

FAT GRAFTING FOR FACIAL CONTOURING

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Autologous fat grafting, which has been used in plastic and reconstructive surgery for more than two decades, is a technique that can replace the loss of soft tissue and correct cosmetic deformities such as acne pits, temporal concaves, wrinkles of nasolabial folds, hollow cheeks, and even hemifacial atrophy. Autologous fat grafting involves a series of procedures, and techniques vary among surgeons. There is no universal agreement regarding how fat should be harvested, processed, or injected,¹⁻³ and many factors are involved in each surgeon's decision: Should manual aspiration or machine suction be used for harvesting fat? Centrifugation or only sedimentation? Washing or not washing for processing? How much overcorrection is needed? Although the technique of fat grafting has been reported to be successful, the relatively high percentage—and variable amount—of resorption after fat grafting often results in even less-desirable cosmetic outcomes and the need for additional fat grafting procedures. In this chapter, we introduce our integrated fat grafting technique and report our experience with autologous fat grafting to improve facial contour.

SPECIAL CONSIDERATIONS

Because the face has an abundant blood supply, fat grafts usually perform well in the face, and only a small amount of fat is usually needed for transplantation.³ As noted in Fig. 10-1, the most common recipient sites in the face can be divided into either *movement sites* (such as the temporal area, cheek area, mandibular

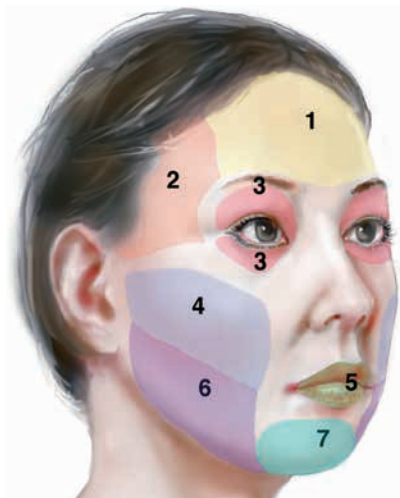


Fig. 10-1 The most common recipient sites in the face: 1, Frontal area. 2, Temporal area. 3, Periocular area. 4, Cheek area. 5, Lips. 6, Mandibular area. 7, Chin area.

area, upper part of the periocular area, and lips) or *relative rest sites* (such as the frontal area, lower part of the periocular area, and chin). Adipose tissue in a relative rest site can usually survive more than that in a movement site; therefore, after each fat injection procedure, the recipient sites should be fully immobilized for approximately 1 week to improve fat graft take and survival.

Fat grafts should be injected into two or three layers of the face. The superficial musculoaponeurotic system (SMAS) layer can be injected with a relatively higher volume of fat if there is reliable support to the superficial layer of the face. The *subcutaneous layer*, which is the layer that changes the most visibly as soon as the fat is injected, is often treated last to correct the contour deformity of the face. In the frontal area, fat can be injected into the subcutaneous layer, submuscular layer, or periosteal layer.

INDICATIONS

The indications for the use of autologous fat grafting to improve or correct facial contouring problems depend on the patient and include temporal, cheek, and periocular hollowing; a lean or aging face; facial asymmetry; hemifacial atrophy; or congenital craniofacial deformity.

Most of our patients with cosmetic complaints present with a hollowing facial deformity after a traumatic or iatrogenic injury, although some have the typical complaints of facial aging. Asian women, especially those from the southern part of China, often go to plastic surgeons with a strong desire for temple augmentation, because they believe that a “plump” temple symbolizes good luck, whereas a narrow temple may bring bad luck to their husbands. Thus fat grafting for temporal augmentation is a very common procedure in our practice.

