



Fat Grafting for Facial Rejuvenation

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Key Points

1. Preoperative detailed communication with the patient, management of expectation, careful evaluation of facial and donor sites' conditions, and marking of the operation areas is critical to postoperative satisfaction.
2. The infiltration of tumescent solution to recipient areas could decrease the incidence of intraoperative hemorrhage, fat embolism and postoperative hematoma. Special attention should be paid for fat grafting onto temple and medial eyebrow arch, where blood vessels are vulnerable to be injured.
3. Asians are characterized by depressed mid face and wide facial contour, with fat grafting in shape of "T". The Asians prefer smooth lines and heart shape of the face to zygomatic arch and mandibular angle protrusion.
4. Fat is mainly placed in the upper layer of periosteum and submuscular layer for structural support, and a moderate amount of subcutaneous fat grafting is performed to form a transition area with the surrounding tissue. The skin texture and color can be improved by microfat grafting for the subcutaneous and intradermal layers.

Synopsis

Fat grafting is one of the most prevalent fields in facial rejuvenation at present. The procedures include the evaluation of recipient and donor areas, fat harvesting, processing and reinjection. Inappropriate treatment of each link may affect the final effect on the whole. The authors believe that understanding of facial anatomy and personalized therapy are the key to successful operation.

Keywords

Fat grafting; Facial rejuvenation; Liposuction; Facial aging

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Introduction

Fat grafting has been widely used in facial rejuvenation in recent years [1,3]. It can be applied to facial cosmetic alone or in combination with other facial lifting surgery [2,4]. With age the skin relaxes with decrease in elasticity, and sags caused by the relaxation of supporting ligaments, accompanied by the volume loss and redistribution of the deep and superficial fat compartment, as well as the absorption of the underlying bone, all of which contribute to the senility of the facial morphology, such as facial hollowness and wrinkles [5-9]. In the past, the applications of facial skin and SMAS fascia lifting surgeries were expected to achieve facial rejuvenation, but often did not acquire satisfactory results [10-14]. With the understanding of changes in facial fat pad of facial aging, and the studies of tissue regeneration of the adipose cell and adipose-derived stem cell, plastic surgeons gradually realized the importance of treating facial aging by restoring the volume of soft tissue and improving the texture of skin through fat grafting. However, due to the unpredictable absorption of the fat, plastic surgeons expect to obtain better results through over-grafting, which often result in complications such as fat necrosis, oil cysts, calcification or overcorrection [15]. For the past 10 years, the authors have treated a large number of patients with facial rejuvenation by autologous fat grafting, acquiring satisfactory and long-lasting results without any severe complications. In this article the authors introduce their preferred techniques of fat grafting for facial rejuvenation in procedure.

Pre-operative evaluation and special considerations

It is crucial to communicate with the patient in detail to identify the patient's on concerns and expectations. The patient should be made understand the principles of fat grafting, therapeutic effects and complications, which would avoid some dispute.



Figure 1: T-shaped area of facial fat grafting: typical areas marked include forehead, temple, nose, tear trough, anterior cheek, nasolabial fold and chin.



Figure 2: A 2.0 mm diameter nine hole anesthetic infiltration cannula (A). Two differences liposuction cannulas both are 25 cm in length and 2.5 mm in diameter with six side holes (B). A locking plunger is placed within a 20 ml Luer-Lok syringe to harvest fat grafts (C).

The facial features and aesthetic standards of Asians are completely different from these of Caucasians. Asian is low forehead, flattening mid face, collapse of nose and retraction of chin, etc. For aesthetic appreciation, full forehead, raised nose and chin are considered to be a symbol of charm and glamour, the smoothness and softness of the curves on lateral face are more emphasized. The zygomatic arch and mandibular angle should not be protruding. Consequently, the sites for facial fat grafting are formed a region of “T”, targeting to create an inverted triangle on the face (Figure 1).

