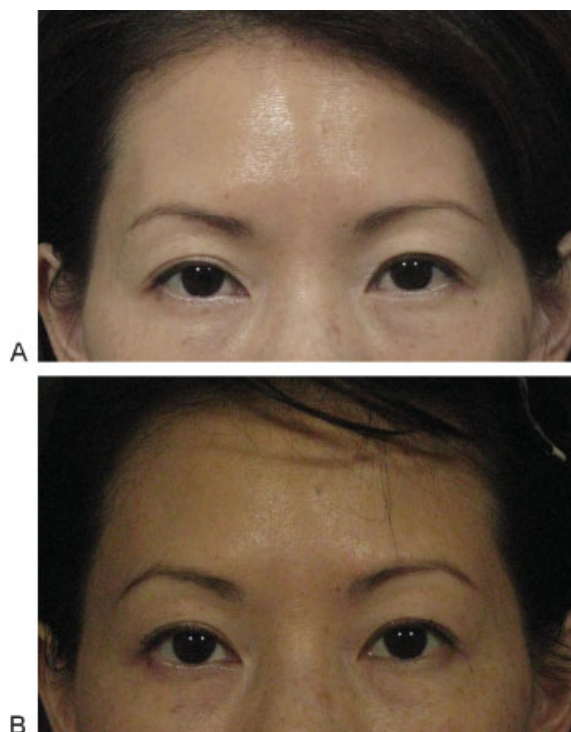


Fig. 7 A 35-year-old female patient was treated with one vial per session in two sessions (4 weeks apart). Approximately 1.5 mL per temple was used at each treatment session. Notice the softening of the skeletonized appearance of this thin face achieved by treatment effacing the shadows at the temporal crest. (A) Baseline; (B) 6 months after treatment.

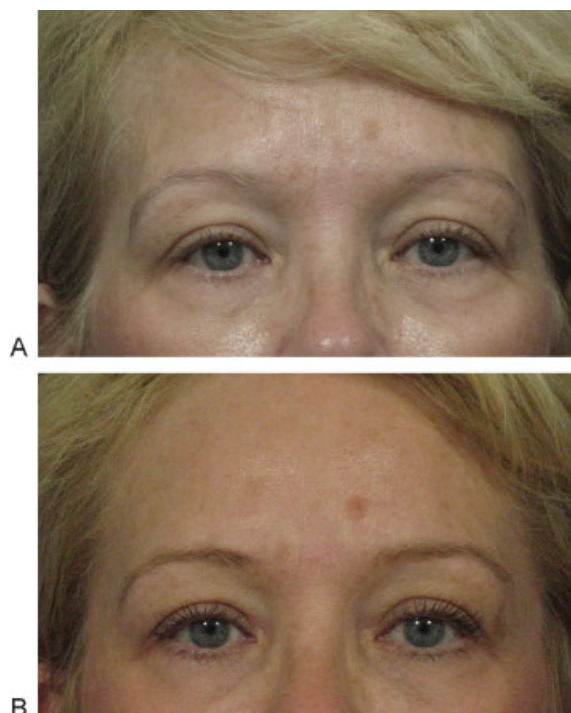


Fig. 8 A 56-year-old female patient was treated with two vials per session in two sessions (4 weeks apart). Approximately 2.5 mL per temple was used at each treatment session. Note the restoration of an oval shape to a full face with temporal atrophy. (A) Baseline; (B) 6 months after treatment.



Fig. 9 A 30-year-old female patient with suboptimal craniofacial support was treated with two vials per session in two sessions (4 weeks apart). The product was placed supraperiosteally along the lateral supraorbital rim, the zygomatic arch, medial maxilla, canine fossa, and mandible. This technique helps to support, project, and lift the lateral brow. No neuromodulator was used in this patient. (A) Baseline; (B) 3 months after treatment.

can be palpated). Once in this location a “reflux” maneuver can be performed before every injection to avoid the possibility of an inadvertent vascular injection. Following needle placement the product can be injected using depot injections of 0.3 to 0.5 mL/cm² followed by a deep massage. All injections should be done slowly, avoiding inadvertent pressure or force. Needle clogging occurs if there is excessive foam in the syringe. This can be cleared by removing and discarding the needle, expelling the foam from the hub of the syringe, then attaching and “priming” a new needle by expelling a small amount of product through the needle before injecting it in the tissue. “Blanketing” of the surface area to be treated at that session is the endpoint. Several depots may be necessary to cover the entire surface area to be treated. Some practitioners use a deep fanning technique with retrograde injections. The patients are instructed to massage the area several times daily for several days. The recovery is usually uneventful however occasional swelling causes some discomfort and tenderness when massaged. This may also occur with chewing in the first few days after treatment.