If cancer patients remain disease free and have no local recurrence for 5 years, they may also be able to have autologous fat transplantation to the tumor-resected area, or a transferred flap for contour improvement.⁴

In patients with hemifacial atrophy, their soft tissue atrophy usually progressed during adolescence, then stabilized in the atrophic area. Before surgery, it is important to ensure that hemifacial atrophy has stabilized; we recommend at least 2 years of stability. In patients with severe congenital craniofacial defects, such as hemifacial microsomia, who have correctable skeletal abnormalities, their skeletal contour needs to be corrected before improvement of the soft tissue contour is even considered. However, if the soft tissue becomes almost completely atrophic, earlier intervention with fat grafting can improve or prevent further atrophy of the overlying skin and may prevent or lessen subsequent skeletal wasting. We have observed that in patients with facial soft tissue atrophy and overlying skin pigmentation, not only can fat grafting improve facial soft tissue symmetry but it can also improve the pigmentation of the overlying skin.

PREOPERATIVE ASSESSMENT

Patients should be informed about autologous fat transplantation—including its benefits, limitations, and potential complications—as an option for soft tissue augmentation. Before surgery, surgeons should thoroughly discuss autologous fat transplantation with patients to try to ensure maximal results and reliable postoperative compliance. The patient should understand that he or she may require two or three fat injections at intervals of 3 to 6 months. During the initial preoperative visit, various surgical details should be determined, including the extent and thickness of facial recontouring required, the location of available donor sites, and the quantity of fat needed. Standard preoperative photos are taken for each patient during this visit. A three-dimensional imaging scan may nicely illustrate the contour deformity of the face, facilitate postoperative follow-up, and provide a comparison of the outcome both before and after surgery.

SURGICAL TECHNIQUE

No matter what technique a surgeon may use, the most important factor to achieve better outcomes with autologous fat grafting is the viability of the adipocytes within the fat graft. To maintain more viable adipocytes of fat during surgery (and thus a higher survival rate of grafted fat), we created the “3L and 3M” technique.⁵

Our 3L and 3M technique consists of low negative pressure for harvesting fat, low speed centrifugation for processing, and low volume (0.1 cc) for each injection. Fat grafts are injected into multiple layers, tunnels, and areas, thus maintaining the greatest viability of adipose tissue. We prefer to use donor sites in the lower part of the body, such as the lower abdomen or thigh. If necessary, repeated fat grafting can be performed after at least 3 months. In some patients with significant contour deformity, two or three consecutive procedures may be required (Fig. 10-2).