In the youth (<35 years), fat grafting aims at correction of the middle face congenital depression, while improving the outline of lateral face to form soft curves. For those >35 years, the skin texture can be improved through the regeneration of micro particle fat grafted into the superficial layer of the face. Therefore, individualized design of the distribution and amount of graft is performed according to gender, age, facial contour, skin texture and degree of relaxation.

Surgical procedure

Donor site selection and assessment: All the fat deposits can be used as donor areas. The purpose of some patients is not only to get facial rejuvenation, but also to improve body shape. Therefore, the patient's expectations can be taken for reference in selection of the donor areas. If only rejuvenation, the authors usually prefer to select abdomen or thigh as donor site for the following reasons: Firstly, liposuction and facial lipofilling can be performed in supine position without changing posture. Secondly, fat grafts can be obtained relatively easily in these areas. In addition, it was reported that there are higher concentrations of Adipose-Derived Stem Cells (ADSCs) in the lower abdomen and medial thigh [16]. It is a useful technique to assess the thickness of fat by skin grasping.

Fat harvesting: The operation is generally carried out under intravenous administration or local anesthesia if less fat is needed. The incisions of liposuction should be concealed. The incision is made 2 mm long with a No. 11 blade after anesthetized with 2.0

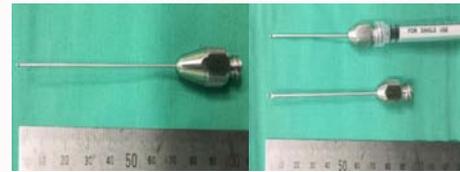


Figure 3: A 7 cm in length, 1.0 mm in diameter and three side holes anesthetic infiltration cannula (A). Ranged from 5 cm to 7 cm in length and 1.2 mm in diameter blunt-tipped cannulas are used for fat grafting (B).

ml of 1% lidocaine and 1:100,000 epinephrine. A 2.0 mm diameter nine-hole cannula (Tonglu Dino Medical Technology Co. Ltd, Hangzhou, China) is used for infiltration anesthesia (Figure 2A), and tumescent solution (490 ml normal saline, 10 ml 2% lidocaine, 1 ml 1:1000 epinephrine) is infiltrated into the deep and superficial layers of subcutaneous fatty tissue as the cannula moves forward and backward. By this way, the tumescent solution can be penetrated uniformly and the fibrous connective tissue can be loosened, which is helpful to subsequent liposuction. We adopt the tumescent technique for liposuction and the ratio of tumescent solution to fat harvested is 3:1, waiting for 15 min at least before liposuction for adequate anesthesia and hemostasis.

Lipoaspirate is harvested through the same incisions previously made for infiltration of tumescent solution. There are two kinds of liposuction cannulas with the same diameter of 2.5 mm and 9 mm side holes, the whole sizes are 3.0 mm × 1.0 mm and 1.0 mm × 0.8 mm respectively, which can be used to obtain fat parcels of different sizes (Figure 2B). The macro fat is used to fill into the deep layer as structural support and volume augmentation, and the microfat is accurately used in the superficial layer to combat the effects of skin aging.

The liposuction cannula connected to a 20 ml Luer-Lok syringe is inserted into the incision and fat grafts will be harvested in an anterior and posterior movement (Figure 2C). To ensure minimal mechanical trauma to the fat parcels, the plunger is pulled back gently at 2 ml to 4 ml to minimize negative pressure and maintained by locking. In general, fat harvested is at least twice as much as anticipated to ensure that an adequate quantity for grafting.

Fat processing: The authors are more inclined to adopt the mesh/gauze for fat processing due to its ability to remove more oily components and tumescent solution. It was reported that the fat obtained by the mesh/gauze technique contains more functional adipocytes and have larger volume retention than that of Coleman centrifugation technique [17]. The obtained lip aspirate is transferred into 60 ml syringes through a connector. After simple precipitation the aqueous portion is discharged and the equal volume of normal saline is inhaled into the 60 ml syringe containing 25 ml precipitated fat twice for rinsing to remove blood, cellular debris and tumescent solution. After that, the fat is dumped on the metal filter with thick cotton pad below for 15 min to absorb aqueous and oil components by capillary action. Meanwhile the coarse fibrous tissues are manually removed to avoid cannula blockage. The purified fat will be collected by 20 ml Luer-Lok syringes and carefully transferred into 1 mm Luer-Lok syringes through a connector, and then be grafted immediately to minimize air exposure.

