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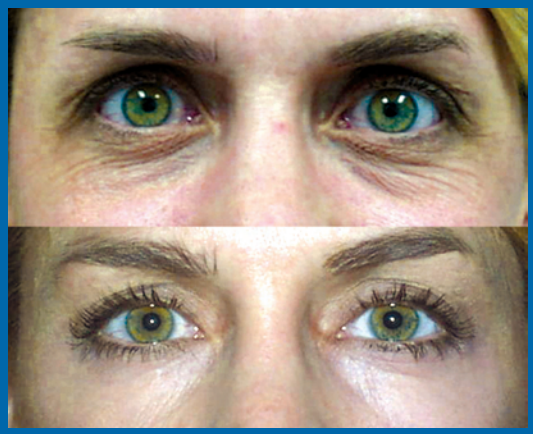

Facial Fillers, Botulinum Toxin, and Facial Rejuvenation

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Learning Objectives

Upon completion of this module, the reader should be able to:

- Demonstrate understanding of the basic types of facial fillers
- List common facial areas for injection of botulinum toxin
- Describe various skin rejuvenation methods

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Introduction

The human desire to alter facial appearance stems in part from the role of the face as a major communicative organ, one that conveys information regarding age, alertness, gender, ethnicity, emotional state, reproductive capacity, intent, and veracity. Procedures involving facial fillers, aesthetic applications of botulinum toxin (Botox), and facial rejuvenation are more popular than ever to improve the skin's appearance and reduce the signs of aging. Fillers may be combined with botulinum injection and other office-based noninvasive techniques. Successful use of fillers requires proper filler selection,

appropriate delivery technique and depth, appropriate anesthesia, and skill acquired through training and experience. Botulinum toxin, once an orphan drug, has now become widely accepted and widely used with a growing variety of clinical applications. Botulinum toxin for facial cosmetic treatment has transformed cosmetic surgery and the demand for these services continues to increase. Facial rejuvenation techniques are defined as those effective at tightening the skin, reducing wrinkles, or improving skin elasticity, texture, pore size, telangiectasias, and pigmentation. A complete discussion of every technology of skin rejuvenation is beyond the scope of this module. The primary goal is to introduce a variety of modalities and to provide a foundation for understanding the principles behind these treatments.

Facial Fillers

Facial fillers are substances injected into the face in order to fill volume deficits and improve surface contours. They have rapidly gained remarkable acceptance over the past decade as a method of reliably enhancing the topographic features of the human face.

Clinical Pharmacology and Product Comparisons

Several classes of facial fillers are available. The safest and most widely accepted filler is cross-linked hyaluronic acid (HA). The lowest rate of antigenicity and least risk of cross-species infection is from nonanimal source HA, which is obtained from the outer cell wall of streptococci. HA is considered a volumizer in that its effect depends largely on the bulk effect of the injected product rather than inflammation and the stimulation of collagen production. HA also may be immediately dissolved by injection of hyaluronidase. The tissue-volumizing effect usually lasts up to 12 months for most HA fillers.

Fillers that create volume primarily through foreign-body reaction (eg, poly-L-lactic acid, dextran) or collagen stimulation (eg, polymethylmethacrylate, calcium hydroxyapatite) are classified as stimulators. Fillers vary considerably in safety, duration, cost, complications, and reversibility (Table 1). Overall, nonanimal source HAs are the safest and most reliable fillers for novice injectors.

Clinical Anatomy

With facial aging comes the appearance of deeper lines, tissue descent, and volume loss in the areas of the nasolabial folds, melolabial folds, jaw line, glabellar furrows, and tear trough. Also there may be hollowing of the cheeks, loss of fullness (or volume) in the lips, and fading of the distinct vermillion border (Figure 1).

Anesthesia and Skin Preparation

Filler injection requires local anesthesia in most patients. Topical anesthetic cream, such as tetracaine 6.0%/lidocaine 6.0%/phenylephrine 0.01% cream, may be applied 30 to 45 minutes before the procedure. Alternatively, local anesthetic may be delivered to the mental and infraorbital nerves and the superior and inferior gingival sulci. Some dermal fillers come premixed with lidocaine

Table 1. 2008 FDA-Approved Non-Collagen Fillers[a]

PRODUCT	MANUFACTURER	PRODUCT DESCRIPTION	COMMENTS
Juvéderm	Allergan	Cross-linked hyaluronic acid	Various viscosities available.
Juvéderm XC	Allergan	Cross-linked hyaluronic acid	With lidocaine added.
Restylane, Perlane	Medicis/Q-Med AB	Cross-linked hyaluronic acid	Various particle-size products available. Products available with lidocaine (eg, Restylane-L, Perlane-L).
Prevelle Silk	Mentor	Cross-linked hyaluronic acid with 0.3% lidocaine	Short-duration filler with lidocaine for a less painful patient experience.
Hydrelle	Coapt Systems	Cross-linked hyaluronic acid with 0.3% lidocaine	Company claims highest concentration of hyaluronic acid. Mixed with lidocaine.
ArteFill	Suneva Medical	PMMA 30–50 µm spheres and bovine collagen	For experienced injectors.
Radiesse	BioForm Medical	Calcium hydroxylapatite 25–45 µm in a polysaccharide gel	Not for intradermal or lip injection.
Sculptra	Sanofi-Aventis	Poly-L-lactic acid hydrogel synthesized from corn	Not for intradermal or lip injection. Approved for HIV-associated facial cheek-area lipoatrophy.

[a]ArteFill contains a collagen component.

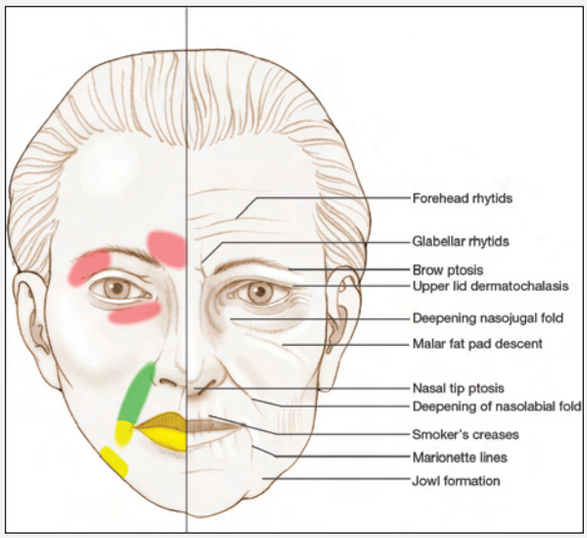

Figure 1 As the human face ages, gravitational volume shifts and rhytids result in typical age-related volume deficits, especially in the areas of the glabella, brow, nasolabial fold, tear trough and upper central cheek, lips, oral commissure, melolabial folds, and jowl. Green areas are relatively safe areas for filler injection. Yellow areas require some caution and expertise. Red areas may be treated with experience but also present special hazards. (Modified, with permission, from McCracken MS, del Prado JD, Kikkawa DO. Eyebrows, eyelids, and face: structure and function. In: Tasman W, Jaeger EA, eds. *Duane's Foundations of Clinical Ophthalmology.* New York, NY: Lippincott-Raven; 2002: vol. 2, chap. 1. Illustration by Christine Gralapp, CMI.)

(eg, Prevelle Silk, Mentor, Santa Barbara, California; Juvéderm XC, Allergan, Irvine, California; and Restylane-L and Perlane-L, Medicis, Scottsdale, Arizona); otherwise, the injector may add 0.2 ml lidocaine 2% per 1 to 2 ml of filler to the syringe. Skin preparation to reduce the surface bacterial count will help reduce the risk of infection.

Injection Techniques

Several injection techniques are useful for filler deposition (Figure 2). The simplest technique for novice injectors is *serial puncture,* where multiple pinprick deposits of filler are placed. With experience, *linear threading* may be used: the needle is advanced at a uniform tissue depth, then filler is deposited as a linear thread during withdrawal. With further mastery, the filler is deposited as the needle is advanced: this *push-ahead* method is useful in the vermillion border area and may help to reduce bleeding because the flowing product displaces vessels and tissue away from the cutting edge of the needle.