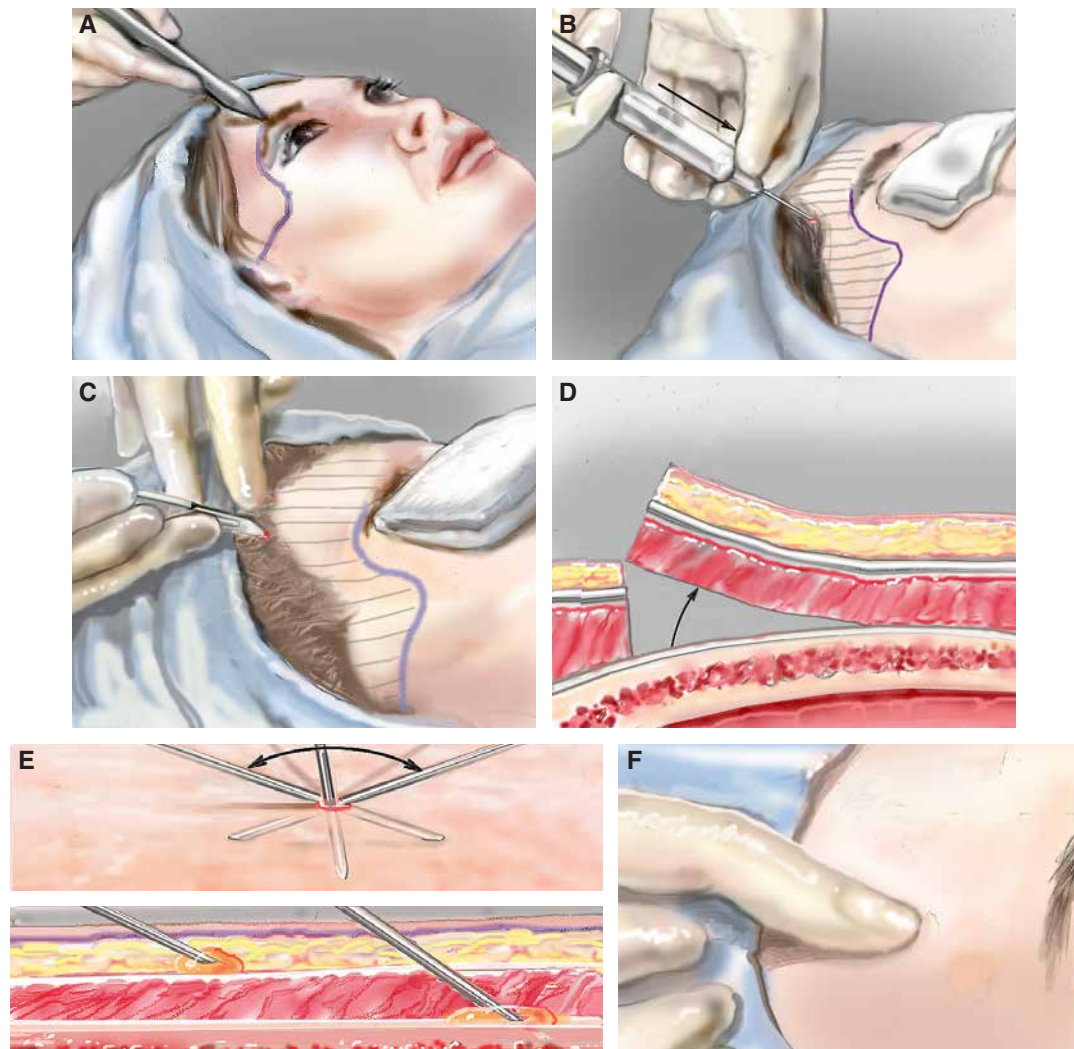


Fig. 10-2 A, Marking the injection region. B, Injecting a local anesthetic. C, Incision. D, Subcutaneous layer and sub-muscular layer. E, The different layers in which the injection can be performed. F, Postoperative massage.

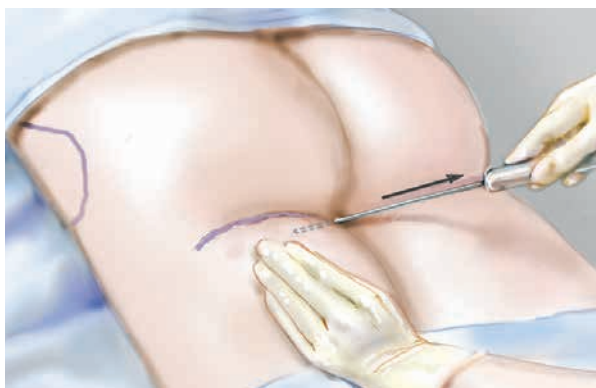


Fig. 10-3 To provide suction with the hand to keep low negative pressure, one must reserve several milliliters in the syringe before pulling back the plunger.



Fig. 10-4 Purifying the fat with a low-speed centrifugation machine. The speed should not exceed 1000 rpm.

A tumescent solution containing 0.08% lidocaine and 1:500,000 of epinephrine is infiltrated into the donor site. A 2.5 mm suction cannula with two holes in the tip is connected with a 50 ml syringe for fat graft harvesting. An appropriate amount of fat is gently aspirated with finger pressure on the plunger of the syringe, without using a suction machine, to minimize trauma to the adipose tissue (Fig. 10-3). The harvested tissue is then washed with normal saline solution inside the syringe in sterile conditions to remove lidocaine, oil, and residual red blood cells, and then is spun at low speed (1000 rpm, g force <100 g) for 2 minutes (Fig. 10-4). After centrifugation, the middle layer of the aspirate—which primarily consists of usable fat parcels—is used for fat injection. The lowest liquid is thrown away, then the middle layer is transferred into the 1 ml or 2 ml syringe through a triple valve, and the rest of the liquid—the upper layer of oil in the 10 ml syringe, which was removed from the centrifugal machine—was also thrown away. The entire procedure is performed within 30 minutes, and the temperature of the lipoaspirates is controlled at 25° C.