Preparation of recipient site: Nerves anesthetic block (usually including the supraorbital nerves, infra orbital nerves and mental

nerve) with 1% lidocaine and 1:200,000 epinephrine is particularly effective in reducing discomfort and pain while the patient is awake. The recipient areas are infiltrated with tumescent solution (0.04% lidocaine with 1:1000,000 epinephrine) using an 18-gauge pointed needle and a three-hole cannula with the length of 7 cm and diameter of 1.0 mm (Figure 3A). We need about 50 ml of tumescent solution for infiltrating entire face. The infiltration of tumescent solution can promote vasoconstriction to reduce the risk of vascular embolism, and the reduction of bleeding is beneficial to the survival of fat by reducing inflammatory response. During the procedure, it should be emphasized that the areas just infiltrated should be pressed by the palm to reduce the mistake of judgment for fat grafting resulted from tissue swelling.

Fat injection: The cannulas we used for fat grafting is blunt-tipped, 5 cm to 9 cm in length and 1.0 mm or 1.2 mm in diameter (Figure 3B). The key to fat grafting is a micro-droplet technique with multiple layers from periosteum to subcutaneous layer. The fat is injected while the cannula is withdrawn, avoiding being injected into the blood vessels. The end plunger of syringe should be held in the palm of hand so as to control injection pressure and avoid over-injection.

Upper facial fat grafting: Entry points of fat injection for forehead are located at the edge of hairline and additional entry points can be made at the eyebrow tail (Figure 4). It is essential to mark the projection of supraorbital vessels and supratrochlear vessels on the surface of supraorbital margin. The supraorbital vessels and nerves leave the supraorbital notch and run upward about 0.5 cm to 1.0 cm on the periosteum before entering into the frontal muscle [18]. The supratrochlear vessels and nerves that have a 1 cm- distant to the medial orbit of the supraorbital notch pass through the orbital margin and then immediately enter into the superficial layer of frontal muscle. Therefore, within the range of superior orbital margin 2 cm at the medial of pupil vertical line, the fat should be meticulously placed in the subcutaneous layer rather than periosteum layer. On the contrary, in other parts of forehead the fat, as structural support, is mainly placed on the periosteum to augment the lost volume resulting from the deep fat atrophy. Small doses of fat should be dispersed subcutaneously, forming a smoother and more natural transition to the surrounding regions. Excessive placement of fat in subcutaneous layer can affect the expression of mimetic muscle. The forehead will appear a clear accumulation of fat, presenting "balloon-like" appearance. According to the inherent contour and depression of patient's forehead, the total amount of fat grafts ranges from 5 ml to 20 ml.

For the injection in temple, eyebrow arch and upper eyelid, an entry site can be made at the eyebrow tail, and another entry point access to the temple is located at the junction of temporal line and hairline. There is an areola space between the superficial temporal fascia and the deep temporal fascia where more fat should be placed to enlarge the volume of temporal fossa. While the superficial temporal artery, zygomatic orbital artery and temporal branch of the facial nerve are distributed in the superficial temporal fascia, Infusing fat into the areola space by a blunt-tipped cannula does not normally damage these blood vessels and nerves. However, the anterior part of lower temporal compartment, that is, the region about one fingerbreadth above the zygomatic arch at the lateral orbital margin, has the sentinel vein and branches of the middle temporal vessels passing through, so particular attention should be paid to the manipulation in this

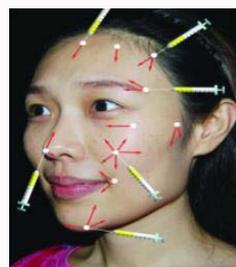


Figure 4: Entry points for fat grafting on upper, middle, and lower face.

area 2. A proper amount of fat grafting should also be performed subcutaneously in the temporal region, avoiding overcorrection of the lateral orbital margin to increase the width of the face. The fat volume in temporal region is about 3 ml to 15 ml on each side.

