

Fat Grafting for Facial Rejuvenation

My Preferred Approach



Lee L.Q. Pu, MD, PhD

KEYWORDS

• Fat transplantation • Fat grafting • Lipotransfer • Coleman technique • Facial rejuvenation

KEY POINTS

- The preferred donor sites for fat grafting should be the lower abdomen or inner thigh.
- Fat grafts should be harvested with low negative pressure to ensure the integrity and viability of adipocytes.
- Fat grafts can be processed with proper centrifugation that can reliably produce purified fat and concentrated growth factors and adipose-derived stem cells.
- Preinjection of local anesthetic with epinephrine to planned fat grafting sites prevents intravascular injections and possible fat embolism.
- Fat grafts should be injected with gentle injection of a tiny amount per pass in multiple tissue planes and levels and with multiple passes to ensure maximal contact of the graft with vascularized tissue in the recipient site.

INTRODUCTION

Fat grafting is considered an excellent option for facial rejuvenation because fat is abundant, readily available, inexpensive, host compatible, and can be harvested easily and repeatedly.¹ Compared with any available synthetic filler, fat can be an ideal filler for facial rejuvenation because the clinical result after fat grafting can be permanent without any concerns or complications related to fillers.² However, the overall survival rate after fat grafting may still be less optimal. To improve fat graft survival has therefore been constantly the driving force for clinicians to search for better techniques of fat grafting.

Since mid-1990s, Dr Sydney R. Coleman from New York City has championed and popularized the technique primarily for facial fat grafting. His technique, also referred to as the Coleman

technique, emphasizes proper harvest, process, and placement of fat grafts.³⁻⁵

For the last 10 years, fat grafting has become a popular procedure in plastic surgery, especially for facial rejuvenation either with or without other surgical procedures. In this article, the author introduces his preferred and more scientifically sound technique for fat grafting to the face. He also describes why each step should be performed based on most recent scientific studies by many investigators. Several case examples are presented to highlight those important principles in facial fat grafting.

PREOPERATIVE EVALUATION AND SPECIAL CONSIDERATIONS

Each patient's general health and past medical or surgical history should be reviewed first.

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Division of Plastic Surgery, University of California Davis, 2335 Stockton Boulevard, Suite 6008, Sacramento, CA 95817, USA

E-mail address: llpu@ucdavis.edu

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Concerns about his or her facial aging from each patient should carefully be evaluated. The quality of facial skin and the anatomy of the face, including symmetry, signs of facial aging such as excess skin, ptosis of structures, prominent lines, and soft tissue atrophy in certain anatomic areas, are analyzed and documented. The potential donor sites for fat graft harvest are also examined. The detailed plan for facial fat grafting can be formulated and communicated with the patient.

Anesthesia for harvest of fat grafts can be performed under general anesthesia or local anesthesia with intravenous sedation. The tumescent solution used for donor site analgesia or hemostasis should contain the lowest concentration of lidocaine possible because its high concentration may have detrimental effect on the adipocyte function and viability.⁶ In general, the author uses 0.03% of lidocaine in 1 L of Ringer lactate solution. The tumescent solution also contains epinephrine with a concentration of 1:200,000. Epinephrine can precipitate vasoconstriction in the donor sites as well as the recipient sites, which may decrease blood loss, bruising, hematoma, and the possibility of intra-arterial injection of the transplanted fat especially when injecting around periorbital or temporal area.

Whether overcorrection is necessary or not for fat grafting remains unclear. Because the viable fat grafts are only observed in the peripheral zone approximately 1.5 mm from the edge of the grafts and the percentage of graft viability depends on its thickness and geometric shape,⁷ overcorrection for “better” graft survival in the recipient site seems to be lack of scientific support. In addition, significant overcorrection may increase the incidence of fat necrosis and subsequent calcification or even severe infection.⁸ Therefore, “significant” overcorrection should be avoided until its necessity and safety can be confirmed by future studies.

Because overall take rate of fat grafting by even experienced surgeons ranges from 50% to 80%,^{1,9,10} additional procedures are always necessary to achieve an optimal outcome. However, there is no scientific study that has addressed the timing of subsequent fat grafting. So far, only one “expert” opinion has been mentioned in the literature regarding this specific issue¹¹: “the timing of additional fat grafting sessions should be deferred until 6 months postoperatively to diminish the “inflammatory response” in the grafted area.”