Fat is injected into multiple tissue areas—within subcutaneous tissue, under the SMAS, and in multiple tissue planes and tunnels—with a syringe connected to a blunt needle that has an external diameter of 2 or 3 mm. Care is taken to inject fat parcels only in small quantities, in one place each time, and radially from distal to proximal. In the buccal area, the needle should be parallel to the facial nerve to avoid direct injury to the nerve. The syringe should be drawn back before each injection to check blood return, with the aim of avoiding hematoma or injection of fat grafts into blood vessels, causing possible fat emboli. In the periorbital area, the surgeon should take extra care to prevent intraarterial injection by using a smaller injection needle. In our practice, we routinely inject 20% to 30% more than the required volume of fat graft in each patient as an overcorrection to compensate for potential absorption after facial recontouring. To ensure a smooth correction, the surgeon can gently massage the patient's periorbital area with his or her finger or palm. In general, the entire procedure takes approximately 60 minutes and is usually performed with one or two assistants.

The grafted site of the face should be immobilized with a compression dressing for 1 week. Patients should be instructed to reduce or avoid moving their facial muscles if possible, because these movements could traumatize the newly formed blood vessels around the injected fat grafts. All patients are seen postoperatively at 1 week, 1 month, and 3 months, and standard photos are taken during each visit. These photos are used to compare the facial contour in the injection sites preoperatively and postoperatively. If the volume of the injected area is stable but the outline of the facial contour is not satisfactorily improved 3 months after the first injection, a second injection is indicated, usually after 3 to 6 months, to add more volume of fat to the area.

We use an integrated fat grafting technique known as the “3Ls and 3Ms” technique rather than Coleman's technique. In our technique, fat grafts are harvested under low pressure with syringes, processed with low-speed centrifugation, and then injected into the affected areas of the face with low volume for each pass through multiple tunnels, multiple planes, and multiple points. If necessary, the second injection will be performed 3 to 6 months later.

POSTOPERATIVE CARE

Slight bruising and swelling will be seen during the first week after surgery. Typically, no obvious scar will be visible during follow-up. Some patients may complain about their appearance in the first month. If a fatty clump still exists after the first month, we recommend that the patient massage the site. Sometimes patients complain of swelling in the upper eyelid, which may be caused by the tight compression bandage, which may be loosened to lessen the swelling. Patients may also massage the area if they develop small cysts or minor sclerosis.

