Many materials and approaches have been used throughout the years to address the challenging issue of soft tissue augmentation. At the end of the eighteenth century, interest in techniques other than those involving large reconstructions with flaps or grafts intensified, and the subject began to be studied in more detail. However, less than favorable results were reported owing to the lack of reliability and longevity of the substances used in such cases. This erratic use of unpredictable materials led to a skewed perception of soft tissue replacement for many years.

During the last three decades the field has advanced to a precise combination of art and science with the development of reliable, safe materials. Three major biomaterials are the focus of the discussion here. Bovine collagen and acellular dermal matrix are readily available in the United States. Since 1976 we have been able to study the success of collagen as a biomaterial for soft tissue augmentation. More recently, LifeCell Corporation (Branchburg, NJ, USA) developed acellular dermal matrix sheets that have been used extensively as grafts, spacers, or fillers. The micronized, injectable form (Cymetra; LifeCell)
is also utilized for facial rejuvenation and reconstruction with several alleged benefits over collagen. Finally, stabilized hyaluronic acid (Restylane Fine Lines, Restylane, Perlane; Q-Med AB, Uppsala, Sweden) is a nonanimal filler used widely throughout the world with apparently excellent results.

Many areas of the face are amenable to soft tissue augmentation (Fig. 11-1). Lip enhancement is becoming popular in patients 25–50 years old. It gives a more luscious look in younger patients and fuller contour in those who have atrophy of the body of the lips. Lifting of the nasolabial folds plumps the area of tissue loss and affected by gravitational forces, giving a younger, fuller look. Occasionally, volume replacement serves to complement a facelift when tightening is not enough to correct fully atrophy of the nasolabial folds. In some patients, we recommend treatment of the nasolabial folds along with lip enhancement and lifting of the oral commissure, or marionette lines, for better aesthetic results of the entire perioral unit. Acne scars also respond well to dermal fillers, especially when thicker material (Cymetra or Restylane) is used as close to the dermis as possible. Cheek augmentation is helpful especially in patients with human immunodeficiency virus (HIV)-related soft tissue atrophy. Soft tissue replacement treatment in the glabellar and forehead areas is usually not recommended with thick, large-particle fillers because of the risk of central retinal artery occlusion and blindness.

COLLAGEN

Collagen has been available to the surgeon in several preparations. Autologous collagen dispersion (Autologen; Collagenesis, Beverly, MA, USA) is processed from the skin of the patient. Surgery is required to harvest the collagen; and, although it seemed an excellent choice for tissue replacement, the production of Autologen ceased owing to the complex procedure of harvesting, processing, and shipping the tissue back to the surgeon. A homologous acellular suspension of collagen (Dermalogen; Collagenesis) is processed skin from tissue banks. It does not require additional surgery or skin testing prior to its use. Finally, highly purified bovine collagen is the material most surgeons have used for the last two decades, and it remains the standard by which other injectable soft tissue fillers are measured.

Testing for allergy to bovine collagen is required, as 3% of the population show a positive reaction. A skin test is easily administered, injecting a 0.1 cc test dose of bovine collagen in the dermis of
the antecubital fossa. A positive skin test response is defined by an area of induration, erythema, edema, tenderness, or itching that lasts more than 6 hours or develops 24 hours or more after testing. Up to 30% of the allergic patients react later than 3 days after inoculation; therefore everyone should be monitored for a month for an allergic response. Both surgeon and patient must understand the possibility of developing an allergy even in the absence of a positive skin test (1% of treated patients). For this reason some advocate double skin testing to confirm the results.