A very large temporal hollow may require 3 to 5 mL product per session while an average temple may need < 2 mL. Recall that the final volumetric correction is determined by the number of treatment sessions. A very hollow temple may need more than three treatment sessions while a younger or fuller face with early temporal volume loss may need only one treatment. The duration of the product in this area may exceed 2 years.³⁵

Treatment along the lateral orbital rim is done by lifting the skin and muscle just medial to the temporal crest at least 1 cm above the orbital rim, and inserting a 25 G 1.5-in needle to the preperiosteal space moving lateral to medial, stopping short of the supraorbital neurovascular bundle. The depth of the needle placement can be checked by lifting the needle (it should not lift if correctly placed). A “reflux” maneuver is then done to avoid inadvertent placement in a vessel, followed by a

slow retrograde linear injection of 0.3 to 0.4 mL. The area is then massaged. This technique helps to support, project, and lift the lateral brow (►Fig. 9). Superficial placement in this area (or in the temple in a thin patient) may lead to visible papules and nodules and should be avoided. If this does occur superficial placement of HA may camouflage the papules.

Polymethylmethacrolate/ArteFill Upper Face: Samuel M. Lam

Volume Rejuvenation of Upper Third—Upper Orbit and Temple with ArteFill

ArteFill (Suneva Medical Inc., San Diego, CA) is a very good product for the upper orbit and the temple. It goes without saying that using a permanent filler in the sensitive periorbital area should only be done by a very experienced injector. I believe that although I still prefer ArteFill as my first choice for the upper orbit and temple I can acquiesce to other options but I am more resistant to do so in the lower orbit, where I believe ArteFill is singularly the best product that I have used and there is no true substitute (see the section below on the lower orbit using ArteFill that I have written). For all injectable fillers, I use a 27 G disposable microcannula for the accuracy of placement, minimization of ecchymosis, and importantly unparalleled patient safety. To be honest, I would feel significantly less comfortable working in the periorbital region with a permanent filler if my route of delivery were a standard needle for the reasons stated above.

The technique in the upper orbit should be conservative in nature because patients may not like the upper orbit being too full that may in turn cause the eyelid to either hang downward over the eye or to bulge too far outward. I enter the orbit from the other canthus region (►Fig. 10, marked “c”) and traverse the expanse of it medially from there. At times I may make a second entry at the superior border of the hairy eyebrow about a third of the way inward from the original site

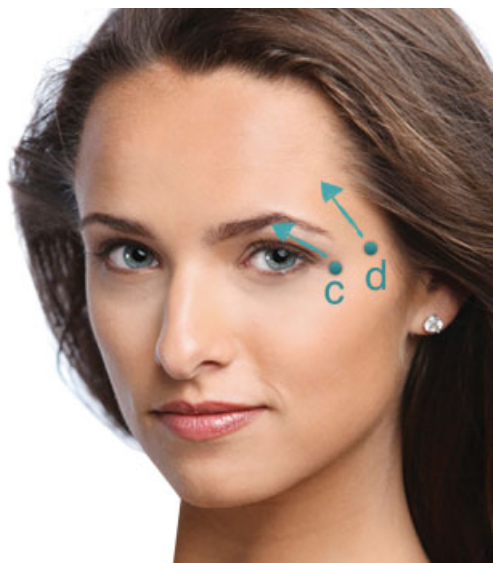


Fig. 10 This figure demonstrates the access point (dots) and the direction of cannula injection to augment the upper eyelid/brow complex (c) and temple (d).

aiming inferomedially to capture the medial hollow if the cannula simply cannot pass that far medially or due to improved access that the second entry site affords. After any product is injected into this area, which is centered over the orbital bone but may extend a bit inferior to it, especially medially in the so-called A-frame hollowness, it is imperative to aggressively massage the area digitally until the product is smooth. I do so in a circular fashion until I see the product evenly distributed. I do not always massage other areas but it is routine for me to do so in the brow area. Again, conservative amounts are the key to success in the upper orbit, especially with a permanent filler. The initial volumes that I inject are very small from a quarter of a milliliter per side to a half a milliliter per side, always progressing tentatively and massaging as I proceed. I typically do not go beyond those amounts to start.