With *cross-hatching,* multiple linear depositions may be deposited in parallel rows, followed by an overlying or

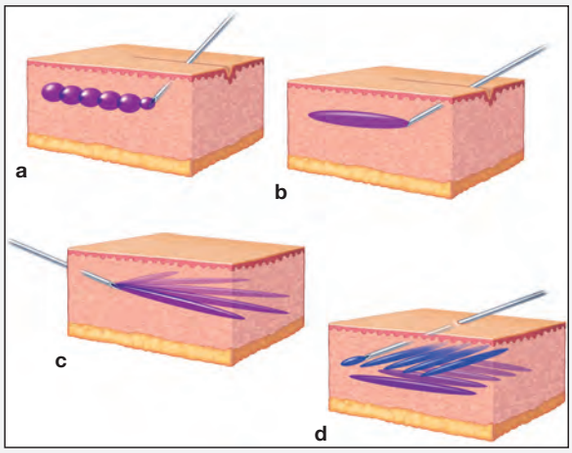

Figure 2 Schematic of filler injection techniques. **a.** Serial puncture. **b.** Linear deposition. **c.** Fanning. **d.** Cross-hatching. (Modified, with permission, from McCracken MS, Khan JA. Hyaluronic acid filler injection. In: Chen WPD, Khan JA, eds. *Color Atlas of Cosmetic Oculofacial Surgery,* 2nd ed. New York, NY: Elsevier; 2010:334–337. Illustration by Christine Gralapp, CMI.)

underlying perpendicular array of linear deposits. This is useful in bulking up deeply corrugated folds such as the nasolabial folds. *Fanning* consists of an array of linear deposits fanning out from a central injection point and is useful when filling triangular depressions such as the upper melolabial fold.

Nasolabial Folds. The nasolabial fold is a common area of filler placement (Figure 3). Folds may be primarily visible due to a discrete furrow; a broad, smooth valley; or a combination thereof. A discrete superficial furrow is best

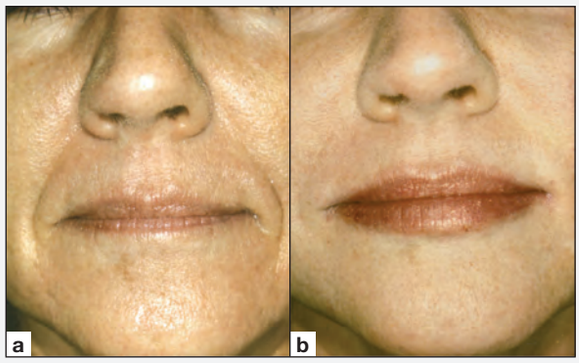

Figure 3 Treatment for lip vermillion, nasolabial folds, and melolabial folds. **a.** Before hyaluronic acid filler treatment. **b.** Immediately after treatment. Note the improved ratio of the vertical lip height of the upper to lower lip.

filled by linear threading, whereas a broad valley may require cross-hatching. Fanning is useful at the juncture of the upper nasolabial fold and the nasal alar rim.

Glabella. The glabella is sometimes injected without any supplemental anesthesia, but most patients are injected after the area has been numbed with ice or topical anesthetic. The glabella responds well to filler, but caution is indicated to avoid aggressive filling because of reports of dermal necrosis due to vascular compromise. Slowly injected intradermal filler is used for treating wrinkles in the glabella. Deeper and forceful injections have been associated with retrograde embolization of the central retinal artery and visual loss.

Tear Trough. The tear trough area is best treated by experienced injectors because of the complex topography, confluence of thick cheek skin and thin eyelid tissues, underlying visual apparatus, embolic hazard, vasculature, and tendency to bruising. Any nodularity in this area can be quite noticeable. Preperiosteal injection of filler followed by aggressive digital molding is a useful method. One method is to make 3 to 5 deep supraperiosteal injections per side and mold these into position (Figure 4). Additional layered deposits may be used to enhance the final contour. Reactive fillers (stimulators) should never be placed superficially in this area.

Cheeks. The cheeks may suffer over time from descent of the malar fat pad, subcutaneous volume loss ("deflation"), and hollowing. Direct subcutaneous filler injection is useful when restoring "high cheekbones" and reversing the underlying volume loss due to descent of the malar fat pads. The cheek hollows respond well to subcutaneous filler. Larger volumes of filler are often required in the cheek areas. One must be cautious to avoid underfilling, overfilling, or lumpiness. Often the "tear trough" depression may be noted to spill over onto the cheek in the area of the mid-inferior orbital rim. Treating this area, as well as the tear trough and the cheek, will often reverse much of the tired appearance associated with descent of the midface.

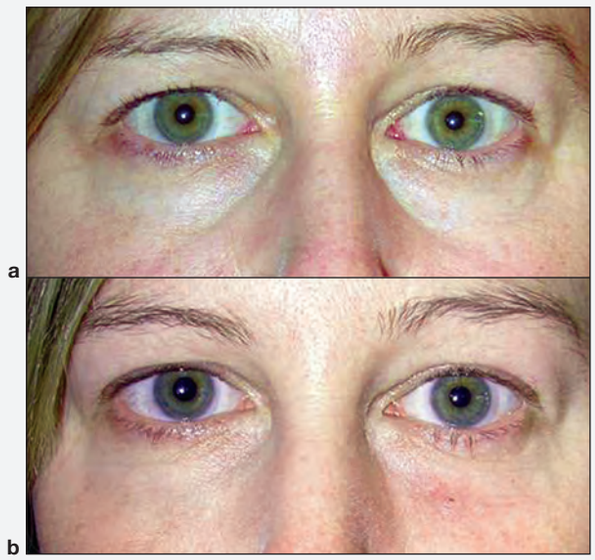

Figure 4 Treatment of tear trough. **a.** Before filling of tear trough with hyaluronic acid. **b.** Immediately after treatment.

Melolabial Folds or Marionette Lines. The melolabial folds extend inferiorly from the oral commissures and angle slightly laterally to end at the mandibular border (Figure 3). The melolabial folds often require large, deep deposits of filler to lift the depressed fold. Where the fold meets the commissure, there is often a triangular depression bordered by the lateral vermillion of the lower lip and the nasolabial fold. This area often is treated with aggressive fanning.

Lips: Vermillion, Commissure, Vertical Lip Lines, and Volume. The sensitive vermillion border of the upper and lower lips may be enhanced by push-ahead linear filling and using a filler that is safe for intradermal injection. Usually 6 injections are used on the upper lip and 4 to 6 on the lower lip (Figure 3). Vertical lip lines may be filled with very superficial intradermal injection along the base of each wrinkle, with care taken not to overfill (Figure 5). Very small doses of supplemental botulinum toxin are also helpful with these lines. Sad and downturned atrophic commissures may be perked up by aggressively filling the lateral vermillion border of the commissure, adding volume to deficient lateral lips, and by aggressively filling the superior aspect of the adjacent

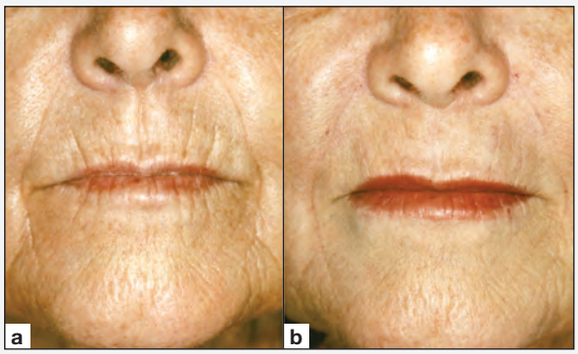

Figure 5 Treatment of fine vertical lip lines. **a.** Before hyaluronic acid filler treatment. **b.** Immediately after treatment.

melolabial fold. The volume of the lip is augmented by superficial submucosal filler. One should try to maintain a slightly fuller lower lip compared to the upper lip, with a vertical height of 60% lower lip and 40% upper lip. Herpes simplex virus prophylaxis (eg, acyclovir) is warranted in susceptible patients.

Jowls. Jowling may be blunted by aggressive filling of the melolabial fold combined with filling the trough where the jowl crosses the mandibular border. The skin is quite thin along the mandibular border, so it is best to inject deep and parallel to mandibular border in order to avoid visible nodularity. One should be careful to avoid injecting the mental vessels.