RESULTS

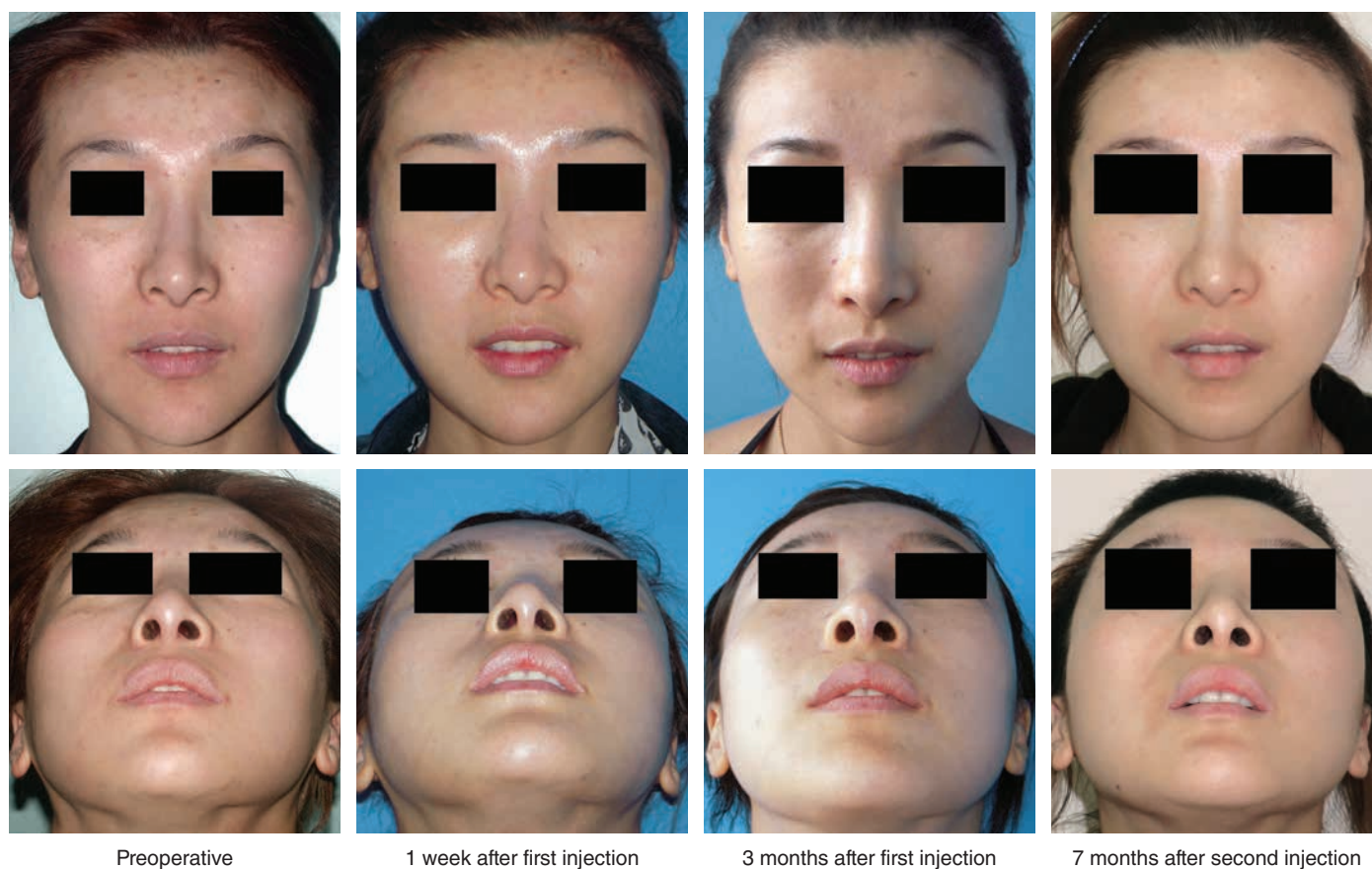


Fig. 10-5

This 30-year-old woman complained about her thin face and temporal concavity, and underwent two autologous fat transplantations, with the second injection occurring 6 months after the first one. She achieved the fullness she desired in her buccal and temporal areas.

**Fig. 10-6**

This woman had been treated for a hemangioma with resection and isotope therapy on the left side of her face when she was 20 years old. At age 33 she expressed a desire to address the scar and to improve the concave area beneath the scar. The patient had one autologous fat transplantation session. The buccal area was almost symmetrical as a result, and the scar was to be treated 6 months after the injection. However, augmented fat in the injection site resorbed somewhat during the next 3 months, then stabilized. No further absorption was evident after 3 months, and the injection site on her face remained stable throughout her long-term follow-up.



Fig. 10-7

This 24-year-old woman had severe hemifacial atrophy on the right side. Her disease had progressed gradually since her childhood but stabilized at age 17. Her disease had been stable for approximately 7 years when she presented to our clinic. She received a total of three subsequent autologous fat transplantations to the right side of her face. Her facial contour on the affected side improved significantly with each injection. She had good facial symmetry, with decreased skin pigmentation on the affected side.