It is often difficult to assess the surgical outcome during the first few weeks after fat

grafting. In general, the extent of swelling and the waiting period that it needs to resolve is also volume dependent. It has been observed that the transplanted fat gradually loses its volume with time and usually becomes stabilized at 3 months postoperatively if surgical recovery is uneventful. Therefore, the timing of a subsequent fat grafting procedure should be deferred to at least 3 months after previous transplantation.

SURGICAL PROCEDURES

Donor Site Selection

As a rule, donor sites are selected that enhance body contour and are easily accessible in the supine position, which is the position that is used for almost all facial fat grafting procedures. Although there is no evidence of a favorable donor site for harvest of fat grafts because the viability of adipocytes within the fat grafts from different donor sites may be considered equal, higher concentration of adipose-derived stem cells (ADSCs) is found in the lower abdomen and inner thigh in one study.¹² In addition, in younger age group (<45 years old), fat grafts harvested from both lower abdomen and inner thigh have higher viability based on a single assay test.¹³ With what is known about the potential role of ADSCs in fat grafting,¹⁴ the lower abdomen and inner thighs should, therefore, be chosen as the “better” donor sites for fat grafting to the face^{12,13} (Fig. 1). These donor sites are not only easily accessible by the surgeons with a patient in the supine position but also scientifically sound as long as patients have adequate amount of adipose tissue in those areas. In the author’s practice, a total of 30 cc is usually needed for most facial rejuvenation cases.



Fig. 1. Lower abdomen is a commonly selected donor site for facial fat grafting.

Fat Grafting Harvesting

The syringe aspiration, as a relatively less traumatic method for harvest of fat grafts, is supported by the more recent studies and should be considered as a standardized technique of choice for harvest of fat grafts.¹⁵ However, this technique can be time consuming even for experienced surgeons and the large quantity of fat grafts may not easily be obtained with this technique.

Placement of incisions can be done with a No. 11 blade in the locations where the future scar can easily be concealed. The size of incision is about 2 to 3 mm. A small clamp is used to dilate the underlying subcutaneous tissue through the incision to allow insertion of the harvesting cannula with ease. The aesthetic solution is then infiltrated to the donor site 10 to 15 minutes before fat extraction, which makes harvesting of fat graft easier and less traumatic. The tip of the infiltration cannula is usually blunt and has one opening on the side. The ratio of aspirated fat to tumescent solution should be about 1:1 so that each pass of fat extraction can be more efficient.

A 10 cc Luer lock syringe is used and connected with a harvesting cannula. For harvesting fat grafts from the lower abdomen or inner thigh, a newly designed harvesting cannula with multiple side holes is used (Fig. 2). This kind of cannula can be more efficient for fat extraction. A gentle pull back on the plunger creates a 2 cc space vacuum negative pressure in the syringe. With gentle back and forth movement of the syringe, the fat is gradually collected inside the syringe (Fig. 3). After harvest, all incision sites are closed with interrupted sutures once excess tumescent fluid or blood is milked out.



Fig. 2. A newly designed cannula with multiple side holes for fat graft harvest. The cannula has a total of 6 side holes and is quite speedy for fat harvest.



Fig. 3. Fat grafts are aspirated with back and forth movement with a 10 cc syringe and a 2 cm space vacuum negative pressure.

Fat Graft Processing

Several methods have been proposed to effectively remove the infiltrated solution and cell debris within the lipoaspirates and to obtain more concentrated fat grafts. However, it is the most controversial and disagreeable issue in fat grafting even among many experts in the field. Common methods for processing fat grafts include centrifugation, filtration, or gravity sedimentation.