Complications

Complications of fillers vary from mild and insignificant to severe and disabling. Common mild complaints include bruising, several days of discomfort, mild swelling, and mild transient erythema. Superficial injections may create a bluish discoloration (Tindall effect). Some patients may demonstrate allergic reactions and nodules, although this is much less common with modern HA fillers when compared to older collagen-based products. Rarely, severe swelling may occur, especially in the lips, and this may be treated with oral steroids. One should inject less in the glabellar area because of the risk of dermal vascular compromise resulting in glabellar necrosis, but vascular compromise may occur in any area with excessive filler. Dermal ischemia should be treated with heat and transdermal nitroglycerin ointment (nitropaste), and, in the case of HA fillers, hyaluronidase injection. Fluctuant or painful nodules that develop shortly after injection may represent bacterial infection (Figure 6), whereas nodules that occur several weeks after injection may be due to atypical mycobacterial infection. Non-tender nodularity is usually due to overfill, superficial injection, or placement of a reactive filler in an area of thin, distensible tissue (Figure 7), such as lips or tear trough. HA is the most forgiving filler as it may be immediately dissolved with hyaluronidase injection. Embolization may result in distal injury to the retinal circulation; therefore, cautious injection following syringe aspiration is useful in the tear trough, glabella, and mandibular border.

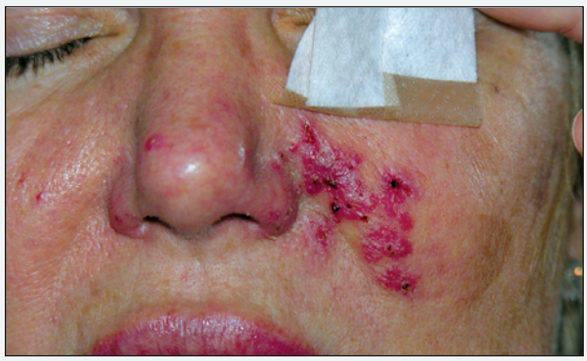

Figure 6 Bacterial infection complicating hyaluronic acid filler injection. Patient presented for second opinion. (Image courtesy of Maziar Bidar, MD)

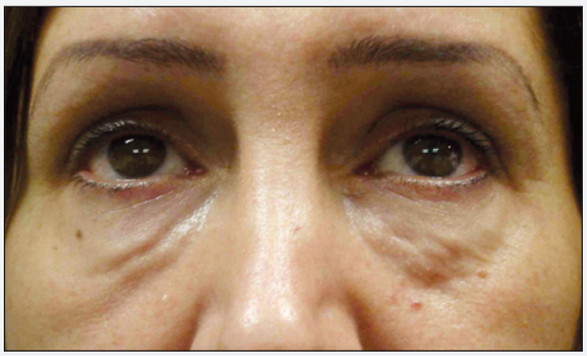

Figure 7 Nodularity subsequent to superficial injection of poly-L-lactic acid in the tear trough area. Patient presented for second opinion. (Image courtesy of Morris E. Hartstein, MD)

Aesthetic Botulinum Toxin

With over 5 million treatments last year, cosmetic botulinum toxin type injection is the most commonly physician-performed aesthetic procedure in the world. The treatment is relatively easy to perform with a low incidence of complications and high patient satisfaction.

Botulinum toxin (BTX) is a toxin class produced by the bacterium *Clostridium botulinum,* which inhibits acetylcholine release at the neuromuscular junction (Figure 8). Seven immunologically distinct serotypes have been identified: A, B, C, D, E, F, and G. Serotypes A (BTA) and B (BTB) have proven clinically useful and are commercially available for clinical use. Treatment with BTA takes about 2 weeks to become fully effective, and effects last approximately 4 months.

Ophthalmologist Allan Scott developed BTA for the treatment of strabismus and blepharospasm. Subsequently, the Carruthers observed improvement of deep glabellar furrows following treatment for blepharospasm ("Suggested Reading"). This insight eventually lead to

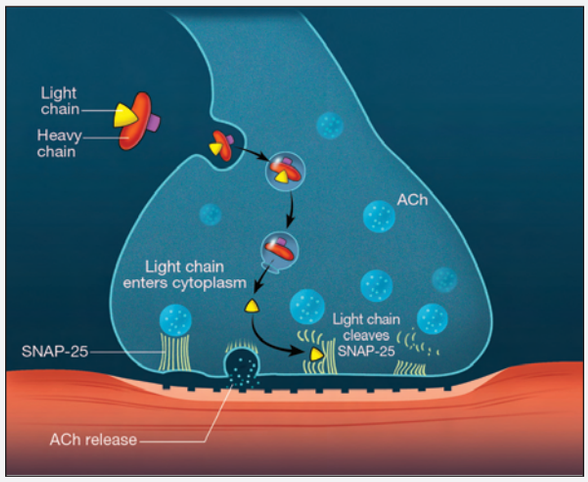

Figure 8 The heavy chain of botulinum toxin A binds to the cell membrane receptors of the nerve terminal to allow endocytosis of the neurotoxin complex. The light chain of botulinum toxin A cleaves synaptic neural-associated protein (SNAP-25), preventing the ability of ACh-containing vesicles to fuse with the cell membrane to transmit ACh into the neuromuscular junction. (Illustration by Christine Gralapp, CMI)

FDA approval of BTA for glabellar rhytids in 2002. Off-label cosmetic indications now include a range of defects around the eyes, forehead, and lower face.

Clinical Pharmacology and Product Comparisons

Botox (Allergan, Irvine, California) was the only FDA-approved botulinum toxin for cosmetic use in the United States until 2009, when Dysport (Ipsen, Slough, United Kingdom) was also approved for glabellar rhytids. Pur-Tox (Johnson & Johnson, New Brunswick, New Jersey) is pending FDA approval. Table 2 summarizes botulinum toxin products approved for the United States and elsewhere. Myobloc (Solstice Neurosciences, South San Francisco, California), the only approved BTB product, has not found much success for off-label use in the cosmetic market. Different botulinum toxin products of the same serotype (eg, Dysport versus Botox) are not bioequivalent, and therefore the doses of different products are not interchangeable.

Table 2. Botulinum Neurotoxin Products Worldwide

PRODUCT	TYPE	MOLECULAR WEIGHT/ COMPLEX	RELATIVE PER-UNIT STRENGTH[a]	INTRODUCED	MANUFACTURER/ DISTRIBUTOR	APPROVED	HOW SUPPLIED
Botox	A	150kD/900kD	1:1	1989	Allergan	75 countries	100-unit vial
Botox Cosmetic	A	150kD/900kD	1:1	2002	Allergan	13 counties	100-unit vial
Dysport	A	150kD/900kD	3:1	1990 (USA 2009)	Ipsen/Medicis	67 countries	125–500 unit vials
Vistabel	A	150kD/900kD	1:1	2003	Allergan	United Kingdom and European Union	50 units
Myobloc[b]	B	150kD/600kD	40:1	2000	Solstice Neurosciences	United States	2500–10000-unit vials
NeuroBloc	B	150kD/600kD	40:1	2001	Solstice Neurosciences	35 countries	2500–10000-unit vials
Purtox	A			Pending	Johnson & Johnson	Pending	Pending
Xeomin	A	150kD/900kD	1:1	2008	Merz Pharmaceuticals	Canada,United Kingdom, European Union, Mexico, Argentina	100-unit vial
Azzalure (Dysport)	A	150kD/900kD	3:1	2009	Ipsen/Galdederma	Germany, United Kingdom	125-unit vial

[a]Suggested bioequivalence ratio compared to botulinum toxin A (Botox, Allergan, Irvine, California) based on current literature. Clinicians are advised to use judgment in working with these ratios.
[b]Known as NeuroBloc outside the United States.

Clinical Anatomy

The forehead and periocular areas are the most important treatment areas. The frontalis muscle has 2 bellies. This muscle arises from the deep galea superiorly. At the orbital rim, the frontalis muscle interdigitates with the orbital orbicularis oculi muscle and the central eyebrow depressors including the corrugator supercilii muscles, the depressor supercilii muscle, and the procerus. These muscles animate the eyebrows and glabellar skin. The action of the frontalis produces horizontal forehead lines, eyebrow elevation, and pinching and ridging along the eyebrow.

The septal and orbital orbicularis oculi muscles function as eyebrow depressors. The lateral orbicularis oculi muscle is responsible for the rhytids in the crow's feet area. In the lower eyelid, activity of the orbital and septal orbicularis oculi accounts for lower eyelid rhytids. The procerus wrinkles the base of the nose and the corrugators produce 2 vertical rhytids between the eyebrows at the root of the nose, the so-called "eleven" lines.

Over the nasal dorsum, activation of the nasalis muscle with the smile creates rhytids referred to as "bunny" lines. The levator labii superioris alaeque nasi and levator labii superioris have been proposed as target muscle to treat the "gummy smile," where the gums above the upper teeth are exposed when the patient smiles.

