



# Nonsurgical Facial Enhancement and Rejuvenation—Fillers, Neurotoxins, and Fat Transfers

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## Introduction

With good skincare and lifestyle habits, including daily sun protection, it is not generally until the third decade of life that the first aging-related changes to the face become apparent. It is then that expression lines start to appear, at first only with dynamic movement, but eventually also visible at rest. In the next decades, individuals may start to notice a change in face shape due to a loss and redistribution of facial fat and bone resorption. Skin also becomes more lax due to a loss of collagen and elastin as a result of genetics, sun exposure, nicotine usage, and other environmental stresses. Muscle tone increases as a result of the decreased tissue resistance of laxer tissues and lengthened resting position.

Continued research into the structural changes involved in face aging has led to the development of improved techniques for facial rejuvenation that target both soft and hard tissue facial volume loss. By combining treatments that act on multiple aspects of facial aging, physicians can address the visible signs of aging with an understanding of their underlying cause. In many patients this can be achieved with minimally invasive procedures using a combination of treatment modalities. Treatment with botulinum toxin A to remove

mimetic wrinkles can also be used prophylactically in younger patients (prejuvenation) to prevent some aging changes resulting from muscular activity (i.e., brow ptosis, perioral rhytids, and down-slanting oral commissures). Dermal fillers and fat transfer can be used to restore facial volume, enhance contours, lift lax tissues, and soften rhytids and folds. Properly placed biostimulatory fillers can improve skin texture and fine rhytids, as well as improve skin quality. These treatments can be combined with light-based modalities such as intense pulsed light (IPL), lasers (CO<sub>2</sub>, Erbium, and YAG), and energy-based modalities such as radiofrequency and ultrasonic devices.

Increasingly, individuals are searching for solutions that offer natural-looking improvements and that are affordable and with minimal downtime. However, when performing aesthetic treatments, practitioners should avoid a price-per-unit or syringe mentality. A global plan should be formulated that enhances the younger patient, and both rejuvenates and enhances the older individual. The plan must evaluate facial aesthetics from multiple angles at rest and in animation. The patient's skin quality (laxity, fine and deep rhytids, dyschromia, and actinic changes), volume, and contour must all be assessed. An "ideal" treatment plan should be discussed and the patient educated as to what treatments and procedures will yield the best results. Patients often require help in visualizing the cause for their dissatisfaction with their appearance. At that point, a patient's budget and desires can modify

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the “ideal” plan. It is certainly acceptable to not treat all concerns simultaneously, but using inadequate volume of material to treat multiple areas (because of budgetary concerns) will result in inadequate treatment of each. This will create an unhappy patient due to a combination of undercorrection and short duration treatment results. If a patient’s finances do not allow for a satisfying correction, this should be explained to them and the treatment delayed. Furthermore, patients’ desires may not always be achievable with a noninvasive approach, in which case appropriate surgery should be recommended. The physician’s knowledge of facial anatomy, the anatomy of aging, facial aesthetics, suitability of a product for a particular indication, and injection technique are all essential for patient safety and optimal aesthetic results.

The stigma surrounding medical aesthetics continues to decrease as traditional, as well as social, media feature influencers and celebrities openly discussing their aesthetic treatments. As a result, minimally invasive aesthetic procedures have become popular with a much wider audience and there has been an increase in younger individuals seeking ways to maintain and enhance their appearance. Millennials are looking to enhance their real life as well as digital appearance and to prevent facial aging, and they offer clinicians the opportunity to forge long-term relationships.

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## Anatomy of Facial Aging

Facial aging involves multidimensional interactions between bone, muscle, fat, and skin that result in changes in quality, shape, and contour [1]. The craniofacial skeleton undergoes resorption, mimetic muscles increase their resting tone, fat compartments lose volume, deflate, and descend, and skin becomes thinner and less elastic, and demonstrates varying degrees of dyspigmentation and wrinkling [2, 3]. The face does not age as a homogeneous unit, but as many individual dynamic components. These changes vary based on hereditary as well as environmental factors.

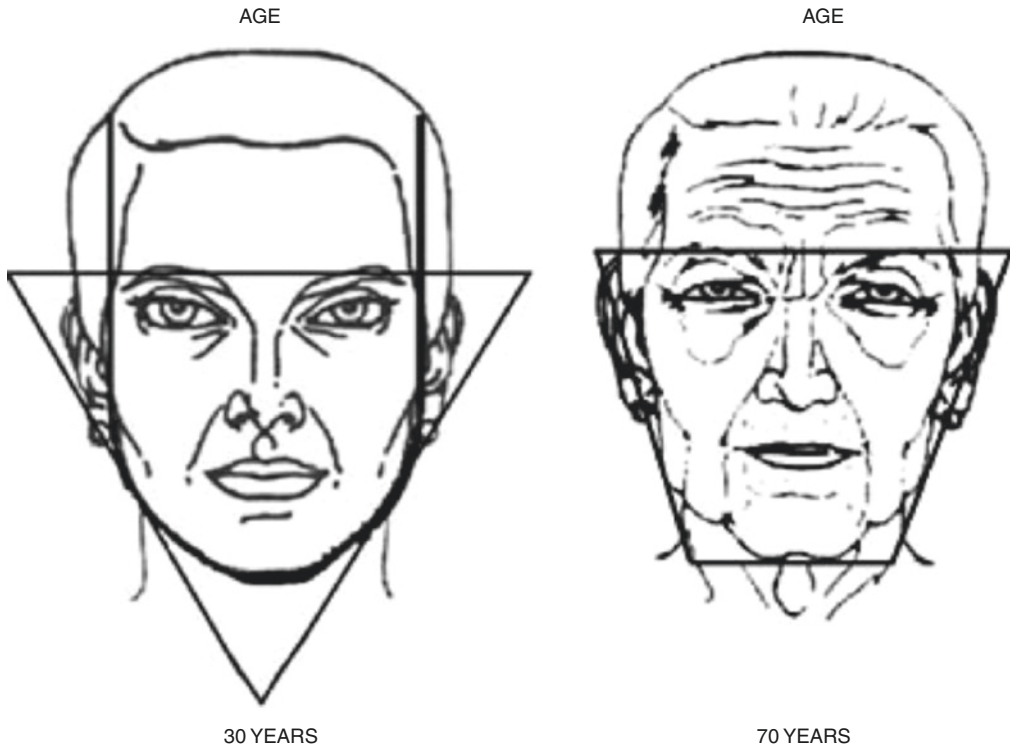
The youthful face is full of well-supported facial fat, typically located overlying the masseter. This is associated with a concavity, or depression,

overlying the buccal recess just anterior to the masseter [1]. The combination of fullness in the malar region and lateral cheek associated with a concavity overlying the buccal recess accounts for the angular, tapered appearance of the youthful face. This appearance has become known as the triangle of beauty. Aging faces are rectangular in their configuration, with little differential between malar highlight and midfacial fat (Fig. 6.1).

In the aging face, facial fat is situated more inferiorly, making the face appear visually longer [4]. Typically, the upper third of the face demonstrates forehead flattening, horizontal rhytids, brow ptosis, and temporal hollowing. In the middle third of the face, there is infraorbital hollowing and tear trough formation, and loss of prominence of the malar eminence, with a crescent or V-shaped deficiency extending along the maxilla to the zygoma [5]. The lower eyelid appears lengthened and distinct from the cheek. There is submalar hollowing, with deepening of the nasolabial folds. The lower one-third of the face demonstrates lengthening of the upper lip, with vermilion thinning, and decrease in projection, with flattening of the philtral columns and cupid’s bow [6]. Both lips develop vertical rhytids along with volume loss. The oral commissures slant downward and marionette lines form. There is loss of a distinct mandibular border, with scalloping of the jawline as jowls develop, increasing the apparent width of the lower face. The skin of the neck becomes lax, platysmal bands increase in visibility, and ringle lines develop.

## Skin Aging

The quality of our skin is a primary indicator of our age [7]. Histologic examination of aged skin demonstrates reduced numbers of fibroblasts, mast cells, and blood vessels [8]. Fibroblasts interact with collagen fibrils to maintain normal cell shape and mechanical tension [9]. In young human dermis, fibroblast binding to intact collagen fibrils allows the generation of traction forces that are necessary for maintaining normal cell size (Fig. 6.2a, b). However, in the aged dermis, fragmentation of the collagen dermal matrix



**Fig. 6.1** Facial changes at various ages. (Reproduced with permission from Gonzalez-Ulloa [46])

makes it harder for fibroblasts to attach. Unattached fibroblasts experience no tension stimuli, which is necessary for normal balanced collagen production. This produces a perpetuating never ending cycle of aging.