I simply love ArteFill for the temple. I find it to be smoother and easier to inject than any other product with a minimal complication rate. I enter from the inferior aspect of the temple (►Fig. 10, marked “d”) in the subcutaneous plane (the same plane for all of my injections with ArteFill) and fill, massaging gently as I do to even out the product. I find it very helpful to look occasionally from the front view to confirm that the temple is not being overfilled and further that the aesthetic hollowness is being managed, that is, the region of the conjoined tendon is being adequately covered and that an elegant ogee of a curve is starting to manifest rather than a bulge. I reiterate that it is so important to constantly check the benefit from the patient’s frontal view to ensure that the bony dip at the anterior aspect where the conjoined tendon is situated is improved and to ensure that there is adequate temple convexity (without excessive bulging) from that view. ArteFill is extremely easy to mold, as compared with any other product, so you can even gently bolus the injection and then massage it out, which is a strategy that I use when injecting the temple. One thing that I have noticed as a

“complication” or risk with ArteFill is that there can be a small hard nodule that arises in the first few months after injection that typically goes away a few months later. It feels like a pebble but is almost never seen and it occurs in approximately 1 in 20 patients as an isolated event. I reassure patients that it is almost never seen, should dissipate over time, but in rare cases if the patient is truly bothered by it I could cut it out. I have only had to excise two minor nodules: one in the corner of the brow because it was visible and one along the jawline because the patient was bothered by how it felt but could not see it. If it is slightly visible, additional product can also be used to blend around it very easily. In 3,500 syringes performed over 6 years, I have fortunately not encountered a formal granuloma but understand and consent of this risk, which with current understanding should be treated as an infected biofilm requiring protracted antibiotics rather than steroid management.^{36–38}

Autologous Lipotransfer Upper Face: Taylor R. Pollei and Edwin F. Williams

Aging of the upper third of the face includes several distinct regions that can be treated individually or collectively. Stigmata of volume loss includes temporal hollowing, deepening of upper eyelid sulci, upper lid lengthening, skeletonization of orbital rim, brow atrophy, and/or exacerbation of forehead rhytids. In addition, loss of overall skin turgor results in visible skin thinning with textural changes and more pronounced bone structure. Each of these concerns can be successfully treated with the use of autologous lipotransfer. Fat transfer has been described in upper face rejuvenation with good efficacy and safety.^{39–43} Attractive considerations include its cost-effectiveness, adequate supply, accessibility, biocompatibility, longevity, and ease of injection.^{40–43} Described detractors include prolonged recovery and unpredictability when compared with fillers.^{40,44} Although more commonly used to treat the lower eyelid/midface complex, rejuvenation of the upper face with autologous lipotransfer remains a viable adjunct to blepharoplasty and brow lifting procedures for aging face treatment.^{45–48}

The technique we utilize for harvesting of fat has been well described previously, therefore this discussion will not focus on the details.^{41,43} Fat harvesting and injection can be performed under local anesthesia with or without oral sedation versus monitored anesthesia care or general anesthesia. Donor site preference in descending order includes: periumbilical abdominal fat, flank, outer thigh, and inner thigh fat. With the use of tumescent solution roughly double the amount of lipoaspirate required for augmentation is harvested, allowing for processing volume loss.

Key Points

Plan to “over deliver” a volume of 10 to 15% to account for early fat loss. Having said that, the dictum “A little bit of volume goes a long way” holds true.

Patients of age extremes, smokers, or who exercise heavily seem more likely to have less immediate graft take and notice a shorter duration of effect.⁴¹



Fig. 11 Temple injection site with marking.

When performed as an isolated procedure, small contour irregularities may become more visible. When used as an adjunct to a lift, blepharoplasty, or skin resurfacing these contour irregularities often become less noticeable.

Aside from the expected volumization, an improvement in skin texture is seen. This effect was not fully recognized early on, but in recent years it has become increasingly apparent as our patients present for extended follow-up.

Lipotransfer longevity has been described to patients as an initial loss of about 30%.^{40,42} Over the next few years approximately 15% may be lost per year. Note that this will coincide and progress with anticipated facial fat volume loss. The question remains: Does this objective loss of facial volume over time correlate with a clinically significant fat graft loss?