The orbicularis oris is the muscle that encircles the lips and is responsible for creating the perioral lip lines as well as lip closure. Cautious treatment of the orbicularis oris with small doses of botulinum toxin may decrease the vertical lip rhytids. The corner of the mouth is pulled down by the depressor anguli oris. Treatment of this muscle helps elevate the corner of the mouth and diminish the melolabial fold. The mentalis muscle is a mild lip depressor but it can also contribute to a pebbly or irregular chin, which is also amenable to treatment with botulinum toxin. Finally the neck cords are caused by the contraction of the platysma muscle. Treating this muscle will soften and in some cases, temporarily alleviate neck cords.

Anesthesia

Botulinum toxin injections are uncomfortable, and topical anesthesia makes the injection much more pleasant. Ice or eutectic mixtures of lidocaine and prilocaine, commercially available as a cream for topical use, provide good topical anesthesia and improve the treatment experience. Skin cooling with ice or cryospray may be helpful.

Injection Techniques

Table 3 summarizes injection techniques. With the exception of the glabellar treatment, all other cosmetic facial treatments are off-label use.

Table 3. Botulinum Treatment Sites, Doses, and Complications

SITE	TARGET MUSCLES	INJECTIONS	TOTAL DOSE[a]	LOCATION DETAILS	POTENTIAL COMPLICATIONS
Forehead	Frontalis	4 to 12 total	10 to 30 units	Treatment of select rhytids	Brow ptosis
Glabella	Corrugator, procerus, depressor supercilii; orbicularis oculi, frontalis	5 to 7 total	20 to 40 units	V-shaped treatment directed away from the orbit	Eyelid ptosis
Crow's feet	Lateral orbicularis	2 to 5 per side	10 to 25 units	1 cm outside the orbital rim	Eyelid ptosis
Bunny lines	Nasalis	2 to 6 total	2 to 5 units	Nasal dorsum	
Lower eyelid	Orbicularis oculi	2 to 3 per side	2 to 8 units	Focal rhytid treatment	Lower eyelid weakness
Toothy smile	Levator labii superioris alaeque nasi	1 per side	10 units	A narrow muscle along each side of the nose	Asymmetric smile
Perioral	Orbicularis oris	2 to 6 total	1 to 4 units	White roll	Lip incompetence
Depression of corner of mouth	Depressor anguli oris	2 per side	2 to 6 units	Pinch muscle while frowning	Smile asymmetry
Mentalis	Mentalis muscle	1 to 2 total	2 to 8 units	Low on chin	Lip incompetence
Neck cords	Platysma	2 to 1 per band	10 to 40 units	Pinch cord	Results variable. Dysphagia, dysphonia

[a]Total dose is expressed relative to botulinum toxin type A (Botox, Allergan, Irvine, California). Clinical judgment should be exercised in converting this dose for any other botulinum toxin product.

Glabellar Rhytids. Contraction of procerus, corrugators, depressor supercilii, and the superior medial aspect of the orbital portion of the orbicularis oculi produce the so-called worry lines between the eyebrows. The FDA approved treatment protocol with Botox or Dysport is a V-pattern of 5 injections with 4 units of Botox at each site for a total treatment of 20 units (Figure 9). The medial corrugators should be injected at least 1 cm above the orbital rim, avoiding treatment of the levator palpebrae superioris, which could result in ptosis.

Crow's Feet Rhytids. Botulinum toxin A is commonly used for crow's feet rhytids. The lateral orbicularis oculi muscle is superficial but broad. To avoid unwanted upper eyelid ptosis, injections should be placed outside the orbital rim. Treatment can involve 2 to 5 injections on each side with a total dose of up to 30 units of BTA (Botox) between the 2 sides (Figure 9). As the temporal aspect of the orbicularis muscle is a depressor of the eyebrow, crow's feet injections are described as a means to help elevate the eyebrow position.

Forehead Rhytids. Treating the frontalis muscle will reduce forehead rhytids. There are a variety of patterns using 4 to 12 injections in horizontal rows of up to 30 units of BTA (Botox) as shown in Figure 9. The goal is a reduction of forehead rhytids. Too much treatment causes eyebrow ptosis, as the frontalis muscle is the elevator of the eyebrows.

Temporal Brow Lift. Brow elevation has been reported after treatment of the crow's feet and glabellar areas, provided the frontalis muscle has not been weakened. Various types of brow lifts have been described using different patterns of treatment. Treatment limited to the glabella and central forehead can induce a compensatory temporal brow elevation. This may cause rhytids at the lateral aspect of the forehead, which are undesirable and can be managed with additional injections to the lateral forehead.

Lower Eyelid Rhytids. Careful placement of 2 to 6 units of botulinum toxin in the lower eyelid rhytids softens these lines (Figure 10). Overtreatment weakens the lower eyelid and drops the resting position of the lower eyelid.

Downturned Lips. The depressor anguli oris muscles may pull down the corners of the mouth. Placement of 2 injections in to this muscle on each side with the equivalent of 2 to 6 units of BTA (Botox) will soften this effect.

Pebbly Chin. With aging, the mentalis muscle can cause chin dimpling. One to 2 deep injections on each side of the chin can soften this effect. Treatment generally consists of 2 to 8 units of Botox.

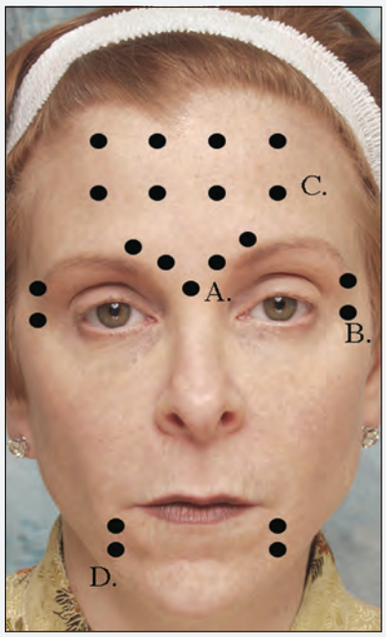

Figure 9 Typical facial botulinum injection sites: glabella furrows **(A)**, crow's feet wrinkles **(B)**, forehead lines **(C)**, and depressed lateral commissure of lips **(D)**.

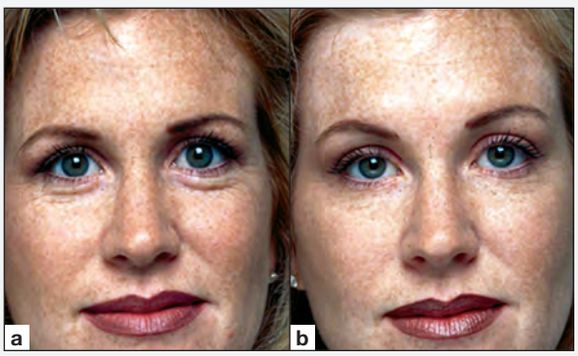

Figure 10 Treatment with botulinum toxin. **a.** 40-year-old woman with mild forehead rhytids, eyebrow descent, a slight pinched brow, mild crow's feet rhytids, and a hyperdynamic lower eyelid orbicularis oculi roll. **b.** The individual 3 weeks after treatment with 33 units of Botox. Note the disappearance of the vertical glabellar rhytids and the dramatic flattening of the lower eyelid orbicularis oculi roll, as well as the subtle but dramatic improvement of eyebrow position. Photos demonstrate both the standard role of botulinum toxin in reducing resting rhytids, as well as more sophisticated techniques for repositioning the eyebrows and flattening the lower eyelid orbicularis.

Complications

Brow ptosis, blepharoptosis, diplopia, dry eye, weakness of the lip elevators, and orbicularis oris incompetence have been reported following botulinum toxin treatment. A small incidence of short-lived idiosyncratic reactions following botulinum toxin includes headache, flu-like symptoms, and malaise. Treatment is contraindicated in pregnant and breast-feeding women; patients with neuromuscular diseases, including myasthenia gravis and Lambert-Eaton myasthenic syndrome; patients taking aminoglycosides, penicillamine, quinine, or calcium-channel blockers; and patients with a history of a hypersensitivity to albumin. The incidence of blocking antibodies is low among those receiving treatment for cosmetic indications. Care must be employed in any cosmetic botulinum toxin treatment to avoid unwanted muscle paralysis. Blepharoptosis is possible when these agents diffuse into the upper eyelid. Treatment includes apraclonidine ophthalmic drops and supportive care until the effects dissipate.