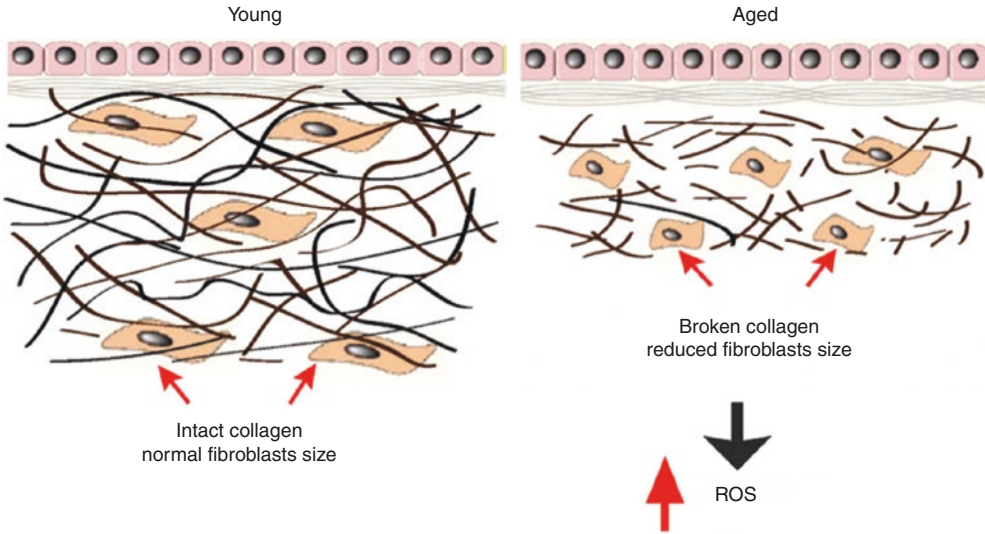
### Fat in the Aging Face

A youthful face demonstrates smooth transitions between convexities and concavities, while aging causes individual fat compartments to appear as distinct entities. Rohrich and Pessa, through cadaver dissections, demonstrated that facial fat exists as well-delineated, separate compartments that have consistent relationships to each other [3]. These individual fat compartments age independently, and this is genetically predetermined. The compartments are defined by fibrous membranes that stabilize blood vessels and nerves [10]. Deep fat compartments are defined by fusion zones where fascial attachments tether muscles to bone as they cross unstable areas [11].

Folds, such as the nasolabial fold, occur at transition points between thick and thinner superficial fat compartments [12].

Changes in deep fat compartments are more causally related to the contour changes seen with aging, and are responsible for the anterior projection of the face. Fat in the superficial compartments is more metabolic and associated with a look of health and vitality. Loss of volume in these compartments makes us look tired and drawn.

Gierloff et al. used CT scans to measure mid-facial fat compartments and to compare the anatomy between human cadavers of younger versus older age subjects. After examining CT scans of 12 cadaver heads, divided into two age groups (54–75 years and 75–104 years), Gierloff concluded that there was an inferior migration of the midfacial fat compartments and an inferior volume shift within the compartments during aging (Fig. 6.3) [13]. Descent and deflation of the buccal fat worsen the changes and add to the jowling.



**Photoprotected or young skin**

Mechanical tension	Procollagen synthesis	Collagenase levels
Normal	Normal	Normal

**Photodamaged or aged skin**

Mechanical tension	Procollagen synthesis	Collagenase levels
Low	Low	High

**Fig. 6.2** (a, b) In young human or photoprotected skin dermis, intact collagen fibrils interact with cells to maintain normal cell spreading and size (a). In contrast, in aged or photodamaged human skin dermis (b), broken collagen fibrils are unable to support normal cell spreading, and this causes reduced fibroblast size. (Reproduced with per-

mission from Tu and Quan [47]. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited)



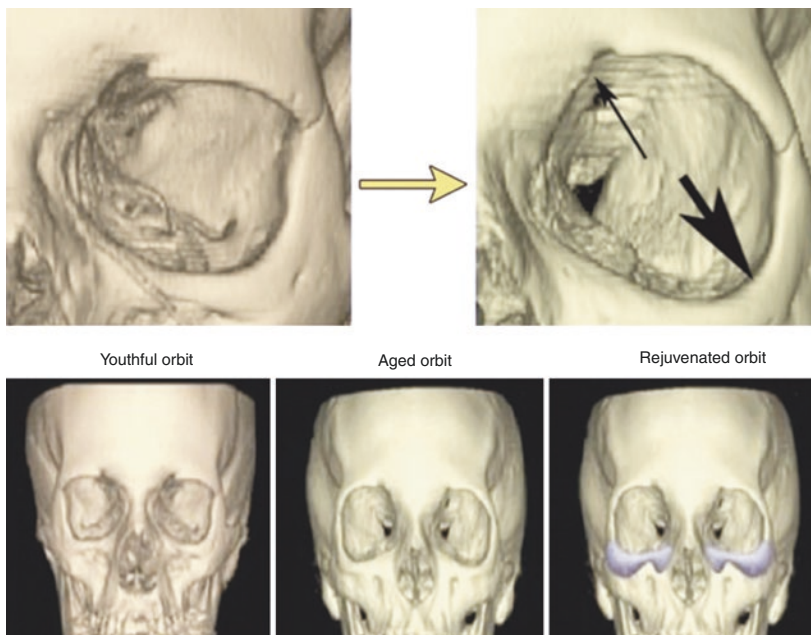
**Fig. 6.3** Stylistic drawing of the facial fat compartments and their aging changes. (Reproduced with permission from Gieffloff et al. [48])

## Changes Resulting from Muscle Activity with Aging

Muscle tone and activity are responsible for many of the changes associated with facial aging. Over time, repeated contraction of facial mimetic muscles contributes to changes in the facial fat positioned above and below these muscles. Le Louarn, et al., showed an increased mimetic muscle tone with age, in contrast to the traditional view of increased facial muscle laxity with age causing downward displacement of tissue [14]. It is the author's opinion that this increased muscular activity against more lax aged tissue is responsible for some of the caricature-like changes that occur as we age. An example would be those affecting the mouth, where we see a widening of the smile; increased tooth show with smiling, talking, and laughing; down-slanting oral commissures; and a lengthened upper lip with a thinned vermillion. The author has also noted involuntary movement of perioral musculature at rest in aging patients, with significant aging changes in this area (more frequent in women than men). It is likely that this increased musculature activity is caused by increased muscle length as a result of bone resorption and decreased resistance offered by lax tissues.

## Bone Aging

Craniofacial bony remodeling appears at age 50+ in both men and women, and also contributes to the facial aging process [15]. The facial skeleton undergoes a decrease in bone density similar to the axial skeleton, and this correlates with an overall decrease in volume and contour changes [16]. Examination of orbital aging using CT scans has shown that the width and area of the orbital aperture increases with age [17]. In both men and women, there is an increase in height of the superior orbital rim, and an increased distance to the inferior orbital rim; the orbit enlarges in a superomedial and inferolateral direction. Bony changes in the superior half of the orbit cause hooding, unmasking of medial upper eyelid fat, crow's feet, and, in combination with deepening of the glabella angle and descent of the medial brow, horizontal glabella skin creases form. In the lower half of the orbit (Fig. 6.4), tissues roll over the recessed inferior orbital rim, contributing to lid lag, descent of the lid cheek junction with infraorbital hollowing, and a deepening of the nasojugal groove [18].

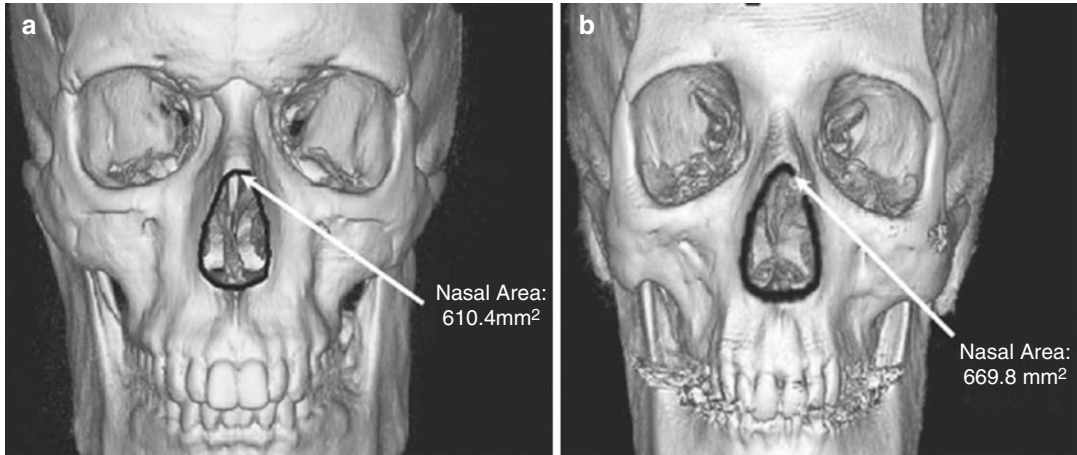


**Fig. 6.4** Example images of the bony orbit of a young female subject on the left and an old female subject on the right (different subject). (Below) Changes in the orbital

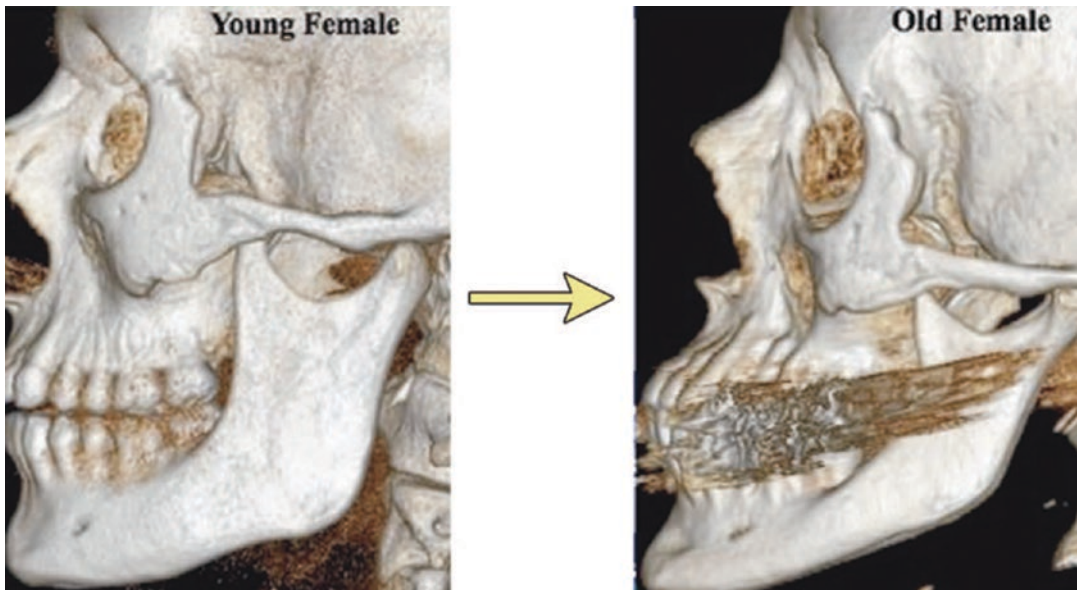
skeleton may be camouflaged with filler. (Reproduced with permission from Shaw et al. [18])