*Fig. 10-8*

This 37-year-old woman with sunken eyes underwent autologous fat transplantation to her upper periorbital area. The fat was aspirated from her abdomen with a 1 mm cannula. Local anesthetic with epinephrine was infiltrated into her periorbital soft tissue to create vasoconstriction. A total of 2.5 cc of purified fat was injected into the orbital septum of each side of her face with our preferred fat grafting technique; a much smaller cannula was used for fat injection, with 0.1 cc injected in each pass. Only one session of fat injection was needed for this patient. At 1-year follow-up, she looked much younger and was quite pleased with the outcome.

DISCUSSION

Grafted autologous fat demonstrably survives after transplantation, although fat grafting is reported in the literature to have unpredictable results. The long-term results are more encouraging, because many of our patients were followed longer than 2 years with well-maintained correction of their soft tissue deficiencies. During follow-up, the perioral area in our patients was found to have more absorption than other facial areas such as the forehead and chin; thus it is evident that the perioral area requires more procedures to improve facial contour. The muscular movements of facial expression and chewing may contribute to less fat graft survival; as a result, patients should be instructed to avoid unnecessary facial movement after fat grafting. Overcorrection should not involve more than 20% to 30% of the volume actually needed; otherwise, lumpiness may occur. On the other hand, the perioral area generally has less fat than other areas, so this friendly environment may make fat graft survival feasible.⁶ Autologous fat grafting can be a permanent option for many patients who are looking for cosmetic soft tissue contouring of the face, even if they need additional procedures.

Our integrated fat grafting technique has several aspects that are different from Coleman's technique. Our methods are based not only on findings from our previous experiments but also on studies conducted by others. Harvesting fat grafts with a syringe can be performed at low negative pressure by using several milliliters of air or saline solution before aspiration; thus low negative pressure can be generated with hand manipulation to aspirate fat grafts while simultaneously avoiding mechanical trauma to adipocytes. Centrifugation is often necessary to purify fat for transplantation.^{7,8} In Coleman's technique, centrifugation at 3000 rpm for 3 minutes is a standard way to process the harvested fat graft⁹; however, our previous studies demonstrated that adipocytes within fat grafts have less viability when the speed of centrifugation

is more than 1000 rpm.¹⁰ Our preferred centrifugation setting of 1000 rpm for 2 minutes can provide not only a high purity of fat but also more viable adipocytes within the fat grafts

Although very rare, fat embolism may develop after fat grafting to the face and may lead to ablepsia, hemiplegia, shock, or even death. Fortunately, the incidence of these complications is extremely low; only two or three cases have been reported every year since the fat grafting technique started to be used widely for facial contouring.¹¹⁻⁸ Because there are communicating branches between the internal and external carotid artery systems in the craniofacial area, the increased pressure of fat injection or an arteriovenous shunt will open these communication branches. The fat emboli will enter the internal carotid artery system vessels and cause a fat embolism. The communicating branches, such as the occipital artery–vertebral artery, ascending pharyngeal artery–vertebral artery, or internal maxillary artery–ophthalmic artery, are closed in the normal condition,¹⁹ but when the pressure of the external carotid artery system increases, these communicating branches can be opened. All reported fat embolism cases took place shortly after the operation and were without pulmonary embolism; therefore we believe that fat emboli may travel to the embolic site through the communicating branches. To avoid these severe complications, we recommend use of a blunt tip and cannulas of appropriate width for fat injection. The injection itself should be gentle and not forceful, and should be performed only while the syringe is being withdrawn. In addition, the surgeon should look for the tunnel carefully before each injection.

PEARLS FOR SUCCESS

- Throughout the entire procedure, it is important to maintain the viability of the adipocytes within the fat grafts
- There should be low negative pressure for fat graft harvest, low speed centrifugation for fat graft processing, and low volume for placement of fat grafts
- Fat grafts are injected into multiple tunnels, planes, and areas of the tissue.
- Proper immobilization of the recipient area is necessary postoperatively, and suitable massage to the grafted area should be performed if indicated.
- If necessary, additional fat grafting can be performed after at least 3 months to achieve the desired results. Two or three additional procedures may be required.

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