Skin Rejuvenation

Aging, chronic sun exposure, smoking, and heredity can all contribute to senescent changes of the skin. These changes include loss of elasticity, lines and wrinkles, change in texture, increased pore size, telangiectasias, and pigmentary changes. Neurotoxins, fillers, and surgical techniques can be used to address wrinkles, volume loss, and facial descent. Any treatment regimen needs to stress smoking cessation, sun avoidance, and daily application of sunscreen of SPF 30 or more.

Technologies and Comparison

Chemical peels, light-based therapy, and laser resurfacing (Table 4) are among the most commonly used skin rejuvenation technologies.

Chemical Peels. These procedures require relatively little initial capital expenditure by the physician, and they can provide reliable skin tightening. The most superficial peels are the alpha hydroxy acids, which include glycolic acid (from sugar cane), lactic acid (from milk), malic acid (from apples), citric acid (from citrus fruits), and tartaric acid (from grapes). The depth of these peels is limited to the epidermis and they produce lightening of the skin. Repeated applications may stimulate dermal production of collagen and elastin. Jessner's solution (composed of resorcinol, salicylic acid, and lactic acid) is another superficial peel. The more aggressive "medium depth" peels consist of trichloroacetic acid (TCA) 20% to 35%. The penetration of this peel may be accelerated by first applying Jessner's solution. The Obagi Blue Peel is a TCA peel mixed in a blue base to aid in judging peel depth. Phenol peels are deep peels that have an increased risk of local complications as well as a risk of cardiac arrhythmias, and they require cardiac monitoring. Phenol peels may also cause renal or hepatic toxicity.

Table 4. Selected Laser Devices[a]

DEVICE TYPE	NONABLATIVE	ABLATIVE
Fractional	Cynosure Affirm (1440 nm) Fraxel re:fine (1400 nm) Fraxel re:store (1550 nm) Fraxel SR (1550 nm) Palomar Lux 1440 Palomar Lux 1540	Affirm CO_2 (10,600 nm) Cynosure SmartSkin (10,600 nm) Fraxel re:pair (10,600 nm) Harmony XL (2940 nm) Juvia CO_2 Fractional (10,600 nm) Lumenis ActiveFX (10,600 nm) Lumenis DeepFX (10,600 nm) Lutronic eCO2 (10,600 nm) MiXto SX (10,600 nm) Palomar Lux 2940 Sciton ProFractional (2940 nm) Sciton ProFractional XC (2940 nm) SmartXide DOT (10,600 nm)
Confluent	CoolTouch CT3 Plus (1320 nm) Sciton ThermaScan (1319 nm)	Coherent Ultrapulse (10,600 nm) Sciton Profile (2940 nm) Sharplan SilkTouch (10,600 nm) Sharplan FeatherTouch (10,600 nm)

[a]Note: the Pixel CO_2 Omnifit is an adapter that may be used to fractionate traditional CO_2 lasers.

Light-Based Therapy. Light devices (Quantum intense pulsed light [IPL], Lumenis, Santa Clara, California; BBL BroadBand Light, Sciton, Palo Alto, California) are not technically lasers, because they use a large range of wavelengths rather than a single wavelength. Such light devices may achieve a small amount of skin tightening, but they are most effective for treating lentigines, telangiectasias, and unwanted hair. Depending upon the treatment application, a filter is chosen to eliminate the wavelengths below the filter, so that only the wavelengths above that of the filter reach the skin. The skin may be photosensitized with 5-aminolevulinic acid (5-ALA) before such treatments to enhance results.

Laser Resurfacing. This procedure employs laser energy to bring about improvement in the skin. Laser resurfacing allows for precisely measured tissue damage to be delivered. Selective photothermolysis refers to the use of thermal injury to ablate selected target tissue. Selective photothermolysis requires a target (chromophore) that preferentially absorbs the wavelength in use, pulse duration of the laser that is less than the time necessary for the tissue to cool, and sufficient heating of the chromophore to cause damage. In 1993, laser resurfacing enjoyed a rapid increase in popularity with the advent of the Coherent UltraPulse laser (now Lumenis). This laser uses tissue ablation (vaporization) to treat continuous areas of the skin (Figure 11). The 2 most commonly used wavelengths are 2940 nm for the erbium:yttrium-aluminum-garnet [Er:YAG] laser and 10,600 nm for the CO_2 laser. Both have water as their chromophore, but the 2940 nm wavelength is more efficiently absorbed by water than the 10,600 nm wavelength. Because of this, erbium lasers cause less thermal damage to surrounding tissues than CO_2 lasers. As a result, erbium lasers may have less efficacy but also have less healing time. Erbium lasers also may leave pinpoint bleeding, which is not seen with CO_2 lasers (Figure 11). Some erbium lasers have a coagulation mode, which causes thermal damage to surrounding tissue in an attempt to replicate the efficacy and deeper ablation of the CO_2 laser. Recently, lasers with 2790 nm wavelength have become available. This

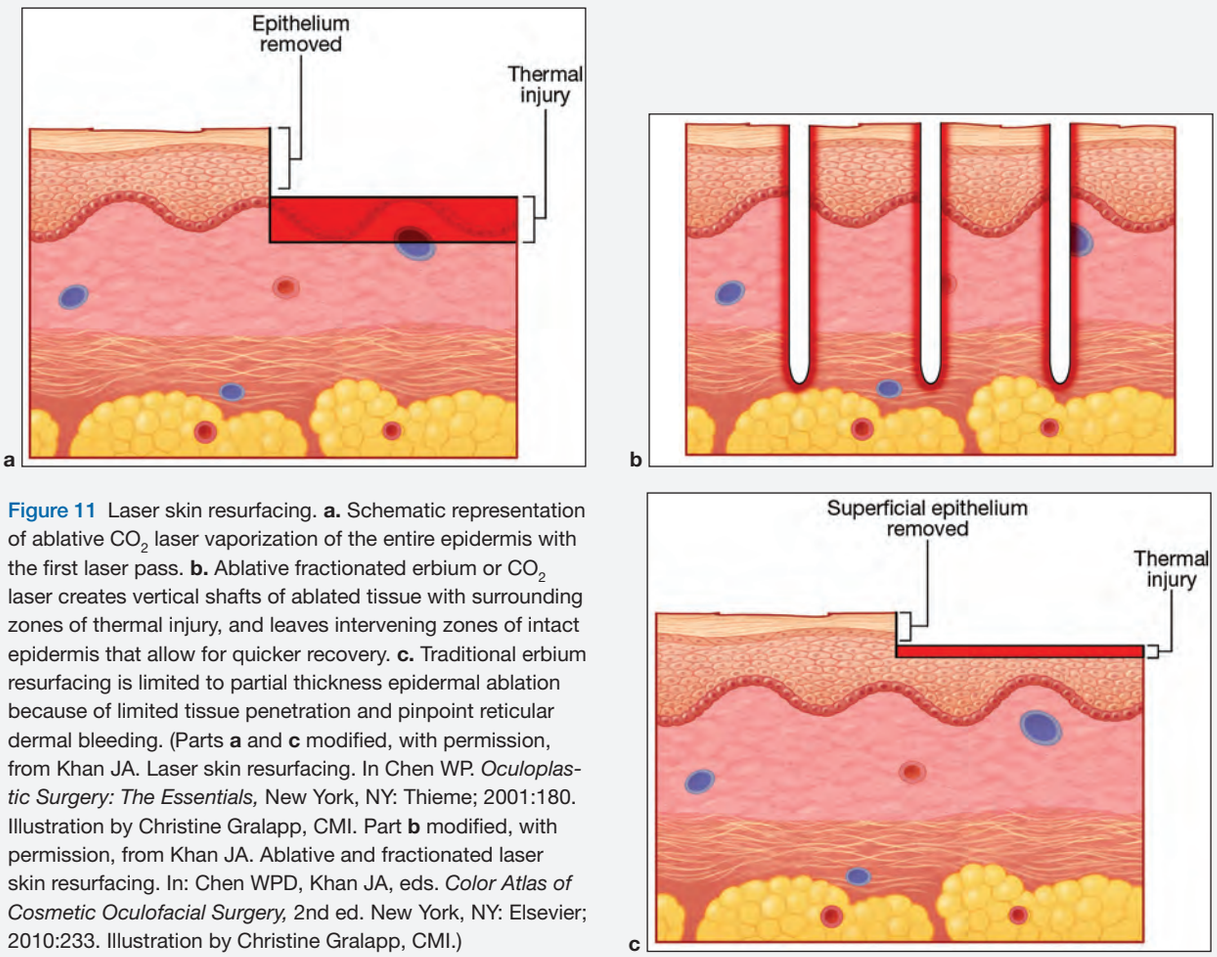

Figure 11 Laser skin resurfacing. **a.** Schematic representation of ablative CO_2 laser vaporization of the entire epidermis with the first laser pass. **b.** Ablative fractionated erbium or CO_2 laser creates vertical shafts of ablated tissue with surrounding zones of thermal injury, and leaves intervening zones of intact epidermis that allow for quicker recovery. **c.** Traditional erbium resurfacing is limited to partial thickness epidermal ablation because of limited tissue penetration and pinpoint reticular dermal bleeding. (Parts **a** and **c** modified, with permission, from Khan JA. Laser skin resurfacing. In Chen WP. *Oculoplastic Surgery: The Essentials,* New York, NY: Thieme; 2001:180. Illustration by Christine Gralapp, CMI. Part **b** modified, with permission, from Khan JA. Ablative and fractionated laser skin resurfacing. In: Chen WPD, Khan JA, eds. *Color Atlas of Cosmetic Oculofacial Surgery,* 2nd ed. New York, NY: Elsevier; 2010:233. Illustration by Christine Gralapp, CMI.)

wavelength is absorbed by water with efficiency between that of 2940 nm and 10,600 nm wavelengths.