Such changes in the craniofacial skeleton are not limited to the orbit [19]. The midface skeleton also has a strong predisposition to resorption, particularly the maxilla, including the pyriform region of the nose. CT scans have shown an aging-related decreased midface vertical height with deepening of the glabella, pyriform, and maxillary angles [17]. Shaw and Kahn [16] found that the pyriform aperture enlarges

with aging as the edges of the nasal bones recede (Fig. 6.5). Other changes in note include maxilla recession (Fig. 6.6), and loss of vertical height of the mandible, with posterior recession of the inferior alveolar ridge. As bone decreases in volume in key anatomical locations, the overlying skin and soft tissue are left with a gradually shrinking support base, contributing to the morphologic aging changes described above [18].



**Fig. 6.5** Sample computed tomographic scans of (a) a male subject in the young age group and (b) a male subject in the old age group, with mean pyriform aperture area applied. (Reproduced with permission from Shaw and Kahn [16])



**Fig. 6.6** Example images of the bony mandible of a young female subject on the left and an old female subject on the right (different subject). Decreased skeletal support

of the overlying soft tissue results in morphologic aging changes. (Reproduced with permission from Shaw et al. [18])

## Patient Examination and Treatment Plan

The goal of aesthetic medicine is to make clients look like the best version of themselves. Whether the patient is seeking enhancement of a particular area or considering facial rejuvenation, it is the provider's job to be able to accurately evaluate the patient's facial aesthetics and determine an appropriate individualized treatment plan. Communication skills are important at this stage, as many clients know they need something, but may not be sure exactly what. It is the clinician's role to understand the clients' needs and to formulate these into a treatment plan that all are agreed on. It is important that we as aesthetic practitioners guide our patients rather than vice versa, as their desires may not always be achievable, and their expectations must be managed tactfully and sensitively.

The practitioner can facilitate this education process by employing photographs, three-dimensional imaging, morphing software, pre- and posttreatment photographs, mirrors, and aging scales. At the time of consultation, the practitioner should determine the patient's complaints and desires. A thorough medical history as well as a history of all previous aesthetic treatments and surgery should be obtained. A careful examination should be performed from various angles, in animation as well as in repose. Asymmetries, both structural as well as those resulting from muscular action, should be noted and pointed out to the patient. A plan involving one or more treatment sessions should be formulated. Costs should be discussed, and all patient's questions should be answered. Standardized photographs should be taken to record the patient's pre- and post procedure appearance.

Regardless of the patient's age, ethnicity, or gender, the physician's role is to create a harmonious, balanced, and natural appearance. Though a patient's desires are always paramount, a physician should guide the patient because everyone has difficulty in properly assessing their own appearance. Whether invasive or noninvasive, all aesthetic procedures carry potential medical consequences and

require informed consent so that patients understand the risks and benefits, and have realistic expectations of the results.

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## Treatment Options

### Dermal Fillers

The selection of a dermal filler is dependent on the indication and site of placement, and largely determined by a product's rheological properties such as cohesivity, G prime, and viscosity, which allow physicians to match the individual properties of a dermal filler to its optimal use [20]. Fillers with high cohesivity combined with low G prime and viscosity give tissue expansion in a predominantly horizontal plane, providing tissue support with natural contours. These are a good choice for more superficial placement, and for mobile areas such as around the mouth or eyes. In contrast, fillers with high cohesivity and high G prime provide more tissue projection and expansion, and are most suited for deep volumizing. An understanding of the rheologic properties of the different fillers allows physicians to select the optimal product for the required indication. It is important to bear in mind that the rheological properties of a filler are determined in a laboratory, and they change when injected into the aqueous tissue environment. These properties serve as a method of comparison of the filler materials.

The anticipated duration of correction is another factor that must be considered. In addition to the hyaluronic acid (HA) fillers, other frequently used options include poly-L-lactic acid (PLLA; Sculptra) and calcium hydroxylapatite (CaHA; Radiesse). The clinical effect of PLLA is not related to its elasticity and viscosity at the time of injection, but depends on the neocollagenesis that it stimulates over a period of several weeks to months thereafter. CaHA has high cohesivity, G prime, and viscosity, as well as having stimulatory capacity to promote collagen synthesis.

## Injection Techniques for Optimal Results and Complication Avoidance

Successful aesthetic treatment with dermal fillers is technique dependent. Adverse events and poor outcomes are a result of an interaction between the characteristics of the filler used, the patient's anatomy and physiology, and the injector's technique. Practitioners must have a thorough understanding of the characteristics of the available fillers, facial anatomy, potential adverse events and their etiology, and the techniques that can be employed to achieve the desired aesthetic enhancement.

Available injection techniques for each facial area will now be individually discussed (Table 6.1 and Fig. 6.7). Appropriate anatomic planes, danger zones, and treatment objectives and technique alternatives will be emphasized. Regardless of the technique and area of the face being treated, sterile technique must be employed. *Fillers are implant materials and must be treated as such.* Appropriate skin preparation with alcohol or chlorhexidine with alcohol (or other appropriate solution, i.e., hypochlorous acid, Technicare) should be employed, and the areas retreated if contaminated. Every time the site in the skin where the needle or cannula enters is touched by

the injectors' unsterile gloves or gauze pad, the area should be wiped again with antiseptic. The needle or cannula used should be changed if no longer sterile. Never handle the needle or cannula with unsterile gloves or gauze pads. Intraoral injection technique is not recommended and will not be discussed here. If the fillers are mixed with local anesthetic, attention must be paid to avoid any contamination. Avoidance of bacterial contamination is essential to prevent not only infection but also inflammatory responses such as nodularity and granuloma formation. The presence of bacteria (not necessarily in sufficient quantity to cause a frank infection) enhances the body's ability to recognize the material as foreign and stimulate an inflammatory response.

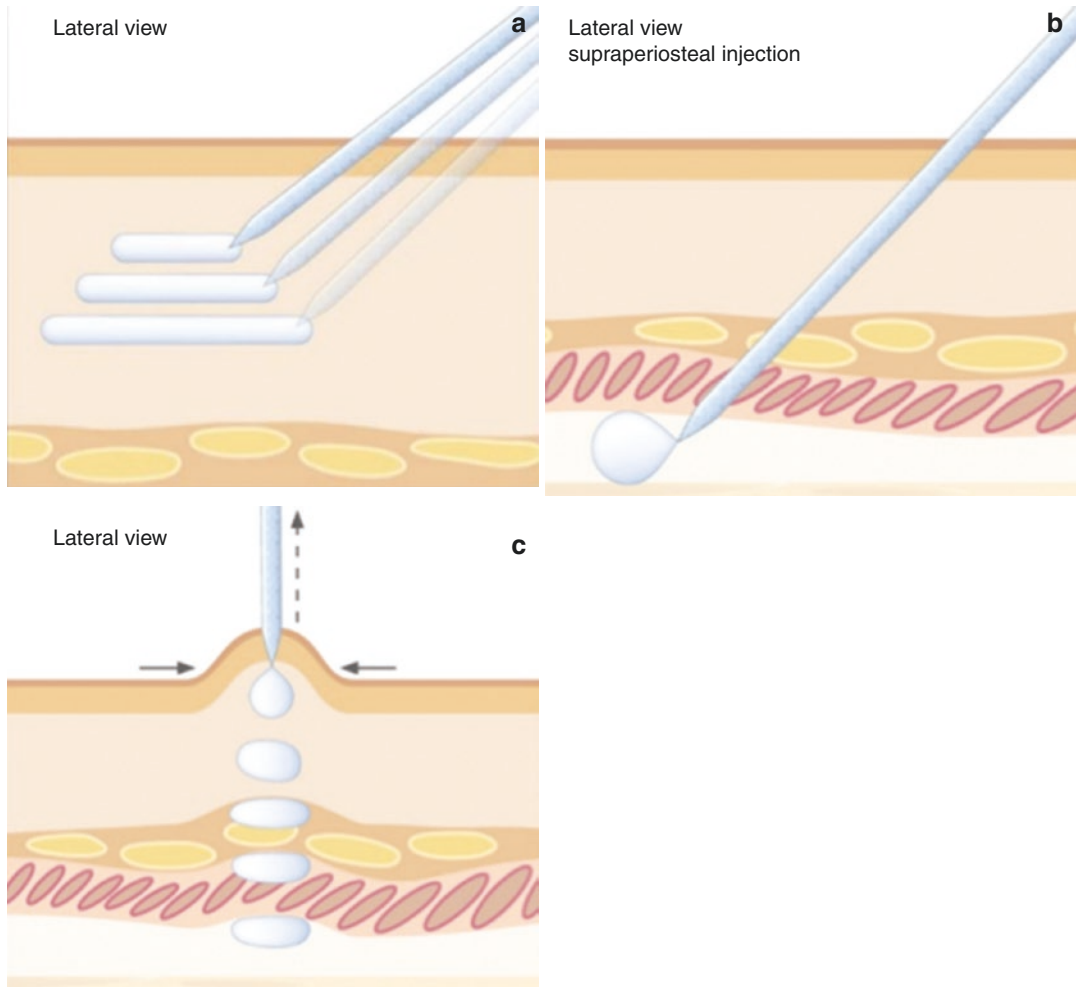
### Safety

Filler adverse events are multifactorial, representing a complex interaction between the filler characteristics, the patient's anatomy and genetics, and the technique employed. After selection of the appropriate filler, and taking a comprehensive medical and filler history (particularly to determine if the patient has experienced any previous filler reactions), the only remaining variable is the injector's technique.