Centrifugation, as proposed by Coleman, is the author's preferred method to process fat grafts. There are several advantages of centrifugation of fat grafts. More viable adipocytes are found at the bottom of middle layer after centrifugation even with a force of 50 g for 2 minutes based on viable cell counts, and this makes manipulation of fat graft for use easier but with better viability.^{16,17} Recent studies have shown that proper centrifugation can concentrate not only on adipocytes and ADSCs but also on several angiogenic growth factors within the processed fat grafts.^{18,19} Because higher content of stem cell or angiogenic growth factor positively correlated with fat graft survival both in experimental and clinical studies,²⁰ centrifugation at 3000 rpm (about 1200 g) for 3 minutes seems to offer more benefits for this effectively concentrating adipocytes and ADSCs and should be a valid method of choice for processing fat grafts, especially for small volume fat grafting.¹⁵

The Luer lock aperture of the 10 cc syringe locked with a plug at completion of harvest is ready for centrifugation (Fig. 4). After careful removal of the plunger, all lipoaspirate-filled 10 cc syringes are placed into a centrifuge and are then centrifuged with 3000 rpm (about 1200 g) for 3 minutes. Greater g-force or longer

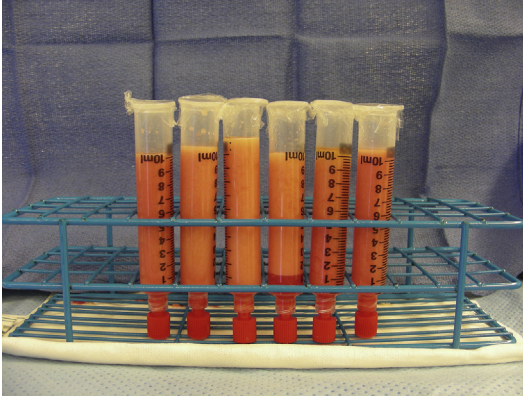


Fig. 4. At completion of fat harvest, each syringe is locked with a plug and covered with a transparent film dressing to prevent prolonged exposure to air and possible contamination. It is ready for centrifugation.

duration of centrifugation may be harmful to adipocytes and is therefore not recommended.²¹

Attention should be made to avoid prolonged exposure of fat grafts to air and to avoid bacterial contamination. After being centrifuged, lipoaspirates with the syringe are divided into 3 layers: the oil content in the upper layer, fatty tissue in the middle layer, and the fluid portion at the bottom (**Fig. 5**). The oil can be decanted from the Luer lock syringe. The residual oil is wicked with a cotton strip or swab. The fluid at the bottom can be easily drained out once the plug at the Luer lock aperture is removed.

The concentrated fat in the syringe can then be transferred to a 1 cc syringe (preferred size of syringe for fat injection to the face) via an adaptor. A 1 cc syringe is made of acrylic material and

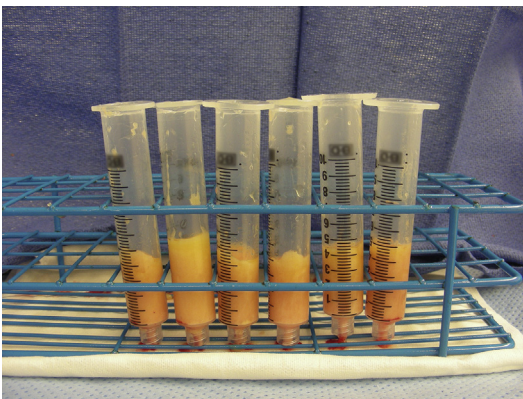


Fig. 5. Syringes are placed after centrifugation at 3000 rpm for 3 minutes. Oil in the upper layer and liquid in the lower layer are discarded. Only the fat grafts in the middle layer are collected.

has little resistance while fat grafts are injected. In addition, the injected volume can easily be controlled by the surgeon with such a syringe (**Fig. 6**).

Preparation of Recipient Site

Unlike other parts of the body such as breast, pre-expansion to the face for facial rejuvenation is usually not required. Because of rich blood supply in the face, the possibility of intravascular injections causing fat embolism to the brain or eye can be real and may be avoided by preinjection of 1% lidocaine with 1:200,000 epinephrine to planned fat grafting sites for possible vasoconstriction especially in the temporal and periorbital areas. Adequate compression to those areas after injection of abovementioned anesthetic solution is needed in order to minimize swelling in the area so that precise placement of fat grafts can still be made by the surgeon according to the volume requirement of fat grafts in each area. In addition, release firm attachment of the skin over the proposed injected areas such as in the nasolabial fold with a sharp cannula can also be performed so that the space is created between the skin and underlining tissue for placement of fat grafts (**Fig. 7**).