After traditional ablative therapy, the skin re-epithelializes from the epithelium of hair follicles. Traditional nonablative lasers use surface cooling to protect the epidermis but cause photodamage in the dermis. The Fraxel SR (Solta Medical, Hayward, California) was FDA approved in 2003 and brought the breakthrough of fractional photothermolysis. This technology uses nonablative erbium laser (1550 nm) to create microscopic treatment zones of heated tissue with intervening segments of untreated skin. These zones are columns of thermal damage with overlying intact epidermis to protect against infection.

Fractionated technology has since expanded to the realm of ablative lasers of both erbium and CO_2 wavelengths. These lasers ablate tunnels of epidermis and dermis while sparing the intervening tissue (Figure 11). After ablative fractional treatments, the treated zones re-epithelialize via the epithelium of the surrounding untreated tissue. This technology offers results that may approximate those of traditional ablative therapy, but with decreased downtime and fewer adverse outcomes.

Clinical Science and Healing

The skin is composed of epidermis above the papillary dermis, which in turn lies above the reticular dermis. Within the epidermis are melanosomes that contain melanin. The dermis supplies the avascular epidermis with its blood supply. The epidermis ranges from 0.5 to 1.5 mm in thickness.

The majority of the dermis is comprised of collagen, although elastin also plays an important role in the function of the dermis. The dermal layer is also home to a number of skin appendages, including sebaceous glands, sweat glands, apocrine glands, and hair follicles. The dermis ranges from 0.3 to 3.0 mm in thickness.

After nonfractional (confluent) ablative therapy, the re-epithelialization process is dependent upon the epidermal cells of the hair follicles, whereas fractional ablative therapy allows epithelialization from the surrounding untreated epithelium.

With chemical peels and traditional ablative technology, care must be taken to respect the facial cosmetic units to avoid demarcation lines due to hypopigmentation of the treated areas. However, with more modern techniques—such as light therapy, nonablative lasers, and fractional lasers—the risk of hypopigmentation is much lower. Because the eyelid skin is significantly thinner than that of the rest of the face, the eyelids are frequently treated with lower settings or fewer passes. The surgeon must remember that light or laser therapy of hair-bearing areas may lead to hair loss.

Anesthesia

As with any procedure, patients exhibit variable pain thresholds during the array of resurfacing techniques mentioned in this module. These techniques require varying levels of anesthesia, which may include an air chiller, topical anesthesia, local anesthesia, regional nerve blocks, and general anesthesia. Treatments limited to the periocular area are usually administered with local anesthetic. Full-face, nonablative fractional treatments are commonly performed with topical anesthesia with or without regional nerve blocks. Full-face, ablative fractional procedures more frequently require regional nerve blocks in addition to topical anesthesia. Full-face, traditional ablative CO_2 laser is often performed with general anesthesia or deep IV sedation.

Pretreatment, Treatment Techniques, and Recovery

Pretreatment. Facial rejuvenation techniques are contraindicated in the presence of active infection of the facial skin. Before therapy, patients should be questioned to identify their Fitzpatrick skin type (Table 5). Patients with a higher Fitzpatrick skin type are more likely to manifest post-inflammatory hyperpigmentation after facial rejuvenation procedures.

Patients who have been exposed to radiation should not be treated with techniques that remove the epithelium, as these patients may have an impaired ability to re-epithelialize. Tretinoin 0.1% may be prescribed for several weeks before medium or deep peels or ablative laser therapy in order to speed healing. Hydroquinone or kojic acid may be prescribed preoperatively for patients undergoing therapy that removes the epidermis, as they may decrease the risk of post-inflammatory hyperpigmentation. Such patients are commonly treated with an antiviral agent, such as acyclovir, Famvir, or Valtrex

Table 5. Fitzpatrick Skin Types

Type I: Always burns, never tans—pale skin, redheads/blondes
Type II: Always burns, may tan with difficulty—fair skin
Type III: Burns moderately, tans moderately—darker white skin
Type IV: Always tans, burns minimally—light brown skin
Type V: Rarely burns, tans thoroughly—Mediterranean, Hispanic/Latino, Asian, or dark brown skin
Type VI: Never burns, always tans—dark brown or black skin

throughout the healing phase, and it may be started several days before their treatment.

Basic Principles of Treatment Techniques. Specific treatment regimens are beyond the scope of this module. Instead, a review of basic principles of technique may be instructive. Epidermal sliding is the ability of the epidermis to slide across the dermis and produce wrinkles when tension is applied to the skin. During chemical peels, epidermal sliding is a sign that the peel has reached the papillary dermis. For nonlaser, light-based treatments, adhesive patches are often used over the patient's closed eyelids. For any laser procedure, laser-resistant metal eye shields or goggles must be used to protect the patient's eyes. During laser treatments, the physician and staff must wear protective eyewear appropriate for the wavelength in use.

During full-face ablative laser treatment, it is important to treat the cheek before treating the lower eyelid, as tightening of the cheek and lower eyelid are additive. Excessive tightening can cause ectropion. Nonfractional ablative CO_2 lasers leave residual char that should be wiped away between passes. On the other hand, ablative erbium lasers may leave pinpoint bleeding. When using ablative lasers, it is advisable to "feather" the boundaries of the treated area in order to decrease the risk of leaving a demarcation line.

Post-Treatment Care and Recovery. After light therapy, light chemical peels, or nonablative laser, patients are instructed to avoid the sun for 1 to 2 weeks. Sunscreen use is stressed, and generally, no topical medications are necessary. Patients are instructed to call if blistering occurs.

After moderate or deep chemical peels, dermabrasion, or ablative laser, sun avoidance is advised for approximately 6 to 8 weeks. Antiviral medication is prescribed for approximately 1 week after treatment to reduce the risk of postoperative herpes infection. The skin should be kept moist with a bland ointment such as Aquaphor (Beiersdorf, Wilton, Connecticut) until re-epithelialization, at which time sunscreen with SPF 30 or higher should be used daily. Antibiotic therapy such as a fluoroquinolone is often prescribed as well. Figure 12 shows before and after images of a patient who underwent ablative CO_2 laser resurfacing of lower eyelid rhytids and crow's feet.

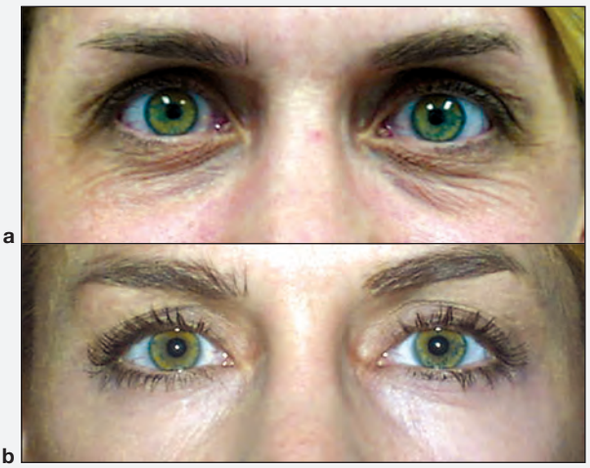

Figure 12 Ablative CO_2 laser resurfacing of lower eyelid rhytids and crow's feet. **a.** Before treatment. **b.** Two weeks after treatment. Subject is wearing concealer to cover up post-resurfacing erythema.