**Table 6.1** Dermal filler injection techniques: uses and advantages

Technique	Uses and advantages
Threading	Primarily used for line filling. Material can be placed antegrade or retrograde. When antegrade, the material is expressed as the needle or cannula is advanced. Amounts should be small 0.05 cc per thread. With retrograde product deposition, the needle or cannula is advanced in the desired plane to the distal most extent of the deposition location and material is expressed upon withdrawal. Again, amounts should be no greater than 0.05 cc per thread. The author prefers the retrograde technique because depth and location are determined prior to material deposition
Fanning	Variation on threading where multiple radial threads originate from a single skin puncture. Again the author prefers a retrograde technique. The injector should be cautioned to discontinue expressing material when coming close to the skin puncture site so that excess is not deposited at this location (can accumulate from each of the radial threads)
Depot	The needle or cannula is directed to a location and while stationary material is deposited. In most circumstances no more than 0.2 cc depot injections should be performed. This technique is not recommended unless in an avascular location such as the vermilion white roll or when directly in contact with bone
Pylon or tower technique	This is similar to threading but in a perpendicular axis. The needle or cannula pierces the skin and moves in a perpendicular direction (slightly obliquely is preferable) until in contact with bone. Material is expressed as a thread as the needle or cannula is withdrawn. Attempt to elevate the overlying tissue upon withdrawal to accommodate the filler





**Fig. 6.7** Commonly used injection techniques: (a) linear threading, (b) depot injection, and (c) pylon or tower. (Reproduced with permission from Funt [49]. Copyright © 2017, © 2018 S. Karger AG, Basel)

Injectors should always use a sterile or the cleanest possible technique. Bacterial or fungal contamination can cause immediate infection, late chronic infection (biofilm), granulomas, or stimulate immune-related responses (erythema, edema, and nodules). The FDA-approved fillers are biocompatible and in most cases are not generally immune stimulators. Once bacteria are introduced, even if not in numbers sufficient to cause infection, they become immune stimulators.

Cleansing the skin and prepping (alcohol, chlorhexidine, chlorhexidine and alcohol, phenol-based solutions, etc.), and reprepping after each contamination of the treatment site (massage, mold-

ing, and intraoral contact) is essential. Injections should not be performed in areas where infection is present or in areas of traumatized tissue.

Before undertaking any aesthetic treatments, all injectors should obtain a thorough knowledge of facial anatomy, including facial bony architecture, location and action of facial musculature, location of facial sensory nerves and their sensory territories, and the vascular anatomy of the face. They should be aware of the danger zones, where intravascular filler injection resulting in emboli events are more likely. That being said, the face is highly vascular, so injectors should be vigilant at all locations.

Injectors should always use injection techniques that mitigate against neural or vascular injury. When using a needle, material should be injected directly on bone when volumizing in areas where bony support is present. The needle should enter at an oblique angle, as this avoids the unlikely event that the bevel remains in a vessel, and also limits filler moving retrograde following the path of the needle. If not in direct contact with bone, the needle should always be in motion with gentle plunger pressure. Have the path of the needle or cannula oblique or perpendicular to the path of major vessels rather than parallel to them. These measures reduce the volume of material that would be intraluminally injected into any vessel the needle or cannula penetrates. Though the facial vasculature varies significantly in its horizontal positioning, and there are numerous collateral vessels in addition to the named vessels, the location of these vessels in a vertical dimension (depth) is constant. The facial vessels lie at the level of the SMAS (subcutaneous musculoaponeurotic system), so, in general, injections should always be within the dermis, or in the immediate subdermal plane when fanning and threading. Depot injections should occur only in avascular locations, in contact with bone, within the dermis, or the vermilion white roll (when using a needle). When using a cannula, the injector must be aware that cannula thinner than 25 gauge can pierce a vessel as easily as a needle, and one should not have a false sense of security. The cannula should also be kept moving, and material injected at the bony level or superficially, as described above. Larger-gauge cannulae (25 g or thicker) reduce the risk of intravascular injection, but the injector sacrifices some ability to control its position, particularly in fibrotic previously injected areas.

Injectors should avoid injecting highly cross-linked, high G prime HA fillers into the dermis, as these can be more reactive. PLLA and CaHA should not be injected intradermally either. At this injection depth, PLLA will have an increased nodule rate and CaHA particles may be visible.

Malar edema can best be avoided by a careful examination of the patient to look for a history of intermittent malar edema. Material is best placed at

the periosteal level and should be in small aliquots. The G prime of the filler used is less important than the patient's degree of preexisting lymphatic compromise. In the area of the infraorbital hollow, an HA filler should be employed so that hyaluronidase may be used to break down the filler should malar edema occur, but a highly hydrophilic HA material should be avoided in this region.

Finally, injections into the facial musculature should be avoided, as these are more prone to granuloma formation.

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## Facial Volumizing and Contouring

When thinking about facial soft tissues, think of them as a mask that is stapled to the face by a series of ligamentous attachments that lie in a vertical line in the midportion of each side of the face. As a result of the orientation and location of these attachments, filler placement medial to this line volumizes, while material placed laterally volumizes, but also lifts the tissue, correcting the descent of the tissue caused by aging [21]. These attachments are at the temporal crest, the zygomaticocutaneous ligament, and the masseteric and mandibular ligaments.

## Forehead

The objectives of treating the forehead include softening horizontal forehead rhytids that are not corrected with neurotoxin treatments; volumizing a skeletonized forehead; correcting volume deficiency resultant from bone resorption; altering the frontal angle and shape; and achieving brow elevation, particularly laterally.

The forehead area may suffer from lines that are present at rest, or volume depletion, both of which can be treated with dermal filler. Fine lines can be treated by superficial injection within the dermis with a low G prime filler (sequential, superficial depot injection can be employed). Deeper volumizing is performed by placing the tip of a needle or cannula on the periosteum (in the subgaleal space) and placing small depot aliquots or threads of filler. Placement of retrograde

threads with a moving cannula is the author's preferred technique.

**Danger zones** The supratrochlear and supraorbital arteries travel beneath and within the corrugator and frontalis muscles, arising from their bony foramina, and become increasingly superficial as they course through the frontalis muscle until they become subcutaneous. Due to the lack of collateral blood supply (axial pattern) in this area, dermal filler occlusion of these arterial vessels is likely to lead to ischemia, followed by necrosis.

#### Tips and Tricks

To create space for injection of filler, the forehead tissues can first be elevated by injection of dilute lidocaine or saline. This technique allows for a more uniform placement of filler in patients who have adherence of their soft tissue to the frontal bone. It also reduces the potential for intravascular injection, as the vessels are lifted anteriorly prior to the filler injection.

## Brows

The lateral brow can be elevated by placing a high G prime filler at the periosteal level using a needle or cannula. Material can be deposited as threads or depots (0.1–0.2 cc each). When injecting using a depot technique with a needle, the tip should be in contact with bone at an oblique angle, walking the tip along the bone without withdrawing it from the skin. When using a cannula, start laterally and keep the cannula in contact with the bone. Stop injections when the midpoint of the brow is reached, to avoid vessel and nerve injury. Molding to smoothness is essential. Care should be taken not to inject too much volume, as this can masculinize a female face by creating a prominent supraorbital ridge. Treating the temporal hollows will also elevate the lateral brow (see below).

**Danger zones** They include the supratrochlear and supraorbital neurovascular bundles, branches of the superficial temporal artery, and the frontal branch of the facial nerve.

## Temporal Hollows

In the temporal hollows, preperiosteal injection is performed with a needle in contact with bone using a depot technique, and is the author's preference for the medial hollow near the temporal crest. Begin at a point 1 cm superior to the orbital rim and 1.5 cm lateral to the temporal crest. Here, the volumes are 0.2–0.5 cc. Injections are directed medially. Additional injections superior to this point can be placed in a similar fashion. Alternatively, using a threading technique with a cannula, filler can be placed in the loose areola plane above the deep temporal fascia. This plane can be entered either medially or laterally, but it is easier to find the proper plane from a lateral entry point. This is the author's preferred technique for correction of the more lateral temporal hollow using a high G prime, high-viscosity filler. Remember that the temporal fossa is a large bony concavity containing the temporalis muscle. It is shallowest at the edge near the temporal crest and is most efficiently filled in this area. Lifting of the facial tissues can also be accomplished by placing filler subdermally with a needle or cannula posterior to the superficial temporal artery, beneath the sideburn and temporal hairline, using a needle or cannula (cannula is preferable).

**Danger zones** They include the superficial temporal artery, zygomaticotemporal artery, and the deep temporal arteries. Avoidance is by injecting at the periosteal level with the needle tip in contact with bone when injecting using a depot technique, or retrograde threads with a moving cannula in the relatively avascular plane on the surface of the deep temporal fascia. The zygomaticotemporal artery is a terminal branch of the ophthalmic artery, and an embolic event here may result in blindness.