Blunt-tipped cannula of 1.0 mm diameter can be used to fill the sunken upper eyelid. The operator or assistant should pull the eyebrows to the side of head to maintain the tension of upper eyelid skin, so that the cannula can be easily access to below the orbicularis oculi muscle through the entry point of the eyebrow tail for fat injection in this area. 0.5 ml to 2 ml fat is needed for each side. Subcutaneous layer should be avoided since it can result in complications such as bloated upper eyelids, laborious eye opening, palpable oil cysts and nodules.

Middle facial fat Grafting: The site of anterior cheek serves as a enter point for middle facial fat transplants, where the fat can be easily placed in the inferior lower eyelid, medial and lateral cheeks, nasolabial fold. An additional entry point may also be made at suborbital lateral margin as supplement, allowing access to the suborbital region and anterior cheek regions (Figure 4).

In correction of the palpebral cheek sulcus and palpebral zygomatic sulcus deformity, firstly the larger fat parcels should be deposited in the periosteum and SOOF layers along the inferior orbital rim as structural support, and then the microfat parcels should be meticulously placed in the subcutaneous to avoid irregular nodules. When the cannula is closing to the lower orbital rim, the index finger of the non-dominant hand should touch the inferior orbital rim, which can guide the cannula to inject the fat into the proper position and prevent the cannula from penetrating the eyelid conjunctiva to injure the eyeball. A total of no more than 3 ml of fat is placed per side. Overcorrection in these areas is not recommended.

Fat grafting in anterior cheek is critical to facial rejuvenation by providing highlight projection, Injecting can be undertaken in all layers including deep, middle and superficial through the entry points of the anterior cheek and suborbital lateral margin.

In order to smoothes out the nasolabial fold, fat should be placed in multiple layers at a fan-shaped manner, especially in the Ristrow space of nasal alar basal region [19]. The critical technique is infiltration of areas around the folds rather than linear placement that will aggravate the original creases, avoiding placing fat grafts in the superficial nasolabial fat pad because the fat pad in this area is mainly displaced downward rather than reduced with age. 2 mL to 4 mL of fat is required on each side.

For correction of the lateral cheek depression, the enter point is located at the leading edge of the sideburns. Fat should be placed



Figure 5: A 35-year-old woman presented for facial rejuvenation with fat grafting. Preoperatively, this patient demonstrated the temporal hollowness and sunken buccal region (A,C,E). Fat grafting was performed with a total of 39 ml in the forehead, temples, medial and lateral cheeks, inferior lower eyelids, nasolabial folds. One year after surgery showed removal of shadows on both sides of the face and a youthful appearance (B,D,F).

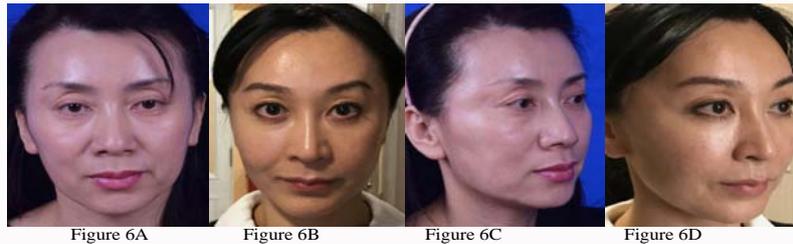


Figure 6: A 47-year-old woman presented for fat grafting to restore his forehead, temples, anterior and lateral cheeks, upper and lower eyelids, anterior and lateral cheeks, nasolabial folds and chin (Pre-operation in A,C; Post-operation with one years in B,D).