Injection of Fat Grafts

One of the most important techniques of fat grafting may be how to inject fat grafts. The key to a successful fat graft injection is to achieve an even distribution of fat grafts in the recipient site. By doing so, the injected fat grafts may have a maximal amount of contact with the tissue in the recipient site for better fat graft survival through plasmatic imbibition and neovascularization



Fig. 6. Fat grafts are transferred to multiple 1 cc syringes for injection. A 1 cc acrylic syringe is preferred for facial fat grafting.

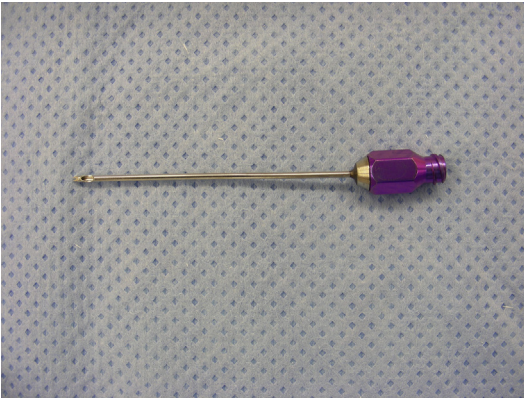


Fig. 7. The forked-tip cannula can be used to release fibrotic tissue, scar, or adhesion.

(**Fig. 8**). Not only grafting with small volume in each pass can get better surgical outcomes but also complications such as fibrosis, oil cyst formation, calcification, or even infection with large bolus grafting can be avoided. To achieve this goal, small volume (no more than 0.1 cc) of fat grafts should be injected in each pass. Slow injection of 0.5 to -1 cc per second during the withdrawal phase in each pass minimizes trauma to the fat graft.^{9,22} Fat grafts should be placed via multiple passes within multiple tissue planes and tunnels in multiple directions^{1,9} (**Fig. 9**). The volume requirement for each area of the face in the author’s practice is summarized in **Box 1**.

Injection should be as gentle as possible to avoid a possible injury to vessel or nerve. Injection with resistance would compromise the result and increase the chance of associated complications (**Fig. 10**). Only a dull tip injection cannula is selected to avoid accidental intravascular injection (**Fig. 11**). The most commonly used cannulas are 5



Fig. 8. An example of well-processed and concentrated fat grafts without oils and red blood cells.



Fig. 9. An intraoperative view shows fat injection to the face. The injection should be meticulously performed based on the techniques described in the article.

Box 1 Volume requirement of fat grafting for each area of the face	
Forehead	10–15 cc
Temporal fossa	4–6 cc
Upper eyelid	1 cc
Lower eyelid/cheek junction	1–2 cc
Cheek	4–10 cc
Nasal dorsum	2–4 cc
Nasolabial fold	1–2 cc
Upper/lower lip	1–2 cc
Marionette line	1–2 cc
Chin	4–6 cc

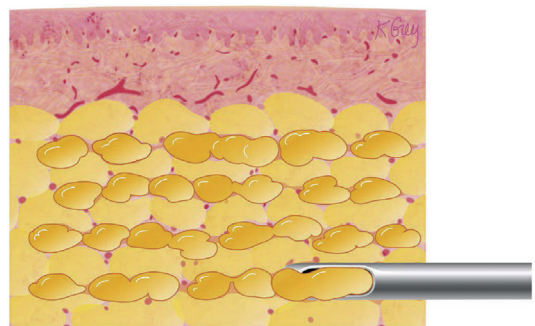


Fig. 10. A proper technique of fat injection. Placement of minuscule amounts of fat grafts with each pass as the cannula is withdrawn. Fat grafts should be placed with multiple bypasses but in multiple tissue planes and tunnels. (From Coleman S., et al. Fat Injection from Filling to Regeneration. Thieme New York 2018; with permission.)

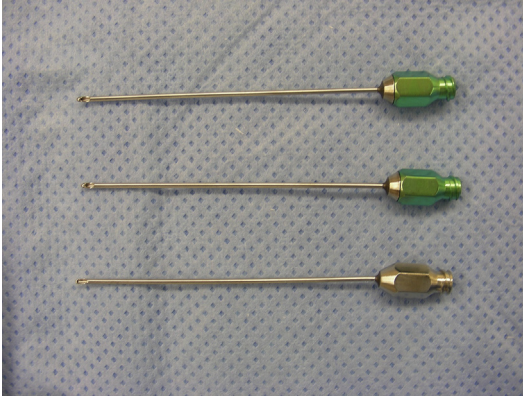


Fig. 11. Several dull tip injection cannulas are used for facial fat grafting.