Temporal Region Lipotransfer

Temporal hollowing/wasting can be addressed through either an individual cannula entry site centered in the temporal region or immediately before completion of browlift temporal incision (→ **Figs. 11** and **12**). The goal is a smooth transition from the lateral forehead to the malar eminence, while avoiding surface irregularities. Plane for injection is between the temporoparietal fascia and temporalis fascia. Injection with massage in this plane allows for a good recipient pocket while being deep enough to affect gradual/diffuse volumization without surface contour abnormalities. Typically 6 to 8 mL of fat is injected on each side.



Fig. 12 Temporal injection with concomitant brow lift.



Fig. 13 Glabella (or eyelid) injection site with marking.

Upper Eyelid and Brow Lipotransfer

Improvement of upper eyelid hollowing and brow ptosis can be effected with autologous fat transfer. Although combination with surgical rejuvenation may be ideal, isolated fat transfer results in good effect; as seen in younger patients or those where no additional skin should be removed (i.e., previous upper lid blepharoplasty). A single entry site 1 to 2 cm lateral to the lateral canthus allows for linear, slow injection of fat running parallel to the orbital rim (→ **Fig. 13**). The upper lid fat injection should be kept superior to the tarsal crease in the subcutaneous plane, with more volume placed laterally. Be conservative since the upper lid is very unforgiving. In the brow either an intramuscular or subgaleal plane (results in decreased superficial ecchymosis and swelling) is used, while avoiding injection superior to the superior eyebrow margin. Between 0.5 and 1 mL is placed in each upper lid, and 1 to 3 mL in each brow.

Glabella and Forehead Lipotransfer

Although used mostly as an adjunct to botulinum toxin, good improvement in skin quality and diffuse fullness is noted with low volume subcutaneous injections. Specific focal areas of



Fig. 14 Lipotransfer to bilateral temple and glabella, lower lid, midface, and perioral/prejowl regions in addition to full face 35% TCA peel. TCA, trichloroacetic acid.



Fig. 15 (A and B) Lipotransfer to bilateral upper eyelids and forehead.



Fig. 16 Before (A) and after (B) full face lipotransfer.

age-related tissue deflation can be addressed individually. When addressing the glabella and forehead, mirrored trocar entry points to each side of midline are used: two above the glabella and two in the upper forehead. By fanning the injections in a subcutaneous plane with < 0.1 mL of fat injected per pass, contour irregularity can be decreased. Between the glabella and forehead, 4 to 6 mL is usually injected (► **Figs. 14 and 15**).

Patient satisfaction tends to be based on two factors: longevity of results and degree of correction. If repeat lipotransfer is indicated, a latency period of 1 to 2 years is reasonable. When degree of patient satisfaction, cost, procedure-related factors, duration of effect, and potential complications/detractors are weighed, autologous fat transfer a good value, and adjunct as a facial volumizer (► **Fig. 16**).

References

- 1 Glasgold RA, Lam SM, Glasgold MJ. Peri-orbital Fat Grafting. In: Massry G, Azzizadeh B, Murphy M, eds. *Master Techniques in Blepharoplasty and Peri-orbital Rejuvenation*. New York, NY: Springer; 2011
- 2 Kahn DM, Shaw RB Jr. Aging of the bony orbit: a three-dimensional computed tomographic study. *Aesthet Surg J* 2008;28(3): 258–264
- 3 Kahn DM, Shaw RB. Overview of current thoughts on facial volume and aging. *Facial Plast Surg* 2010;26(5):350–355
- 4 Freund RM, Nolan WB III. Correlation between brow lift outcomes and aesthetic ideals for eyebrow height and shape in females. *Plast Reconstr Surg* 1996;97(7):1343–1348
- 5 Park KH, Kim YK, Woo SJ, et al; Korean Retina Society. Iatrogenic occlusion of the ophthalmic artery after cosmetic facial filler injections: a national survey by the Korean Retina Society. *JAMA Ophthalmol* 2014;132(6):714–723