### Tips and Tricks

The temporal fossa is like a shallow bowl, with the depth reducing at the edges. Less volume of filler will be required if the filler is placed preperiosteally near the temporal crest. A surprising amount of facial elevation can be accomplished by the subcutaneous injection mentioned above when combined with lateral cheek augmentation along the zygoma. Injection of the temporal hollow generally also results in some degree of lateral brow elevation.

## Infraorbital Hollows and Tear Trough

Infraorbital hollow refers to the curvilinear depression under the eyes that comprises the tear trough, as well as the nasojugal fold and palpebromalar groove [22]. Anatomically, it is related to the underlying bony anatomy, amount of fat present, and the tethering effect of the orbitomalar and zygomaticofacial ligaments. With thin skin overlying bone, little to no subcutaneous fat, and thin orbicularis oculi muscle in this region, the infraorbital hollow can be a challenging region to treat. Injections should be performed at the preperiosteal level with the needle tip in contact with bone when injecting using a depot technique, or using retrograde threads at the same plane with a moving needle or cannula. Depot technique is preferred by the author. A lower G prime HA filler is recommended by many injectors (though the author uses more longer-lasting fillers in this location to decrease the need for frequent injections). It should be placed in small volume aliquots to reduce the incidence of visible material and malar edema, and to allow correction with hyaluronidase if a complication occurs. In stubborn cases, the skin can be subcised, and subcutaneous microdroplets placed to correct a persistent skin crease.

**Danger zones** The skin and soft tissue in this area are thin and translucent and, as a result, HA fillers can cause a bluish hue (Tyndall effect), and other materials can be visible. All materials can cause contour irregularity in this area. The tear

trough area is highly vascular, and the injector must inject atraumatically to reduce the risk of bleeding and bruising. The infraorbital neurovascular bundle lies in a vertical line with the lateral limbus of the iris and between 5 and 7 mm inferior to the inferior orbital rim. Embolic events are not uncommon here, and injury to the infraorbital nerve can result in dysesthesia or anesthesia of the ipsilateral cheek and upper lip. Injection in this area can also result in lymphatic compression and malar edema. The incidence of malar edema can be reduced by proper patient selection (patients must be examined for any degree of pre-existing lymphatic compromise), by limiting filler volume, and by placing filler material deep to the malar septum (orbitomalar ligament) directly on periosteum [23]. Malar edema is likely more related to the patient's pre-existing degree of lymphatic compromise and the degree of correction more than the physical qualities of the injectate. It can occur with a low G prime filler if the patient has existing lymphatic compromise.

### Tips and Tricks

The author strongly recommends only using an HA product in this area so that if lymphatic compromise occurs, it can be corrected with the use of hyaluronidase, and the malar edema resolved within 24 hours.

## Cheeks

Midfacial volume restoration and contour enhancement using fillers are performed laterally to medially, with smaller volumes used medially in the infraorbital hollow. If the nasolabial folds are to be treated, the midface should be volumized first, as expansion of the midfacial soft tissue will in itself soften the nasolabial folds and reduce filler volume required for their correction. Using a high G prime filler, injections are performed at the level of the periosteum using a depot technique employing small aliquots of material. Alternatively,

a tower technique with a needle or threading preperiosteally with a cannula can be employed. As mentioned earlier, the injections placed laterally cause lifting and contour change, and medially more of a contour change.

**Danger zones** They include the infraorbital neurovascular bundle, zygomaticofacial artery, and angular artery. An embolic event into the zygomaticofacial artery, or angular artery (anastomosis with the dorsal nasal artery), can result in blindness.

### Nasolabial Folds

This area is most frequently treated using immediate subdermal and subcutaneous threads placed with antegrade or retrograde fanning using a needle or cannula. In patients who have deep folds with significant amounts of soft tissue lateral to the fold, correction is best achieved by augmentation of the maxilla at the pyriform aperture. These patients have significant recession of the maxilla and will achieve the most natural correction employing this technique. This is accomplished using a high G prime filler placed directly on bone using a depot technique.

#### Tips and Tricks

Look at the cheek globally—infraorbital hollow, medial cheek, malar eminence, zygomatic arch, temporal hollow, and submalar hollow. Fill the area of greatest deficiency first, then proportionately fill all other areas. The high point of the cheek is more lateral on a female than a male. Have the treatment extend laterally along the zygomatic arch as far as necessary (to the hairline in many cases) to achieve smooth blending. Increasing the projection of the malar eminence will make deficiencies in the temporal hollow and submalar hollow appear more apparent. These areas may need to be treated in order to create a harmonious and natural-appearing volumization (otherwise the effect is to create a skeleton-like effect). Whether performing

enhancement or rejuvenation, the objective is not to create “apple” cheeks, but rather increase midfacial projection and definition. There is no other area of the face that when corrected gives the patient a more rejuvenated, refreshed appearance than the midface. Patients frequently present with an oblique line of volume deficiency extending from the tear trough inferiorly. This line is parallel with the nasolabial fold and the marionette line. These three lines draw the eye downward and outward, creating a tired, older appearance. When corrected, an appearance of vitality is restored to the face.

**Danger zones** The facial artery runs at the level of the SMAS in this area, and vascular-adverse events are common here. In the area of the pyriform aperture, the facial artery is large and tortuous and no material should be deposited unless the needle is directly in contact with bone or immediately subdermal or intradermal. When using a threading technique in the treatment of the nasolabial fold, avoid deeper subcutaneous injections in the fat layer and keep the needle moving at all times. Cannula injections should also be placed as threads in the subdermal plane while moving.

#### Tips and Tricks

The nasolabial fold is a correction site frequently requested by patients, but is a site that, when corrected, usually does not make the patient look significantly better. In almost all cases, midface correction will serve the patient better (and will cause effacement of the nasolabial fold). When observing a patient with nasolabial folds, the viewer anticipates seeing a trough medial to the fold. When excessively obliterated, it can result in an unnatural appearance. The injector must guide the patient, and not the other way around.

## Submalar Hollow

This area is frequently neglected by injectors when treating the midface. It is technically more difficult to achieve smooth and natural results here because there is no underlying bony support and the surface area to correct is large. The area is best treated by superficial subcutaneous threads placed retrograde using either a needle or cannula. A high G prime HA filler or CaHA mixed with lidocaine will yield good results. Use of a stimulatory filler such as PLLA is also ideal here. The material is placed in linear threads in the superficial subcutaneous plane and then molded to smoothness. Replacement of the lost superficial fat pad in this zone in the aging patient can make them look softer and healthier.

**Danger zones** The transverse facial artery, a branch of the superficial temporal artery, and the superficial temporal artery should be avoided by injection in the proper plane. The superficial lobe of the parotid gland lies deep to the injection plane and should also be avoided, as intraglandular injection can result in parotitis.

### Tips and Tricks

In patients with deficiency in this area, augmentation of the malar eminence and zygoma will exaggerate the deficit and make the patient look skeletonized. The same is true for temporal hollowing. In patients with volume deficits in these two areas, augmentation in the malar area should be conservative unless adequate submalar and temporal blending is performed at the same time.

## Perioral Area and Lips

Aging of the perioral region involves lengthening of the upper lip, down slanting of the oral commissures, loss of prominence of the vermilion border, vertical lip rhytids, marionette lines, and

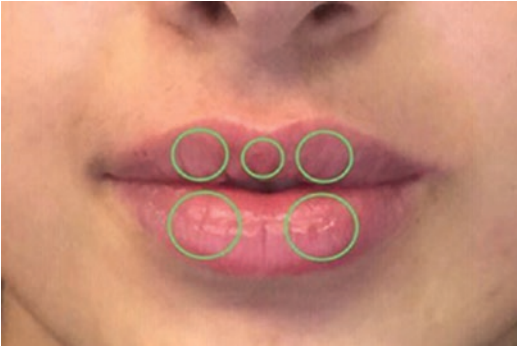
volume loss anterior to the jawl. In addition to rejuvenation, the lips are also an area where enhancement is frequently requested. Patients also present for correction of lip asymmetry.

## Vertical Lip and Fine Lines

These are best treated using a depot, blanching technique with a low G prime HA filler formulated for fine lines. Placement of the needle is almost parallel to the skin, to ensure superficial, intradermal placement of material, using a 30-gauge needle and entering either perpendicular or axially to the lines [24]. Multiple punctures are injected very close to each other, leading to deposition of tiny aliquots that are visible for a short period under the skin. Postinjection molding of the area should be completed to ensure a smooth final correction. This technique is the same as that which is employed for fine lines in other facial areas.

## Upper and Lower Lips

Augmentation of the vermilion white roll is accomplished using a lower G prime filler that is injected using a needle inserted almost parallel to the white roll. If the needle is properly placed into the potential space of the vermilion white roll, the filler will track along the roll, extending across that hemi lip. Alternatively, a needle or cannula can be placed along the vermilion white roll and then filler injected retrograde. The tubercles of the lip are then augmented using a threading or depot technique in the submucosal plane. The injector should be intimately familiar with the anatomy of the lips and capable of balancing the three tubercles of the upper lip and the two of the lower lip (Fig. 6.8). The location of the labial arteries is quite variable, and placement of filler is safest in the immediate submucosal plane rather than within the muscle. The philtral columns also need to be recreated and/or augmented. This is most expeditiously accomplished by pinching the column



**Fig. 6.8** The tubercles of the upper and lower lips are natural areas of prominence that should be enhanced during lip augmentation

between the nondominant thumb and index finger and threading the needle from the vermilion white roll superiorly toward the nasal sill. Product is then deposited as the needle is withdrawn (retrograde). Do not exaggerate the philtral columns in older patients, as it creates an artificial appearance.