Figure 7: A 55-year-old woman presented preoperative and postoperative images who underwent fat grafting for facial rejuvenation (Pre-operation in A,C; Post-operation with one and a half years in B,D).

on the surface of the masseter fascia and parotid gland, as well as subcutaneously, with special care to avoid injuring the deep important tissues. The volume placed varies from 5 mL to 15 mL in each cheek area.

Lower facial fat grafting: For fat grafting in lower facial, we select both sides of the mental edge as entry points, allowing the cannula readily approaching to the chin, bottom of lips and lateral of mandible. Additional entry points can be made as needed such as the lateral of oral commissure, which can be used for fat grafting to the upper and lower lips (Figure 4).

Fat can be placed in multiple levels of the chin. A poneuros tissue tightly attached to the periosteum can be stripped off with a blunt cannula, thus expanding the space to facilitate fat survival. For patients with insufficient mental protrusion, the improvement of lower facial aesthetics is mainly to increase the chin horizontally rather than vertically. Other areas fat grafting is needed are on both sides of the chin, where significant hollows occur with age.

For correction of the droop of mouth angle, volume restoration of atrophic fat by placing fat into the deep layers under orbicular is muscle can obtain satisfactory effect. The effacement of marionettes lines involves fat infiltration around the wrinkles at a cross manner,

similar to that of nasolabial fold. The aggravation of marionettes lines is not only caused by the atrophy of labiomandibular fat pad, but also by the ptosis and hypertrophy of jowl fat [13]. Therefore, the effect of fat grafting alone is not satisfactory, the authors' experience was to combine fat grafting with facial liposuction and facial lifting surgery to get better aesthetic results. The amount of fat grafted for lower face requires approximately 3 ml to 10 ml per side, depending on the individual needs.

Case demonstrations

Photographs of 4 representative patients are illustrated in (Figure 5 to 8).

Postoperative care

Remove sutures after 5 days and forbid facial massage within 1 month. For liposuction of large area, we recommend that the patient should wear elastic garment for more than 6 weeks to pressurize the donor areas.

Expected outcome and management of complications

Facial fat grafting is relatively safe with higher satisfactory rate, with relatively low complication rate for experienced surgeons. Complications include fat accumulation, asymmetry, hematoma, infection, cyst formation, fibrosis, calcification and irregularity



Figure 8A Figure 8B Figure 8C Figure 8D Figure 8E Figure 8F

Figure 8: A 41-year-old woman presented for fat grafting to restore his forehead, temples, nose, anterior cheeks, upper and lower eyelids (Pre-operation in A,C,E; Post-operation with one years in B,D,F).

in donor sites. Vascular embolism, though rare, would result in catastrophic consequences. The authors have been performing fat grafting for facial rejuvenation for many years and obtained favorable long-term results without severe complications.

Revision or subsequent procedures

Approximately 40% of the patients with inadequate facial correction achieved satisfactory outcomes after secondary touch-up procedure. Operation interval should be at least six months.

Discussion

Fat grafting has been widely used in facial rejuvenation. However, clinical results vary greatly resulting from the multiple procedures involved and serious complications have been reported from time to time. Fat harvesting was done by syringe with low pressure to minimize the mechanical damage to adipocytes. Then, the fat was rinsed by normal saline and processed by mesh/gauze technique for removal of the debris, oil and inflammatory components.

A small amount of tumescent solution was injected in the recipient sites for vasoconstriction and make space for fat injection. Fat is mainly placed in the upper layer of periosteum and submuscular layer for structural support and hollows correction. Meanwhile, facial wrinkles can be alleviated and a natural transition into the adjacent areas can be achieved by appropriate grafting in the superficial subcutaneous layer. Although inadequate correction is commonly seen, over-correction is not recommended in one operation since it increases the incidence of complications. The graft gradually survived and the inflammation subsided 6 months postoperatively. A second procedure can be performed for patients who did not achieve desired results. At present, although we have made great progress on operative skills, unpredictability of fat survival is still a problem. The authors expect further development in basic experiment and clinical practice to achieve higher survival rate of fat grafting. More accurate treatment can be performed with the aid of various methods, such as the three-dimensional volume measurement.