- 6 Merz Aesthetics, Inc. (2013). Radiesse® injectable implant: Instructions for use. Available at: http://www.radiesse.com/RADIESSE_Wrinkle_Filler_Instructions_for_Use.pdf. Accessed July 1, 2014
- 7 Costantino PD, Friedman CD, Jones K, Chow LC, Pelzer HJ, Sisson GA Sr. Hydroxyapatite cement. I. Basic chemistry and histologic properties. *Arch Otolaryngol Head Neck Surg* 1991;117(4):379–384
- 8 Marmur ES, Phelps R, Goldberg DJ. Clinical, histologic and electron microscopic findings after injection of a calcium hydroxylapatite filler. *J Cosmet Laser Ther* 2004;6(4):223–226
- 9 LeGeros RZ. Biodegradation and bioresorption of calcium phosphate ceramics. *Clin Mater* 1993;14(1):65–88
- 10 Jacovella PF. Calcium hydroxylapatite facial filler (Radiesse): indications, technique, and results. *Clin Plast Surg* 2006;33(4):511–523
- 11 Havlik RJ; PSEF DATA Committee. Hydroxyapatite. *Plast Reconstr Surg* 2002;110(4):1176–1179
- 12 Emer J, Sundaram H. Aesthetic applications of calcium hydroxylapatite volumizing filler: an evidence-based review and discussion of current concepts: (part 1 of 2). *J Drugs Dermatol* 2013;12(12):1345–1354
- 13 Sundaram H, Voigts B, Beer K, Meland M. Comparison of the rheological properties of viscosity and elasticity in two categories of soft tissue fillers: calcium hydroxylapatite and hyaluronic acid. *Dermatol Surg* 2010;36(Suppl 3):1859–1865
- 14 Select Committee on GRAS Substances. 1973. Opinion: Carboxymethyl cellulose. Available at: <http://www.fda.gov/Food/IngredientsPackagingLabeling/GRAS/SCOGS/ucm261244.htm>. Accessed July 1, 2014
- 15 Smith S, Busso M, McClaren M, Bass LS. A randomized, bilateral, prospective comparison of calcium hydroxylapatite microspheres versus human-based collagen for the correction of nasolabial folds. *Dermatol Surg* 2007;33(Suppl 2):S112–S121, discussion S121
- 16 Bass LS, Smith S, Busso M, McClaren M. Calcium hydroxylapatite (Radiesse) for treatment of nasolabial folds: long-term safety and efficacy results. *Aesthet Surg J* 2010;30(2):235–238
- 17 Tzikas TL. A 52-month summary of results using calcium hydroxylapatite for facial soft tissue augmentation. *Dermatol Surg* 2008;34(Suppl 1):S9–S15
- 18 Sadick NS, Katz BE, Roy D. A multicenter, 47-month study of safety and efficacy of calcium hydroxylapatite for soft tissue augmentation of nasolabial folds and other areas of the face. *Dermatol Surg* 2007;33(Suppl 2):S122–S126, discussion S126–S127
- 19 Marmur ES, Taylor SC, Grimes PE, Boyd CM, Porter JP, Yoo JY. Six-month safety results of calcium hydroxylapatite for treatment of nasolabial folds in Fitzpatrick skin types IV to VI. *Dermatol Surg* 2009;35(Suppl 2):1641–1645
- 20 Sklar JA, White SM. Radiance FN: a new soft tissue filler. *Dermatol Surg* 2004;30(5):764–768, discussion 768
- 21 Carroll TL, Rosen CA. Long-term results of calcium hydroxylapatite for vocal fold augmentation. *Laryngoscope* 2011;121(2):313–319
- 22 Jansen DA, Graivier MH. Evaluation of a calcium hydroxylapatite-based implant (Radiesse) for facial soft-tissue augmentation. *Plast Reconstr Surg* 2006;118(3, Suppl):22S–30S, discussion 31S–33S
- 23 Graivier MH, Bass LS, Busso M, Jasin ME, Narins RS, Tzikas TL. Calcium hydroxylapatite (Radiesse) for correction of the mid- and lower face: consensus recommendations. *Plast Reconstr Surg* 2007;120(6, Suppl):55S–66S
- 24 Berlin AL, Hussain M, Goldberg DJ. Calcium hydroxylapatite filler for facial rejuvenation: a histologic and immunohistochemical analysis. *Dermatol Surg* 2008;34(Suppl 1):S64–S67
- 25 Coleman KM, Voigts R, DeVore DP, Termin P, Coleman WP III. Neocollagenesis after injection of calcium hydroxylapatite composition in a canine model. *Dermatol Surg* 2008;34(Suppl 1):S53–S55