Fig. 12. Taping the injected area for immediate post-operative care after facial fat grafting.

to 9 cm in length and 1 mm in diameter for facial procedure. In general, a smaller cannula should be used for fat grafting to the area such as the peri-orbital region where only a smaller volume of fat

grafts is injected in each pass. Smaller cannulas may also allow the surgeon to have more precise control over the volume when extremely tiny amount of fat grafts is injected. The cannula

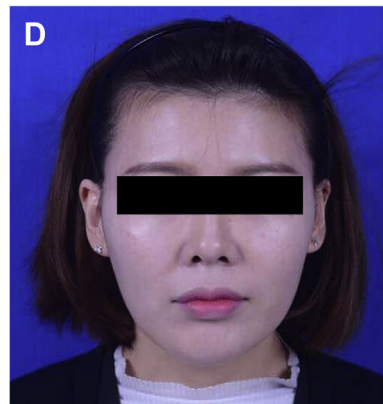
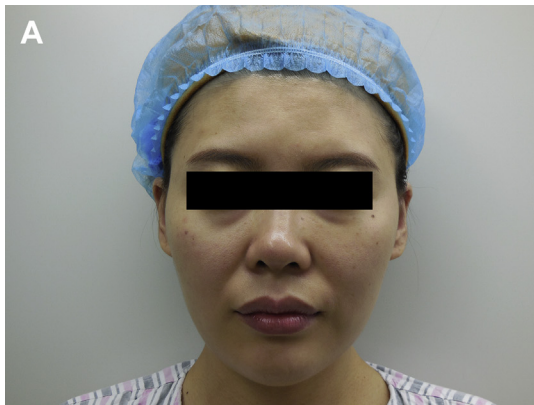


Fig. 13. (A) A 29-year-old Asian woman desired facial rejuvenation and contouring. (B) The preoperative design and plan for her facial rejuvenation and contouring. (C) An immediate intraoperative appearance after her facial fat grafting. She had a total of 37 cc fat grafting to her face (forehead: 15 cc; temporal fossa: 5 cc for each side; medial lid/cheek junction: 1.5 cc for each side; nasolabial fold: 2 cc for each side; and chin: 5 cc). (D) The results at 5-month follow-up.

includes straight or curved one and blunt or forked tip in order to meet different needs. The cannula with forked tip can cut through tissues and can be used to release fibrotic tissue or scar, adhesion, or ligament attachments.

Preoperative photograph with a detail planning marked on the patient is important for intraoperative comparison, because the changes need to be made with fat grafting in the operating room usually are very subtle. The surgeon should