Conclusion

Fat grafting is a safe and effective measure for facial rejuvenation. It is of importance to understand comprehensively the mechanism and the role of volume loss in facial aging. Satisfactory results can be achieved if plastic surgeons are skilled in applying the strategies described in the article.

References

- Coleman SR. Structural fat grafting: more than permanent filler. *Plast Reconstr Surg.* 2006;118(3):108S-20S.
- Huang RL, Xie Y, Wang W, Herrler T, Zhou J, Zhao P, et al. Anatomical Study of Temporal Fat Compartments and its Clinical Application for Temporal Fat Grafting. *Aesthet Surg J.* 2017;37(8): 855-62.
- Marten TJ, Elyassnia D. Fat grafting in facial rejuvenation. *Clin Plast Surg.* 2015;42(2):219-52.
- Rohrich RJ, Afrooz PN. Finesse in Face Lifting: The Role of Facial Fat Compartment Augmentation in Facial Rejuvenation. *Plast Reconstr Surg.* 2019;143(1):98-101.
- Furas DW. The retaining ligaments of the cheek. *Plast Reconstr Surg.* 1989;83(1):11-6.
- Pessa JE, Chen Y. Curve analysis of the aging orbital aperture. *Plast Reconstr Surg.* 2002;109(2):751-5.
- Shaw RB Jr, Kahn DM. Aging of the midface bony elements: a three-dimensional computed tomographic study. *Plast Reconstr Surg.* 2007;119(2):675-81, discussion 682-3.
- Mendelson B, Wong CH. Changes in the facial skeleton with aging: implications and clinical applications in facial rejuvenation. *Aesthetic Plast Surg.* 2012;36(4):753-60.
- Mendelson BC, Hartley W, Scott M. Age-related changes of the orbit and midcheek and the implications for facial rejuvenation. *Aesthetic Plast Surg.* 2017;31(5):419-23.
- Rohrich RJ, Pessa JE. The fat compartments of the face: Anatomy and clinical implications for cosmetic surgery. *Plast Reconstr Surg.* 2007;119(7):2219-27; discussion 2228-31.
- Donofrio LM. Fat distribution: A morphologic study of the aging face. *Dermatol Surg.* 2000;26(12):1107-12.
- Gierloff M, Stohring C, Buder T, Gassling V, Açil Y, Wiltfang J. Aging changes of the midfacial fat compartments: A computed tomographic study. *Plast Reconstr Surg.* 2012;129(1):263-73.
- Gierloff M, Stohring C, Buder T, Wiltfang J. The subcutaneous fat compartments in relation to aesthetically important facial folds and rhytides. *J Plast Reconstr Aesthet Surg.* 2012;65(10):1292-97.
- Wan D, Amirlak B, Giessler P, Rasko Y, Rohrich RJ, Yuan C, et al. The differing adipocyte morphologies of deep versus superficial midfacial fat compartments: A cadaveric study. *Plast Reconstr Surg.* 2014;133(5):615e-622e.
- Yoshimura K, Coleman SR. Complications of fat grafting: how they occur and how to find, avoid, and treat them. *Clin Plast Surg.* 2015;42(3):383-8.
- Geissler PJ, Davis K, Roostaiean J, Unger J, Huang J, Rohrich RJ. Improving fat transfer viability: the role of aging, body mass index, and harvest site. *Plast Reconstr Surg.* 2014;134(2):227-32.
- Canizares O Jr, Thomson JE, Allen RJ Jr, Davidson EH, Tutela JP, Saadeh PB, et al. The effect of processing technique on fat graft survival. *Plast Reconstr Surg.* 2017;140(5):933-43.
- Seckel BR. *Facial danger zones: avoiding nerve injury in facial plastic surgery.* 2nd ed. St. Louis: Quality Medical Publishing Inc. 2010.
- Ristow B. Personal communication. 2001.