- 26 Carruthers A, Liebeskind M, Carruthers J, Forster BB. Radiographic and computed tomographic studies of calcium hydroxylapatite for treatment of HIV-associated facial lipotrophy and correction of nasolabial folds. *Dermatol Surg* 2008;34(Suppl 1):S78–S84
- 27 Feeney JN, Fox JJ, Akhurst T. Radiological impact of the use of calcium hydroxylapatite dermal fillers. *Clin Radiol* 2009;64(9):897–902
- 28 Marmur E, Green L, Busso M. Controlled, randomized study of pain levels in subjects treated with calcium hydroxylapatite premixed with lidocaine for correction of nasolabial folds. *Dermatol Surg* 2010;36(3):309–315
- 29 Busso M, Voigts R. An investigation of changes in physical properties of injectable calcium hydroxylapatite in a carrier gel when mixed with lidocaine and with lidocaine/epinephrine. *Dermatol Surg* 2008;34(Suppl 1):S16–S23, discussion S24
- 30 Rose AE, Day D. Esthetic rejuvenation of the temple. *Clin Plast Surg* 2013;40(1):77–89
- 31 Fitzgerald R, Vleggaar D. Facial volume restoration of the aging face with poly-L-lactic acid. *Dermatol Ther* 2011;24(1):2–27
- 32 Vleggaar D, Fitzgerald R, Lorenc ZP. Composition and mechanism of action of poly-L-lactic acid in soft tissue augmentation. *J Drugs Dermatol* 2014;13(4, Suppl):s29–s31
- 33 Vleggaar D, Fitzgerald R, Lorenc ZP. The history behind the use of injectable poly-L-lactic acid for facial and nonfacial volumization: the positive impact of evolving methodology. *J Drugs Dermatol* 2014;13(4, Suppl):s32–s34
- 34 Vleggaar D, Fitzgerald R, Lorenc ZP. Understanding, avoiding, and treating potential adverse events following the use of injectable poly-L-lactic acid for facial and nonfacial volumization. *J Drugs Dermatol* 2014;13(4, Suppl):s35–s39
- 35 Vleggaar D, Fitzgerald R, Lorenc ZP, et al. Consensus recommendations on the use of poly-L-lactic acid for facial and nonfacial volumization. *J Drugs Dermatol* 2014;13(4, Suppl):s44–s51
- 36 Glasgold MJ, Glasgold RA, Lam SM. Volume restoration and facial aesthetics. *Facial Plast Surg Clin North Am* 2008;16(4):435–442, vi
- 37 Lam SM, Glasgold RA, Glasgold MJ. Limitations, complications, and long-term sequelae of fat transfer. *Facial Plast Surg Clin North Am* 2008;16(4):391–399, v
- 38 Lam SM, Glasgold MJ, Glasgold RA. *Complementary Fat Grafting*. Philadelphia, PA: Lippincott Williams, & Wilkins; 2007
- 39 Collar RM, Boahene KD, Byrne PJ. Adjunctive fat grafting to the upper lid and brow. *Clin Plast Surg* 2013;40(1):191–199
- 40 Glasgold M, Lam SM, Glasgold R. Volumetric rejuvenation of the periorbital region. *Facial Plast Surg* 2010;26(3):252–259
- 41 Minton TJ, Williams EF. Lipotransfer in the upper third of the face. *Facial Plast Surg* 2010;26(5):362–368
- 42 Ciuci PM, Obagi S. Rejuvenation of the periorbital complex with autologous fat transfer: current therapy. *J Oral Maxillofac Surg* 2008;66(8):1686–1693
- 43 Chen HH, Williams EF. Lipotransfer in the upper third of the face. *Curr Opin Otolaryngol Head Neck Surg* 2011;19(4):289–294
- 44 Coleman SR. Structural fat grafting: more than a permanent filler. *Plast Reconstr Surg* 2006;118(3, Suppl):108S–120S
- 45 Trepsat F. Periorbital rejuvenation combining fat grafting and blepharoplasties. *Aesthetic Plast Surg* 2003;27(4):243–253
- 46 Kranendonk S, Obagi S. Autologous fat transfer for periorbital rejuvenation: indications, technique, and complications. *Dermatol Surg* 2007;33(5):572–578
- 47 Xie Y, Zheng DN, Li QF, et al. An integrated fat grafting technique for cosmetic facial contouring. *J Plast Reconstr Aesthet Surg* 2010;63(2):270–276
- 48 Krishna S, Williams EF III. Lipocontouring in conjunction with the minimal incision brow and subperiosteal midface lift: the next dimension in midface rejuvenation. *Facial Plast Surg Clin North Am* 2006;14(3):221–228