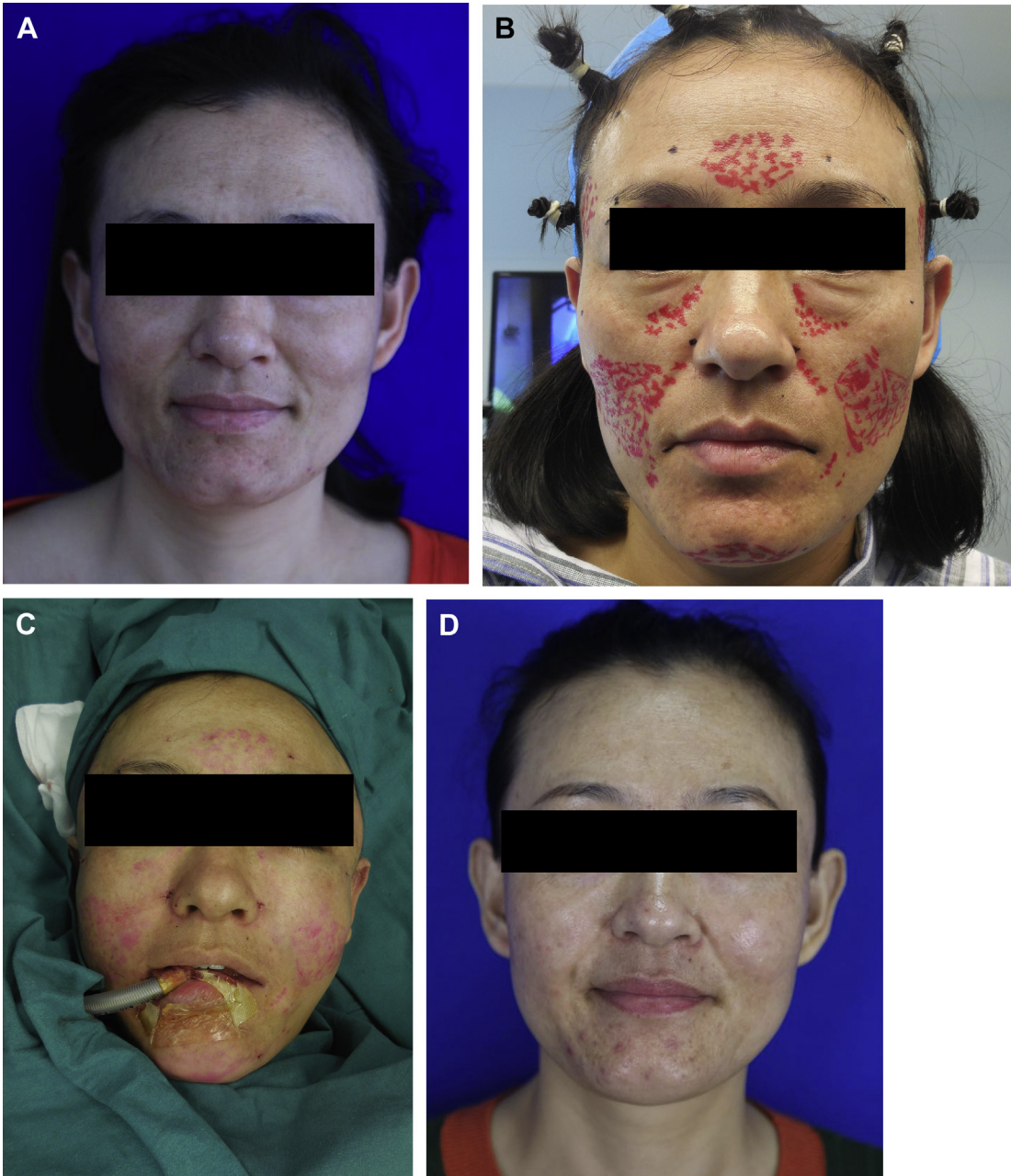


Fig. 14. (A) A 42-year-old Asian woman desired facial rejuvenation. (B) The preoperative design and plan for her facial rejuvenation. (C) An immediate intraoperative appearance after her facial fat grafting. She had a total of 36.8 cc fat grafting to her face (glabella: 2 cc; temporal fossa: 4 cc for right side and 3 cc to left side; upper eyelid: 0.5 cc for each side; medial lower eyelid/cheek junction: 1 cc for each side; nasolabial fold: 1 cc for each side; cheek: 9 cc for right side and 6 cc for left side; perioral: 1 cc for right side and 0.8 cc for left side; and chin: 6 cc). (D) The results at 12-month follow-up.

make sure where the cannula tip is during the entire injection process. If there is any doubt about the tip location, tent the cannula tip toward the skin and then see blanching of the skin overlying the advanced cannula to reveal its exact location. If fat grafts are placed in a correct location, the “augmented” effect in the grafted area can easily be identified. If volume is not increased even though grafting is in the right place, other factors that may restrict volume enlargement should be taken into consideration such as fibrotic adhesion or tight skin envelope. Fibrosis or adhesion can be dissected with an 18 gauge needle or a forked tip cannula. Attention should be made to avoid a “bolus” injection, and the basic principles for fat injection should

be followed to ensure the better outcome and avoid fat necrosis.