**Danger zones** Injection procedures in the perioral area can lead to reactivation of herpes virus infections. If the individual has a history of cold sores, consider prophylactic treatment with valacyclovir (500 mg BID for 2–3 days) to be started immediately prior to injection. The use of particulate fillers in highly mobile areas with concentric muscular action such as the lips should be avoided as early-onset, noninflammatory nodules may develop. The injector should also be aware that intramuscular injection of any product increases the likelihood of foreign body granuloma development.

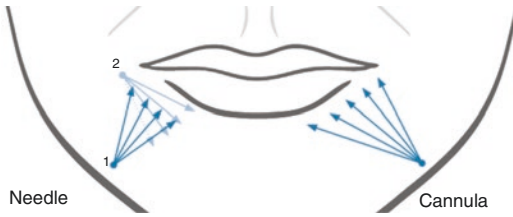
The superior and inferior labial arteries travel within the body of the lips in the orbicularis oris muscle and are at risk for embolization. Their location with the muscle is very unpredictable. Deep injection into the lip should, therefore, be avoided, and the location of the arteries understood by all injectors [25, 26]. A moving needle or cannula in the submucosal plane is less likely to result in a significant vascular event.

### Tips and Tricks

Injectors should remember the balance between the upper and lower lip: upper lip 40% and lower lip 60% (1:1.6 in Caucasians, 1:1 in Africans, and in-between in Asians). The lower lip should be either slightly protruding or vertically in line with the upper lip. Make sure that the lip volumes enhance and are in harmony with the patient's other facial features, and are age appropriate. Most middle-aged and elderly patients appear cartoonish with excessive lip volume. The delicate architecture of the lip must be respected, and lips should never have a sausage-like appearance. Neuromodulators can greatly enhance the results of lip enhancement by putting the lip edge and reducing the appearance of vertical lip rhytids. The closer the neurotoxin is placed to the lip vermilion, the more the pout. Vertical rhytids are treated with toxin placed more superiorly. Toxin will also extend the clinical correction achieved with fillers by reducing lip motion. Not all patients tolerate that reduction of motion, however.

### Marionette Lines and Oral Commissures

The injector should visualize the marionette lines and prejowl sulcus as a single unit. When visualized in this way, the opposing triangles of deficiency can be appreciated (Fig. 6.9). The upper triangle should be treated with a fanning approach in the subdermal and immediate subcutaneous plane. The initiation points should be immediately lateral to the oral commissure, followed by injections beginning within the marionette line inferiorly, allowing for crosshatching to occur. The lower triangle of the marionette line that forms in the area of the prejowl sulcus may be treated with preperiosteal depot injections, as well as a fanning technique in the immediate subcutaneous plane.



**Fig. 6.9** Injection technique for marionette lines

Down-slanting oral commissures represent the uppermost part of the marionette lines. Down-slanting oral commissures can be treated by placing a small aliquot of filler within the vermilion white roll at the commissure. This injection is accomplished by placing the needle perpendicular to the commissure and injecting filler in the immediate submucosal plane. Alternatively, filler can be placed using linear threads beginning immediately lateral to the oral commissure and immediately adjacent to the upper and lower lip vermilion white rolls. The material increases tissue structure and supports and elevates the commissure.

**Danger zones** When treating the inferior aspect of the marionette lines and the prejowl sulcus, bruising is frequently seen. The mental and inferior labial arteries must be avoided by keeping material subdermal or preperiosteal.

#### Tips and Tricks

Evaluate the amount of lax skin lateral to the marionette line. If significant redundant skin is present, then this skin can be driven laterally by the filler, causing the appearance of a pouch lateral to the fold. Lifting from the temple and lateral cheek should accompany the marionette line correction in these cases.

## Jawline

With aging, the jawline loses its definition and becomes scalloped as jowls develop. Individuals will frequently be aesthetically enhanced by increasing their jawline definition. Younger indi-

viduals may present with genetic weakness and asymmetries of the mandible and overlying soft tissue. When injecting over the parotid gland, immediate subcutaneous threading using a fanning technique will yield good results. A needle or cannula can be employed. These injections can be continued superiorly into the preauricular area, following the ascending ramus of the mandible. The angle is sharper in a male ( $90\text{--}100^\circ$ ) and more obtuse ( $110\text{--}120^\circ$ ) in a female. The mandibular angle is most easily defined using a depot injection on bone (0.2–0.3 cc). These techniques can be used to either widen or define the jawline, and/or to camouflage the jowl and restore the more youthful distinction between the jawline and neck. Alternatively, all injections can be placed directly on bone using a depot technique. Laterally, this will involve passing through the masseter and parotid gland. The material will be compressed by the masseter muscle, resulting in less longevity of the correction. The author uses subcutaneous placement of mixed CaHA (0.8 cc Lidocaine with 1.5 cc CaHA) with a single on-bone depot injection at the angle of the mandible. Avoid aggressive molding if using the depot technique to prevent material tracking back into the parotid gland.

**Danger zones** In the preauricular area, the superficial temporal artery is at risk for embolization, as is the facial artery, as it crosses the mandibular border immediately anterior to the masseter muscle. As mentioned above, injections should not be placed within the parotid gland. Parotitis from intraglandular injection has occurred and can be longstanding.

#### Tips and Tricks

These techniques restore the distinction between the cheek and neck and camouflage the jowl in the aging patient, and can greatly enhance the appearance of select younger patients. Widening the lateral jaw along the mandibular angle is particularly useful in the male patient. Threads should be of small volume placed evenly to avoid irregularity of the jawline contour.



## Chin

Filler injections can be used to reduce chin ptosis, as well as to enhance chin projection. Injections are placed either at the periosteal level using a depot technique, or alternatively, immediate subcutaneous threading can be employed, beginning laterally on either side of the chin. Female chins should not be overly squared, and injections should be primarily confined to the area between two vertical lines originating from the alar cheek junction. In men, a square chin masculinizes the face, and is defined by two vertical lines extending inferiorly from the pupil.

**Danger zones** The mental neurovascular bundle lies approximately 1 cm superior to the mandibular border, in line with the canine tooth. The artery is at risk for embolic events, and injury to the mental nerve will result in anesthesia or dysesthesias of the lower lip. The vessels lie in the muscular layer.

### Tips and Tricks

This procedure can be used in conjunction with a nonsurgical rhinoplasty to reduce the appearance of an overprojecting nose. It can also be used to show a patient the effect that a permanent surgically placed implant would have.

## Nonsurgical Rhinoplasty

It is the author's opinion that this area should be reserved for the experienced injector with a thorough knowledge of anatomy. This area and the glabella are true danger zones, with a significant risk of vascular events with the potential for blindness and soft tissue loss.

This procedure, which can be exceptionally gratifying for injector and patient, can be used to mask the appearance of a dorsal hump, reduce the apparent nasal width by increasing height, elevate a drooping tip by increasing tip projec-

tion, correct asymmetries, and correct postsurgical deformities. Injections are placed at the skeletal level with a needle or cannula. Vascularity is again in the SMAS layer. Surgeons visualize the filler as they would visualize the placement of cartilage grafts. Insertion points are in the midline on the nasal dorsum and lateral to the midline in the tip. Injectors should use an HA filler and make sure hyaluronidase (at least 1200 units) is immediately available.

**Danger zones** They include the lateral nasal, dorsal nasal, columella, and angular arteries. Skin necrosis and blindness can result from embolic events. Injectors must have hyaluronidase (minimum 1200 units) present and watch for blanching.

## Improving Skin Texture and Tone

Stimulatory fillers such as CaHA and PLLA can be used not only for volume restoration but also to improve the texture and tone of the skin. Small aliquots of HA filler injected into large areas of the dermis have been shown to induce neocollagenesis and enhance skin turgor and firmness, leading to skin that looks smoother and refreshed [27]. Perhaps the most studied product in this field is CaHA, which when mixed with lidocaine or saline and injected superficially in the subdermal plane appears to promote dermal remodeling through stimulation of collagen and elastin [28–30]. Guidelines have recently been published for this novel off-label use of CaHA for biostimulation in the face and body [31]. This application extends beyond the face to areas such as the neck, décolleté, medial upper arms, elbows, knees, supraumbilical skin, and neck. The ideal amount of lidocaine or saline added to the product is still unknown, but when using CaHA a 2:1 or 3:1 ratio is common. It is known that the greater the amount of CaHA particles present, the greater the amount of fibroblastic response. In most circumstances the author employs a 1:1 dilution using 1.5 cc of CaHA per 10 cm<sup>2</sup>.

### Tips and Tricks

When deciding on the dilution, the author recommends setting objectives as to how much volumizing versus stimulating effect is required, with less diluent resulting in more volumizing, and more diluent resulting in less volumizing and a more stimulatory effect. These techniques are also the basis for using PLLA and CaHA for buttock augmentation and cellulite correction (with subcision).

## Aesthetic Applications of Botulinum Neurotoxins

It is now well established and common to prevent and treat unwanted expression lines for people from their third decade (even younger for preventative maintenance) with botulinum neurotoxins. Years of experience and use in therapeutics and aesthetics have proven their efficacy and the safety, and a number of consensus recommendations on the use of botulinum toxin for aesthetic indications have been published [32, 33], including in combination with other treatment modalities [34].