Zyderm I (McGhan, Santa Barbara, CA, USA) is composed of a 35 mg/ml suspension of bovine collagen fiber fragments originating from the dermis. Its use is recommended to treat superficial facial wrinkles. It is commonly used for fine, superficial wrinkles in the periorbital and perioral areas. In contrast, the collagen in Zyplast (McGhan) is cross-linked to glutaraldehyde. Although it contains the same concentration of collagen in the suspension as does Zyderm I, it provides more rigidity and should be injected deeper in the dermis. Because

FIGURE 11-1. Soft tissue augmentation with a variety of materials can be used in the following regions. A, glabellar frown lines; B, nasolabial fold; C, vermilion border; D, acne scars; E, perioral lines; F, vertical lip lines; G, marionette lines.
of its viscosity and rigidity, Zyplast is a better choice for nasolabial and melolabial folds and for lip augmentation and deep scars. Zyplast is not indicated in the glabellar area, where the potential of vascular complications is higher with thicker materials.

Cymetra (Micronized AlloDerm: Acellular Allograft Dermal Matrix)

AlloDerm has been well accepted and is used by many specialties as a graft, spacer, and filler since its introduction in 1992. Currently, this acellular dermal graft is also available as an injectable soft tissue filler (micronized AlloDerm, or Cymetra). The skin allograft is harvested from cadaveric banked tissue and is meticulously processed to remove the antigenic components.

There are several advantages when using an acellular, immunologically inert tissue such as Cymetra. First, there should be a more enduring effect because there is no cell-mediated rejection of the tissue. Second, in theory, an acellular matrix should be a safer material as it eliminates the opportunity for viral transmission. Third, in contrast to bovine collagen, no testing is necessary prior to treatment. Finally, the acellular collagen and elastin matrix should provide a scaffold for neovascularization, host fibroblast infiltration, and proliferation with collagen deposition. In other words, the host dermis adopts the tissue and begins a repopulation process with minimal reaction, preventing rapid absorption of the material.

The best results are obtained when Cymetra is injected for correction of prominent nasolabial folds, lip atrophy, depressed scars from injury or acne, or facial creases including marionette lines. Use of Cymetra in the glabellar or periocular area should be avoided because there is increased potential for occlusion of the retinal circulation, resulting in blindness through retrograde flow. Other contraindications include known autoimmune collagen disease and sensitivity to gentamicin, cefoxitin, lincomycin, polymyxin B, and vancomycin. Poorly vascularized or infected skin areas should be avoided. Although a history of herpetic lesions in the area is not a contraindication, pretreatment with systemic antiviral medication is advised as a prophylactic measure.

With the exception of being nonallergenic, the adverse effects found with Cymetra and bovine collagen are similar. They include edema, bruising, inflammation, skin discoloration, and activation of herpetic lesions. Although the graft is processed, and donors are

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screened carefully, the manufacturers of Cymetra warn that there is still a potential for infection and an allergic response.

**HYALURONIC ACID**

Along with Cymetra and bovine collagen, using stabilized hyaluronic acid is another option for filling areas of facial and lip atrophy. This elastic molecule is naturally found in various parts of the human body, including between collagen fibers in the skin. Being highly hydrophilic, it pulls water to itself, preventing damage by compression. With age, there is a marked reduction in the production of hyaluronic acid and in its ability to draw water.

Hyaluronic acid has been used successfully for many medical reasons including orthopedic problems and ophthalmic surgery. Replacement therapy for soft tissue augmentation has a long history worldwide but is still pending approval in the United States. Hyaluronic acid is a polysaccharide found with identical chemical composition in all living organisms, making it an attractive nonanimal, noncadaveric biomaterial. Products such as Perlane, Restylane, and Restylane Fine Lines (Q-Med, Uppsala, Sweden) are derived from bacterial fermentation and are stabilized to retard the degradation process in the dermis.

Each of these products has a different particle size, so each can address a specific problem and a specific skin layer. Restylane Fine Lines contains the smallest gel particle size and should be used in superficial wrinkles in the perioral area. The manufacturers believe it is also safe to inject Restylane Fine Lines in the periorbital area. Restylane is best used when injected into the mid-dermal or submucosal plane for facial rhytides and the vermilion border. Finally, of these three products, Perlane contains the largest gel size particle, and its placement should be in the deeper dermal plane for correction of deeper folds (e.g., nasolabial and melolabial folds) and for lip augmentation.