Complications

All of the techniques described above will result in some erythema. However, some patients may experience prolonged erythema after treatment. Thin skin such as that of the eyelids may be predisposed to long-lasting erythema. When erythema becomes blotchy or is associated with itching, contact dermatitis and infection should be considered. Green- or yellow-tinted makeup may be used to conceal prolonged redness. Antioxidants such as vitamin C may help curtail post-procedure erythema. Topical steroids have also been used for prolonged erythema, but they may result in hypopigmentation and skin atrophy.

Contact dermatitis is treated with discontinuation of the offending agent, and sometimes with topical steroid therapy. The use of bland ointments such as white petroleum or Aquaphor will decrease the incidence of contact dermatitis.

Milia are caused by the occlusion of eccrine ducts by topical therapy or aberrant keratinization. Milia may be treated by unroofing with a 30-gauge needle.

Hypopigmentation, often due to damage to melanocytes, is commonly seen after phenol and nonfractional ablative CO_2 laser treatment, particularly along the jaw line, but it may be seen after other laser treatments, dermabrasion, and medium chemical peels. Hypopigmentation may take up to a year to appear, and it does not resolve without treatment. A medium-depth chemical peel or repeat laser procedure without hydroquinone therapy may help to blend the transition area.

Except for light chemical peels, any of the modalities mentioned above may cause hyperpigmentation due to stimulation of melanocytes by inflammation, especially if the patient is not careful to avoid sun exposure. The risk of hyperpigmentation increases for individuals with Fitzpatrick skin type III or higher. Hyperpigmentation

may last up to a year, and its resolution may be hastened with topical hydroquinone 2% to 4% daily as well as topical tretinoin 0.025% to 0.1% daily.

Post-treatment infection must be worked up with gram stain and culture, Tzanck smear, and potassium hydroxide (KOH) examination. Patients should be empirically treated for viral, bacterial, and fungal infection. Also, it is important to remember that infections by multiple agents may coexist. Patients with post-treatment infection commonly complain of pain, intense itching, and burning. Viral infection due to herpes simplex virus (HSV) is the most common infection after facial resurfacing. This is seen more commonly, although not exclusively, in patients with a history of HSV. It is important to remember that until epidermal regeneration has occurred, ablated skin will not be able to respond to HSV infection with the typical manifestation of grouped vesicles and erythema. Signs may include grouped erosions and erythema. Patients suspected of having post-treatment viral infection should immediately begin antiviral therapy. If the patient develops infection in spite of prophylaxis with one antiviral medication, they should be switched to another.

Bacterial infection is most often caused by *Staphylococcus, Streptococcus, Pseudomonas,* or *Enterobacter* species. It may manifest with erythema and yellow crust or exudates. Patients with bacterial infection are treated with oral cephalosporins pending the results of culture and sensitivity testing. Fungal infection, usually due to *Candida,* may manifest with pink papules or plaques. It can be treated with fluconazole or newer imidazole agents.

Cicatricial ectropion may result from overly aggressive treatment of the lower eyelids, especially in patients with untreated lower eyelid laxity. Mild cases may respond to lateral canthal tightening, but more severe cases will require midface lifting or skin grafting.

Conclusion

A wide variety of technologies are available to perform facial rejuvenation. The physician and patient must weigh the risks and benefits of each technology in order to choose the appropriate modality for a given treatment.

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Clinicians' **Corner**

Clinicians' Corner provides additional viewpoints on the subject covered in this issue of *Focal Points*. Consultants have been invited by the Editorial Review Board to respond to questions posed by the Academy's Practicing Ophthalmologists Advisory Committee for Education. While the advisory committee reviews the modules, consultants respond without reading the module or one another's responses. –*Ed.*

1. Do you use photography to document pre- and post-treatment status in selected patients or all patients? Is photographic documentation needed for botulinum treatments as well as fillers?

Dr. Patrinely: We photograph all new cosmetic patients for baseline reference. In the initial consultation we do not know what procedure(s) they will ultimately choose. If patients have only Botox or filler, then we typically do not photograph them after treatment unless there is something instructive or other issues we want to document. The sheer volume of filler and Botox patients alone makes pre- and post-photography prohibitive in terms of time and cost. I don't routinely see postoperative Botox and filler patients at this point in my practice unless there are issues to address. I will just see them at the next treatment. If you are new in practice and want to develop a photo portfolio of your results, I think having photographs of your own results can help with internal marketing and conversion of patients who are undecided.

Dr. Wulc: Experience has taught me to employ archived digital photography to document pretreatment status in all patients, whether they have filler, neuromodulator injections (eg Botox), or surgery. Photographs are among the most important elements of the medical record. No other better record exists of the patient's pretreatment status. Some patients, regardless of how improved they may seem to the clinician, will point out an asymmetry, for example of the lips or the nasolabial fold, and emphatically state that it was not there prior to your injection. These patients are the ones who, when shown preprocedural photographs, immediately appreciate the improvement that has occurred as the result of the filler, or appreciate a pre-existing asymmetry. Without these preprocedural photographs, it becomes your word against the patient's.

We document pre-treatment status and post-treatment results from neuromodulators (Botox or Dysport) in all

patients. At the first visit, we take photographs in the resting state as well as with animation, to demonstrate static and dynamic wrinkling. They return again 2 weeks later for another set of images. We do not repeat photography again in our neuromodulator patients unless we are asked to do so during their course of treatment.

If patients do not experience complete resolution of their lines in the initial injections with a neuromodulator, we always have the ability to show them that their static wrinkles have improved, and that their ability to create effort-induced dynamic wrinkles has also diminished with the treatments. In this way, they are motivated to return for additional treatments when muscle effort returns. Often, after a series of injections over the course of a year, patients with deep static wrinkles show marked improvement.

We often give patients their pre- and post-procedural injection photos to take home. They show them to friends who often come in and mention that they saw how improved their friend was in the photos and that they want the same type of treatment. In this way, clinical photographs are also a marketing tool.

2. How do you determine which patients would benefit from lower eyelid blepharoplasty compared to those who would likely do better with facial fillers?

Dr. Patrinely: In general, I think various forms of blepharoplasty are preferred for patients with excess fine loose skin, moderate to severe muscle redundancy, and/or deep tear trough deformities. Trying to fill very deep tear trough deformities with a lot of filler can sometimes make the eyelids look bulky, poorly mobile, and unnatural. Likewise, true skin excess can be nicely corrected with a pinch blepharoplasty alone. On the other hand, mild to moderate tear trough and contour deformities do very well with fillers. Since fillers work better in a tighter skin and tissue environment, I find that younger patients (30s to 40s) benefit more with fillers. Both modalities may be needed to achieve optimal results.

Dr. Wulc: At the outset of the cosmetic consultation, I ask patients whether their interest is in obtaining a nonsurgical or surgical correction of their problem(s). Most patients are seeking a nonsurgical and a permanent correction of their aesthetic issues. I explain that this alternative currently does not exist. I offer all patients the choice of nonsurgical or a surgical cosmetic solution. Many patients opt for the former, because of fear of surgery, more prolonged downtime, or expense.

Lower eyelid blepharoplasty as it is commonly performed is a subtractive procedure. The lower eyelid fat pads are removed, with a transconjunctival approach or with a transcutaneous approach. The fat can be repositioned, but the goal is usually to remove fat that protrudes along the preseptal portion of the lower eyelid. The fat pads can either be minimal, moderate, or excessive in quantity.

Filler injection, on the other hand, is an augmentation procedure, most commonly performed to obliterate the tear trough convexity below the area of preseptal fat protrusion. The tear trough, in turn, can be mild, minimal, or severe in depth. The interface between the hollow of the tear trough and the convexity of the nasal and central fat pads can be diminished in patients with mild to moderate bags, and the tear trough can be augmented regardless of how quantitatively deep it is. In patients with excessive preseptal lower eyelid fat, no amount of filler will correct the convexity deformity and surgery is required. With the exception of this group of patients, most patients can be improved with filler injections to the tear trough to blur the interface convexity-concavity deformity.

I inform patients with large convexity-concavity deformities that surgery is the better solution. Many patients would do anything to avoid a surgical procedure, and, in these patients, I try to make an honest assessment of the amount of filler that will be required to correct a given patient's interface deformity. The greater the problem, the more filler will be required to correct it, and the expense of obtaining the result in combination with the expense of maintaining it often sways patients in the appropriate direction based on their budget and whether they opt for surgery. The requirements range from 0.3 to 2 cc hyaluronic acid per side.