Careful patient evaluation and setting realistic expectations at the time of consultation are essential for patient satisfaction and success with botulinum toxin treatments. A number of patient characteristics and anatomical features help define their suitability for botulinum neurotoxin injection. The positions, strength, and insertion points of the facial muscles can be determined by inspecting them at rest, by observing their movements while the patient makes varying facial expressions, and by palpating them. Signs for areas of stronger contraction include greater dynamic movement, deeper lines, and larger apparent mass during use. Patients with dynamic rhytids show the most dramatic improvements from botulinum toxin injection, and are ideal candidates for treatment. Deep static lines due to loss of skin elasticity, environmental injury, and aging are not responsive to botulinum toxin injection. When evaluating a patient, look for specific

clinical findings such as preexisting brow ptosis, lid ptosis, pattern of frontalis muscle motion, brow shape, poor lower lid tone, and malar edema. Evaluation should be done with the patient at rest and then in animation, smiling, then squinting, frowning, elevating their eyebrows, and pursing their lips. Asymmetries should be noted and pointed out to the patient prior to treatment. The aim of treatment is to eliminate lines when the patient is at rest, but to leave the ability for some movement, and minimal wrinkling, when the patient is animated or actively expressing emotion.

### Tips and Tricks

When treating the periorbital area, the goal is to change the balance of muscular action toward brow elevation by eliminating the depressor and opposer muscle actions, while maintaining a degree of frontalis strength. This will reduce the effect of gravity on the brow and reduce the development of brow ptosis. If one fully paralyzes the frontalis muscle, the only brow elevator, the preventative maintenance aspect of this treatment is diminished.

Until recently, three products were approved for aesthetic use in Western markets: onabotulinumtoxin A (Botox®/Vistabel®; Allergan Inc., Irvine, CA), abobotulinumtoxin A (Dysport®/Azzalure®; Ipsen, Paris, France), and incobotulinumtoxin A (Xeomin®/Bocouture®; Merz Pharmaceuticals GmbH, Frankfurt, Germany). In 2019, these were joined by prabotulinumtoxin A (Jeuveau®; Evolus Inc., Santa Barbara, CA), which received FDA approval in February 2019 for the temporary improvement in the appearance of moderate-to-severe glabellar lines associated with corrugator and/or procerus muscle activity in adults. There are also a number of BoNT products approved in Asian countries. Licensed indications for use vary, and are specific for each country.

## Glabellar Frown Lines

Vertical lines between the eyebrows seen at maximum frown are a result of contraction of the paired corrugator supercilii, and horizontal lines are the result of contraction of the procerus muscle. Injection points are determined by observing muscle contraction both visually and by palpation. The body of the corrugator supercilii is deep to the frontalis muscle, becoming more superficial at its tail; depth of injection needs to be tailored accordingly. The injection points should be to the medial end of the corrugator just lateral to the frown line, and then 1–1.5 cm lateral to this toward the end of the corrugator muscle, 1 cm above the bony orbital rim. Injection into the medial part is deep, as the muscle originates from the bone. The lateral injection point, verified by muscular contraction, is more superficial. During injection, the nondominant hand delineates the location of the superior orbital rim. The fifth injection point is into the belly of the procerus muscle. The optimal injection pattern will be achieved by adapting the injection points to the individual anatomy of the patient.

### Tips and Tricks

To avoid medial brow ptosis, when treating the corrugator muscle, do not inject greater than 1 cm superior to the super orbital rim, to avoid excessive paralysis of the frontalis muscle that overlies the corrugator muscle. Drift of the neurotoxin onto the levator palpebrae muscle with subsequent ptosis is prevented by the superior orbital rim retaining ligament that lies 2–3 mm superior to the orbital rim. Do not inject inferior to the ligament, and avoid injection in the axis of the supraorbital neurovascular bundle, as this pierces the ligament and provides a pathway for toxin to drift inferiorly. It is the author's experience that duration of effect is directly related to the dosage administered, with inadequate dosing leading to short duration of action.

## Horizontal Forehead Lines

Horizontal forehead lines are produced by contraction of the muscle fibers of the frontalis, which elevates the eyebrows. Rhytids created by muscles are always perpendicular to the axis of their fibers. By weakening the middle and upper portions of the frontalis, the horizontal lines can be softened or eliminated. To avoid worsening of existing brow ptosis, the muscle fibers of the frontalis must remain functional 1.5–2.5 cm above the brow (the maximal excursion of frontalis muscle is in its inferior portion, superiorly it becomes increasingly aponeurotic).

When treating horizontal forehead lines, the number of injection sites and dose should be tailored to the patient. The degree of existing brow ptosis is the limiting factor in reduction of forehead rhytids. Some patients may have many rows of fine forehead wrinkles, whereas others may have one or two rows of deeply set lines. The number and dosage of injections will, therefore, depend on many factors, including the number and depth of the wrinkles; the size, shape, and strength of the muscle; and the height, width, and shape of the forehead [35]. This has led to the development of techniques such as Grid 21 (developed for use with incobotulinumtoxin A), which allows treatment to be tailored to the individual. Grid 21 identifies the individual's unique structural and functional anatomy to determine the optimal protocol for predictable eyebrow shaping and forehead treatment. The technique identifies anatomically defined vertical lines based on the midpupillary line, inner and outer canthus, and medial facial line (Fig. 6.10). The horizontal lines of the grid are functionally defined, starting with the lowest horizontal frown line. The intersection of these lines defines 21 potential injection points, each of which has a different influence on the individual treatment outcome. Dosing is determined by the force of the muscle at each injection point.

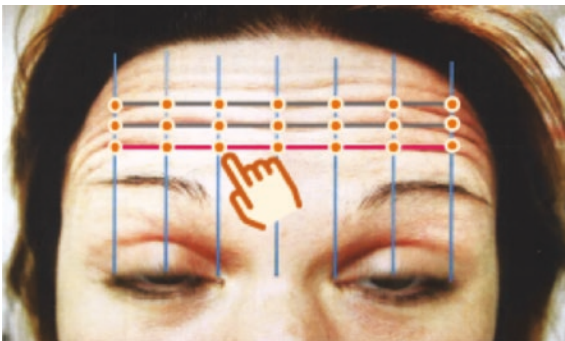
### Tips and Tricks

It is essential that the injector observe the pretreatment brow shape, excursion, and asymmetry. Individuals who naturally peak their lateral brows will have this exaggerated by the neurotoxin, and so a 2 U injection of toxin should be placed at the second forehead crease in the axis of maximal peaking to prevent this. Patients who have no medial brow excursion are more likely to have medial brow ptosis after treating the corrugators, and medial frontalis injections should be avoided. Injections should be placed in the superficial subcutaneous plane.

Using a 30–33G needle (0.2–0.3 mm diameter and 13 mm long), the standard dose is 1–4 U intradermally divided among five or six (or more) injection points; up to 20 U (10 average) may be required in some patients. Do not overinject the frontalis muscle. When in doubt, inject less and bring the patient back in 7–10 days for reassessment. Always assess for existing brow ptosis, and avoid injecting the inferior frontalis muscle in these patients.

### Lateral Periorbital Lines

The orbicularis oculi is a circular muscle that functions to close the eyelids. Its fibers are vertically oriented at its medial and lateral-most aspects, where they also function as depressors of the eyebrow. Medially, at the level of the eyebrow, this portion of the orbicularis is known as the depressor supercillii. Laterally, contraction of the vertically orientated fibers produces lateral periorbital lines or crow's feet. The application of neurotoxin to the lateral portion of the orbicularis oculi muscle will, therefore, prevent or soften the appearance of these lines. Using a 30–33G needle (0.2–0.3 mm diameter and 13 mm long), the recommended dose is 12 U per side. The first injection should be at the level of the inferior aspect of the brow, approximately 1 cm lateral to the orbital rim to avoid unwanted treatment of the muscles of ocular motion, which are inside the orbital rim, resulting in the side effect of diplopia. Two further injections are placed at 1 cm intervals inferior to the first, following the curve of the lateral orbital rim. As the periorbital skin is thin, the needle must be inserted at an acute angle to the skin and the botulinum toxin will diffuse to the underlying muscle.



**Dosing:** depending on the force of the muscle  
(0)–1–2–3 units

- **3 units:** high pressure needed to predict paralyzing effect on very high muscle force
- **2 units:** medium pressure needed to predict paralyzing effect on intermediate muscle force
- **1 units:** little pressure needed to predict paralyzing effect on muscle force
- **0:** no muscle force palpated – no toxin needed

**Rule of thumb for the Grid21 dosing:  
It is as simple as (0)–1–2–3!**

**Fig. 6.10** Grid 21 forehead injection protocol for use with incobotulinumtoxin A

**Tips and Tricks**

Injections into the orbicularis oculi muscle can be extended into the lower eyelid to reduce rhytids. If injections are performed too close to the lid margin, this may result in scleral show, or even ectropion, in patients with lax lid tone. If patients have pseudohermiated fat in their lower eyelids or malar edema, these may become worse, as the tone in the orbicularis oculi is diminished. If injections are placed too inferiorly, the smile can be affected by inadvertent paralysis of the zygomaticus major and /or minor muscles.

**Nasal Rhytides**

Nasal rhytides (bunny lines) may form on the lateral and dorsal aspects of the nose as a result of contraction of the levator labii superioris alaeque nasi muscle (not the nasalis, as is commonly thought, since the nasalis compresses the nasal sidewalls). The levator can be treated with two injection points, one into each side of the nose where the bunny lines are found. When treating this area, it is important to avoid excessive injection into the levator labii superioris, as chemodenervation of this muscle will cause the upper lip to droop (as in treatment of a gummy smile).