Stabilized hyaluronic acid has a few advantages over other biomaterials. First, the fact that it is a nonanimal product makes it an appealing, noninfectious material. Second, as the hyaluronic acid is broken down it draws more water, maintaining the volume and a longer lasting aesthetic effect throughout the degradation process.

Local side effects include edema, erythema, pain, itching, discoloration, and lumpiness at the injection site. It should be noted that
1 in 2000 patients report swelling and induration during the first 4 weeks after injection. This is considered to be a hypersensitivity reaction and should be treated with oral steroids.

TECHNIQUES FOR SOFT TISSUE ENHANCEMENT

Included in this section is a discussion of the techniques used for enhancement of nasolabial and melolabial folds, buccal atrophy, and acne scars using nonbovine tissue such as micronized acellular dermal matrix and stabilized hyaluronic acid.

Several anesthetic choices are available, with the decision depending on the treatment site, the pain threshold of the patient, and the level of comfort of the physician. Some advocate the use of ice and topical anesthetics alone to keep the facial topography undisturbed prior to injections. Others prefer to use small amounts of local anesthetic in the area of needle entrance with 1% lidocaine and epinephrine, nerve blocks, or a combination of the two. Antiseptic solution or alcohol is used to clean the area of interest.

Either one or a combination of the following techniques can be used to enhance the various facial features. The most common are subcision, linear, serial puncture, and fan techniques.

We favor the subcision technique for nasolabial and prominent melolabial folds where the level of injection needs to be deeper into the deep dermal or superficial subdermal plane. Using a long 23-gauge needle with the bevel up, the surgeon punctures the skin and advances it from the caudal limit of the nasolabial fold to its most proximal end next to the ala of the nose where the fold widens into a triangular shape. The needle is then turned bevel down and is used as a knife in a sweeping motion to create a deep dermal–subdermal space. The needle is once again turned bevel up, and the material is injected in a retrograde fashion as the controlled lift of the skin is ensured. This approach enables the surgeon to undermine and release the fold from its subdermal attachments so the material can lift up the tissue in a controlled, manageable fashion.

Although the linear technique (Fig. 11-2) can be utilized in any area, we use it more commonly for linear scars, for marionette lines, and to enhance the lips. A 23-gauge needle is used in the melolabial folds to fill in the dermal–subdermal plane in a retrograde fashion. To treat the upper and lower lips, lateral insertion into the submucosal plane of the vermilion border is performed and advanced to the midline. A
23- to 26-gauge needle can be used depending on the physician’s preference. The injection follows as the needle is withdrawn with the bevel up while the surgeon controls the amount of material injected. The opposite side is then injected in the same fashion. Finally, an injection parallel and posterior to the one in the vermillion border is performed slightly deeper in the body of the lips to obtain a plump look.

Serial punctures (Fig. 11-3) can be made along the area of interest. Philtrum columns, nasolabial folds, marionette lines, and scars can all be enhanced using this approach. Multiple injections should be made close to each other to prevent skip areas that would make the area feel uneven. As expected, more bleeding can occur with this technique. Finally, the fan technique is more commonly used for large areas such as during cheek augmentation. In this fashion a wider area can be easily treated with a minimal number of punctures.

In general, stabilized hyaluronic acid injections are made until the desired appearance is obtained. With Cymetra injections, over-correction of at least 50% is desirable owing to the large amount of lidocaine in the syringe after reconstituting the material. Massaging the treated area is commonly performed by the surgeon—never by the patient—to confirm uniform distribution of the filler and the lack of skip areas, which can produce an uneven appearance.

**POSTOPERATIVE TREATMENT**

The injection areas are expected to become edematous within minutes to hours after the procedure and usually resolve within 1–3 days. Generally, lips tend to swell more and longer than nasolabial folds.
or marionette lines. The patient is instructed to keep the head of the bed elevated at bedtime, ice the treated area as much as possible, and avoid massaging the area to minimize the edema. In addition, ibuprofen 200–400 mg four times a day may be prescribed for 4 days as an antiinflammatory and analgesic. If needed, reinjections to augment an area further can be performed after 3–4 weeks.