3. What are the long-term results with fillers? Do they tend to migrate over time?

Dr. Patrinely: I think the longevity depends in part upon where the filler is placed in the face. Hyaluronic acid filler around the eyes and upper face lasts the longest, 9 to 18 months or longer, whereas filler around the mouth

area seems to last about 6 to 9 months. There are significant individual variations from these numbers, however. Interestingly there seems to be some degree of collagenesis in some patients, such that they get some permanent filling and do not go back to baseline when the product has dissolved.

True migration of fillers does not seem to be a problem, unless someone undergoes very deep facial massage, but there can be adjacent persistent lymphedema that can resemble product migration. Fillers can be manipulated by fingers and reshaped even months after injection, but most easily days after placement, especially around the eyes. Sometimes patients can be overzealous in massaging and displace the filler, making it appear like a secondary "bag."

Dr. Wulc: Fillers have completely changed the practice of cosmetic surgery. What once could be achieved only by a tightening procedure, or use of alloplastic implants, can now be achieved with volume augmentation using fillers. Hyaluronic acid fillers can be removed easily in the case of overcorrection. Artfully used, fillers can conceal many facial defects and issues related to aging. Fillers can be used selectively at various depths to fill bony defects such as the prejowl sulcus or the inferior orbital rim, to re-inflate areas of volume loss such as the temporalis fossa or the malar fat pad, and to redefine areas that have lost prominence such as the vermilion border. Fillers can also be combined. Calcium hydroxyapatite can be used to fill bony defects, high-density cross-linked hyaluronic acid can be used to replace fatty volumes, and low-density hyaluronic acid can be used to fill in wrinkles. Studies show that fillers stimulate collagen synthesis in the dermis, so they have a longer-term benefit than their duration in tissue.

In my experience, fillers do not migrate. While the FDA has granted Restylane a duration of effect of 18 months, it is my experience that the duration of effect is dependent upon the host site in many patients, with the shortest duration of effect seen in the perioral area. I attribute this to the movement of the mouth associated with expression, speech, and eating. In the tear trough and cheek area, where facial movement is more limited, the duration is much greater. I have seen effect up to 4 years in some patients.

4. Is it true that some facial fillers do not promote any collagenesis? It seems that there would be some foreign body reaction to any of the fillers.

Dr. Patrinely: I only use the 2 major brands of hyaluronic acid fillers and have not appreciated a difference in the rates of collagenesis. I don't know if I would classify the reaction as a foreign body type in the classic histopathological definition, but there is a mild inflammatory reaction and rarely a hypersensitivity reaction manifested as a firm red nodule. Granulomas are rarer and can be sclerosing. Permanent fillers differ with respect to composition and chemical and biological characteristics and may have varied host tissue reactions that include foreign body granulomas. Adverse reactions are overwhelmingly product-dependent and to a lesser extent, location-dependent.

Dr. Wulc: I am unaware of facial fillers that do not promote collagenesis. The act of inserting needles through skin alone actually promotes collagenesis. Foreign body reactions do occur with certain facial fillers. They have been described for Sculptra injectable poly-L-lactic acid though the incidence has decreased because new methods of reconstitution have been recommended. Foreign body reactions have also been described with permanent facial fillers. Many of these fillers have not been approved by the FDA. Rarely, allergic reactions occur with the hyaluronic acids.

5. Is fat grafting ever used as a facial filler?

Dr. Patrinely: Newer techniques of micro fat grafting have provided much better graft survival rates and contours than seen in the past when fat grafts were administered in larger particle size and volumes. Micro fat grafting can provide excellent long-term results but must be injected in tiny aliquots in multiple criss-crossing layers using a relatively atraumatic technique. One theoretical advantage of fat grafts is the simultaneous introduction of stem cells, which may provide some rejuvenation effect to the overlying skin. Thus far this effect has mainly been through clinical impression, but ongoing studies should help to quantify this observation. One of the main concerns of fat grafts is the potential for graft hypertrophy to occur if a patient gains weight. This

could cause a doughy, full-looking face with loss of features. For this reason some advocate using fat grafts in only large deeper areas like the malar region.

Dr. Wulc: Fat grafting is an excellent procedure for augmenting areas of facial volume loss, and I use it extensively in my practice. Fat is natural, readily available, and a virtually inexhaustible source of autologous transplant material. One of the basic principles of plastic surgery is to replace like for like, and fat is the ideal filler for areas that have lost fat. Where syringe upon syringe might need to be placed of filler, with a cost both to the patient and to the practice, as much fat as is necessary can be extracted during a procedure and may therefore make it a more economic solution in cases where a large volume of filler is required. However, fat grafting is an extremely technique-dependent and unforgiving procedure with a steep learning curve. Complications range from undercorrection, and hence disappointment, to overcorrection. Overcorrections are difficult to remove. Fat-transfer patients are swollen for a longer period and have more bruising than patients who undergo injection with alloplastic fillers. In my hands, fat grafting is not as successful in the perioral area, the nasolabial fold, and the chin, as it is elsewhere in the face, and exogenous fillers are a better alternative in these areas.

Hyaluronic acid fillers are more appropriate for the practicing ophthalmologist who wishes to add fillers to his or her practice, because they are more forgiving. Undercorrection can be treated with additional filler, and overcorrections can be treated with massage or hyaluronidase injections.

6. Should the cosmetic procedures discussed in this module be performed only by physicians? Some dermatology and plastic surgery practices delegate laser resurfacing and chemical peels to technicians.

Dr. Patrinely: I think who does what is dictated by various state medical boards and liability insurance carriers. Ideally a physician should be involved as much as possible, and most patients expect that. Second best is that a physician has direct oversight in planning the treatment and choosing the parameters, and the technician administers the prescribed treatment. I think the biggest potential problem exists when the technicians are left to autonomously treat patients with little physician oversight or presence.

Dr. Wulc: Comfort levels, experience, and an aesthetic eye are what determine success with many facial injectable procedures and many laser procedures. I have seen as many complications from board-certified plastic surgeons as I have from nonphysicians. State laws often determine who can and cannot inject or perform laser procedures.

7. Are laser skin resurfacing procedures effective for scarring associated with acne vulgaris?

Dr. Patrinely: Yes, but you must make a distinction between a true acne scar (ice pick, boxcar, rolling) from a temporary change that patients often misdiagnose as "acne scars" (erythema or hyperpigmentation). A variety of creams and even laser treatment can be used to manage the temporary color changes, but these changes resolve on their own if given enough time. Spironolactone (Aldactone) is an excellent oral agent for hormonal acne flare-ups in women.

True scarring responds to laser resurfacing including nonfractional ablative resurfacing, fractional nonablative resurfacing, and ablative fractional resurfacing. Of all of those, a nonablative technology like the Fraxel system is the current gold standard as it offers a good combination of results, a low side-effect profile, quick healing, and tolerability. Usually with any of those procedures one can achieve 50% to 75% improvement after a series of treatments (5 or 6 treatments with the Fraxel system, 2 or 3 treatments for an ablative fractional resurfacing device, or 1 treatment for an older-style ablative resurfacing device, such as a CO_2 laser).

Dr. Wulc: Both the CO_2 and the dual erbium laser are remarkably effective at reducing scarring associated with acne vulgaris. Shallow acne scars respond well to these lasers. Deeper "ice-pick" scars can be treated with the laser or with combination therapy. Initially, the deep dermal attachments of the ice pick scar are freed using a technique of "subcision" using a Nokor needle or a wire scalpel. Fillers are then injected into the deep dermis in the area that was freed by subcision to elevate the pitted

depression. The resurfacing laser then is employed to resurface the shoulders of the depression and to obtain contraction of the saucer deformity at the base of the scar. These procedures can be repeated after a suitable period (generally 1 year in our practice) until the desired outcome is obtained. Fractional laser resurfacing with the CO_2 laser is also used in my practice and is associated with less postoperative downtime.

8. Are laser procedures effective for keloid reduction?

Dr. Patrinely: Experienced clinicians have had really good results in the treatment of keloids with a combination of pulse-dye laser therapies and triamcinolone injections. These modalities work better in combination than either alone. This usually takes a series of treatments and the end result is, hopefully, a nice flat scar. The Fraxel system has been shown in anecdotal reports to be helpful as well but there is limited peer-reviewed data to support this. Keloid reduction by laser is still an evolving field of study.

Dr. Wulc: Pulsed dye lasers work well in reducing the redness associated with keloid formation. They are particularly effective when combined with other modalities such as direct scar excision and meticulous primary repair, followed by steroid and 5-fluorouracil injection.

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