**Gummy Smile**

A common cause of a gummy smile is hyperfunctional upper lip elevator muscles (levator labii superioris alaeque nasi, levator labii superioris, levator anguli oris, and zygomaticus minor), which result in excessive upper lip retraction during smiling. It is often associated with deep nasolabial folds. Injection is achieved with 2–3 U at the pyriform aperture 1 cm lateral to the alar crease. Correction should be conservative so as not to create an unnatural appearance where the central upper lip is too low in smiling.

**Perioral Lines**

For the treatment of perioral lines, the target muscle is the orbicularis oris. Unbalanced dosing or asymmetrical injection can lead to dyskinetic movement when pursing the lips. The sites of injection will depend on the wrinkle pattern, but in the upper lip the central aspect should be avoided to maintain the integrity of the Cupid's bow, and should be at least 1 cm medial to the oral commissure (nine muscles attach at the oral commissure). Injections placed close to the vermilion border will evert the lip edge, while those placed overlying the midportion of the rhytids are required for wrinkle reduction. Typical doses are 1–2.5 U per injection site divided across four to six sites. Injections are performed using a 30–33G needle (0.2–0.3 mm diameter and 13 mm long) and should be superficial, subcutaneous, and symmetrical.

**Tips and Tricks**

This is an area where dyskinetic movement occurs when injections are not evenly spaced, resulting in toxin “hotspots.” The author places his toxin injections using a retrograde threading technique, which distributes toxin evenly over the treatment area, eliminating this problem.

It is essential that you discuss the weakness that results from these injections with the patient, as those with the deepest rhytids, who purse the lips the most, are most disturbed by inability to make this motion.

**Masseter Hypertrophy**

The masseter muscle is one of the four principal muscles of mastication and also plays an important role in facial aesthetics [36]. In women, enlarged masseter muscles can have a negative aesthetic impact, creating a square masculine face shape. They may also create facial asymmetry if hypertrophy is unilateral. Thinning of the

masseter gives the lower face a slimmer appearance. Masseter hypertrophy is more prevalent in the Asian population. Patients with bruxism and temporomandibular joint pain benefit greatly from this treatment.

Injecting neurotoxin into the masseter muscles is an effective nonsurgical approach to reduce lower face width [37]. The masseter muscle is located by asking the patient to clench their jaw. A line is then drawn from the corner of the lip to the tragus, and injections are kept below this line. Using a 30–33G needle (0.2–0.3 mm diameter and 13 mm long), 10–25 U per side is injected low into the masseter just above the mandible, with three to five injection sites. Doses can be increased to 25–50 U if required, but before reinjecting the patient, an interval of at least 8 weeks is recommended for the bulk of the muscle to diminish. Injections should be both superficial and deep to effect both the superficial and deep portions of the masseter.

### Platysmal Bands

The platysma is a thin sheet of muscle originating from the fascia over the clavicle, and inserting into the inferior border of the anterior mandible. It distends the skin of the neck and pulls it downward and laterally, lowering the corners of the lower acting in synergy with the depressor anguli oris. The vertical bands become more evident with age as a result of repeated action, resulting in hypertrophy, skin laxity, and thinning of subcutaneous tissue.

The patient should be asked to tense their platysma by trying to expose their lower teeth to expose the bands. Treatment is typically with three to six injection points along each band, spaced 1–2 cm apart, with a total dose of no more than 15–25 U per band. The number of injection points will depend on the length and prominence of the band. Treatment of the platysma along the jawline can sharpen the mandibular definition (known as Nefertiti lift). Injecting over a prominent submandibular gland can increase its prominence (but injecting into the gland can shrink it).

#### Tips and Tricks

Ringlet lines in the neck can be treated by subcutaneous injection into the platysma, but frequently need filler for more complete correction. Avoid injections into the sternocleidomastoid, as the patient will have difficulty elevating their head, and if excessive dosing or deep injection is placed medially, dysphagia can result due to relaxation of the strap muscles. Injections are placed in the superficial subcutaneous plane.

### Oral Commissures

The depressor anguli oris (DAO) depresses the oral commissure while frowning. The oral commissure can be elevated by injecting into the belly of the muscle at least 1 cm lateral and 1.5 cm inferior to the oral commissure (5 U). Alternatively, follow the nasolabial fold inferiorly and inject 5 U into the muscle immediately superior to the mandibular border. Injection into the depressor labii inferioris, which underlies the medial aspect of the DAO, must be avoided.

### Chin

Chin dimpling when lips are pressed together is caused by the action of the mentalis muscle. This can be corrected with a single 5 U injection of neurotoxin in the midline of the chin at the mandibular border. Alternatively, two 2.5 U paramedian injections can be employed, but injections into the depressor labii inferioris must be avoided.

#### Tips and Tricks

As patients age, the muscles become hypertonic, most likely due to bone resorption and lack of resistance from the lax tissue they elevate. The author has noted a significant

degree of spastic motion at rest in patients with significant perioral aging (more common in females). Injection of neurotoxin into the orbicularis oris, mentalis, and depressor anguli oris can result in a change in the pattern of their movement, slowing further motion-induced aging changes.

### Other Aesthetic Toxin Uses

- Excessive sweating (hyperhidrosis) in axilla, palms, soles, or any other area such as the forehead.
- Improvement of skin texture when placed in solution with HA and delivered via microneedling (Aquagold) or direct injection of doses at multiple sites.
- Reduction of acne.

### Aesthetic Applications of Fat Transfer

Fat transfer or fat grafting is the transfer of adipocytes from one part of the body to another to act as a natural filler. It involves the removal of varying amounts of fat from a location such as the abdomen, thighs, or inside of the knee, which may or may not be processed before being re-injected into the face. Fat transfer is increasingly being used for rejuvenation or augmentation of the face [36, 37]. It has the benefits of being biocompatible, feels like normal tissue when touched and, once vascularized, offers a long-term, even permanent, treatment approach.

In addition to lipofilling, fat transfer has also been gaining attention for its observed regenerative properties and overall skin texture improvement [38, 39]. The introduction of microstraining techniques to filter, purify, and reduce particle size has also resulted in the development of nanofat transfer techniques [40]. Although the exact mechanism of action is unclear, these are thought to work by the action of adipose tissue-derived stem cells and growth factors upregulating collagen and elastin production [40]. Indications for

the use of nanofat include intradermal injection for the correction of fine wrinkles, intra- and subdermal injection for the correction of sun damage, and intra- and subdermal injection for the correction of skin discoloration (e.g., in the lower eyelid) [40]. The treatment is particularly effective when combined with a microneedling technique [40, 41].

Any area successfully treated with injectable dermal fillers is potentially treatable with fat transfer, but it is particularly valuable in areas where volume loss is most pronounced, such as around the cheeks and jawline. How the fat is harvested, processed, injected, and the condition of the tissues receiving the fat will all influence the amounts needed and eventual fat retention. Patients who are smokers or previous smokers and patients who have undergone previous noninvasive radiofrequency and ultrasonic skin tightening procedures are likely to have compromised subdermal microcirculation and microlymphatic vessels, and as such are not optimal candidates for this procedure. Autologous fat transfer can play a crucial role in facial rejuvenation as a stand-alone procedure or in combination with traditional facial rejuvenation procedures.

Tissue volume loss after fat transfer can lead to unpredictable outcomes and is influenced by the techniques used for tissue harvest and processing. Gentle harvesting of adipose tissue is important for maintenance of viable fat cells and tissue volume. For small volumes, the use of a closed-syringe lipoaspiration system featuring disposable microcannulas offers a safe and effective means of harvesting adipose tissue in a suspension form.

It is essential to remove the nonviable, proinflammatory components of lipoaspirate, including blood cells, damaged tissue, and debris, before reimplantation. The three most common preparation techniques described in the literature are gravity separation alone (which requires the least user handling and manipulation), centrifugation, and washing of the fat graft prior to gravity separation [42]. For larger volumes, the author uses the Revolve® system (LifeCell; Bridgewater, NJ), which incorporates the harvesting, filtering, and washing steps into a single unit, thus simplifying fat processing [43].

The most common complication of fat transfer is the unpredictable degree of transplant resorption. This occurs because a proportion of the injected adipocytes suffer hypoxic injury before revascularization can occur, resulting in necrosis of the cells, resorption of their lipid content, and loss of volume at the injection site [44]. The practitioner should, therefore, explain to the patient that there is likely to be some loss of volume and a repeat procedure or touch-up may be required. Visibility is another adverse effect, and is most common in the lips and periorcular area. If a patient has been previously treated with an HA dermal filler, it is important to wait until all filler material has been resorbed prior to grafting, as filled areas will not be able to provide the graft with vascular ingrowth, and the area will have future volume loss as the filler is metabolized.

It has been suggested that neurotoxin injection may enhance survival of adipocytes after fat transfer in the face. It is hypothesized that the temporary muscle immobilization provided by the neurotoxin preserves graft viability [45].

Infections are rare, but some practitioners prescribe patients with a 1-week course of antibiotics postoperatively as a precaution. As with all injectables, there is the risk of embolism if the fat is injected directly into a vessel. The use of a blunt-tipped cannula and injecting only when withdrawing the cannula reduce the risk of such complications.

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## Conclusion

The tissue layers into which dermal fillers, botulinum neurotoxin, and fat transfer are placed, and the manner in which they are injected, can have a significant effect on treatment results. Based on anatomical landmarks, specific treatment techniques are suggested to reduce the risk of serious adverse events and optimize patient outcomes, with the aim of making patients look the best version of themselves.

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