POSTOPERATIVE CARE

Swelling in the recipient site is expected for 1 or 2 weeks and the grafted areas can become firm or hard in the first few weeks. Patients should be informed about this normal process after fat grafting and some reassurance to them may be necessary. However, when fat grafting is done to the face, prolonged swelling (up to 6 weeks) may be expected. During the recovery time, ice packing, tight compression with elastic bandage, or massage in the grafted area should be avoided because all the above may compromise fat graft

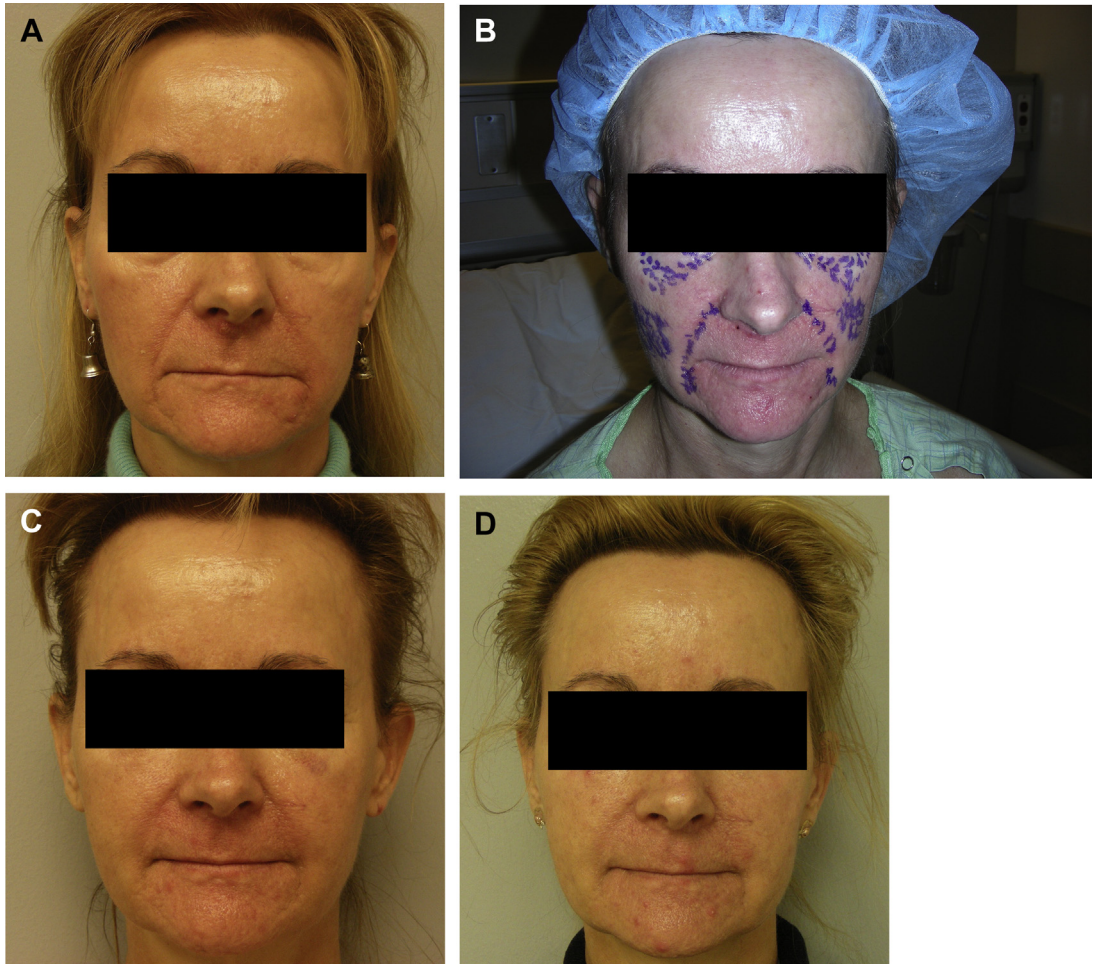


Fig. 15. (A) A 42-year-old white woman desired facial and periorbital rejuvenation. (B) The preoperative design and plan for her facial and periorbital rejuvenation with fat grafting. She had a total of 15 cc fat grafts to her periorbital area and face (lower eyelid/cheek junction: 1.5 cc for each side; cheek: 3 cc for each side; nasolabial fold: 2 cc for each side; and perioral: 1 cc for each side). She also had bilateral upper and lower blepharoplasty and lateral canthopexy. (C) The results at 5 weeks after her facial fat grafting and periorbital procedures. (D) The results at 13-month follow-up.

survival and final outcome. However, taping over the grafted areas may relieve some discomfort from swelling and prevent the patient from pressing or touching the areas (**Fig. 12**). Any direct trauma or shear force over the grafted areas may jeopardize fat graft survival and should be avoided.

EXPECTED OUTCOME AND MANAGEMENT OF COMPLICATIONS

Complications of fat grafting to the face are not common and can usually be avoided with meticulous surgery.^{3,4} Complications from the donor site are the same as those expected from liposuction, which include depression and uneven body surface. Liposuction for graft harvest should aim to enhance lower abdominal or inner thigh contour by careful assessment for the location of the excess fat. The recipient site may develop

hematoma, infection, nerve injury, or rarely, vessel thrombosis as the acute complications or small fat necrosis as the late complications. Fortunately, acute complications are rare and usually do not develop if the procedure is performed by experienced surgeons. Fat necrosis may develop continued fibrosis from the macrophages trying to phagocytose the nonviable adipose graft in the recipient site.¹¹ Fat necrosis in the face usually presents with a subcutaneous nodule, especially in the junction of the lower eyelid and cheek. It may require direct excision or precise liposuction for removal depending on severity of those conditions.

REVISIONS AND SUBSEQUENT PROCEDURES

In the author's practice, facial fat grafting is usually performed once for most patients with satisfactory outcome. However, subsequent fat



Fig. 16. (A) A 62-year-old woman desired facial and periorbital rejuvenation. (B) The preoperative design and plan for her facial and periorbital rejuvenation with fat grafting. She had a total of 25 cc fat grafts to her entire face (forehead: 2 cc; glabella: 2 cc; lower eyelid/cheek junction: 2 cc for each side; cheek: 2 cc for right side and 3 cc for left side; nasolabial fold: 3 cc for each side; mental crease: 2 cc; and perioral: 2 cc for each side). She also had bilateral upper and lower blepharoplasty, lateral canthopexy, and face and neck lifts. (C) The results at 6 weeks after her facial fat grafting and periorbital procedures and face and neck lift. (D) The results at 10-month follow-up.

grafting may be needed for some patients if additional fat grafting is necessary to improve clinical outcome. Occasionally some degree of asymmetry after fat grafting may be presented in an area of the face and gentle and precise liposuction should be performed to correct it.

CASE DEMONSTRATIONS

Case 1. See **Fig. 13**.

Case 2. See **Fig. 14**.

Case 3. See **Fig. 15**.

Case 4. See **Fig. 16**.

DISCUSSION

Much of the current scientific studies support this rationalized approach to facial fat grafting described in this article for small volume fat grafting.^{23,24} Besides the proper selection of donor sites (ie, the lower abdomen or inner thigh for small volume fat grafting), fat grafts should be harvested with a less traumatic method such as syringe aspiration or lower suction pressure and then processed with proper centrifugation. Fat grafts should be placed in a small amount (no more than 0.1 cc or equivalent amount for large volume) each pass but with multiple passes in multiple tunnels, multiple tissue levels, and multiple directions. Anesthetic (or tumescent) solution with low lidocaine concentration should be chosen for infiltration of the donor site. Significant overcorrection should be avoided to minimize complications such as fat necrosis. The timing for subsequent injection may be about 3 to 6 months after previous injection (**Box 2**). It is also critical to inform the patient that a subsequent procedure may be necessary after the first fat grafting if the expected results have not been achieved.

SUMMARY

Improvement of fat grafting techniques can be accomplished with donor site selection, fat graft harvesting, processing, recipient site preparation, and placement. With the techniques and other important considerations described in this article, fat grafting can be performed in a more satisfactory fashion for facial rejuvenation with expected good clinical outcome but with no complications. Although a more rationalized approach to facial fat grafting is described by the author, future investigations may still be needed to provide more scientific evidences for what would be the best approach for facial rejuvenations.

Box 2

Summary of techniques and special considerations for facial fat grafting

Preferred donor sites	Lower abdomen or inner thigh
Anesthesia	Low concentration of lidocaine for infiltration
Fat graft harvesting	A less traumatic syringe technique
Fat graft processing	Centrifugation with a proper setting
Recipient site preparation	Injection of anesthetics for vasoconstriction. Percutaneous scar or adhesion release if needed.
Placement of fat grafts	Placed in a small amount (0.1 cc or equivalent amount) for each pass in the withdraw phase but with multiple passes in multiple tissue planes, multiple levels, and multiple directions
Overcorrection	Not recommended
Postoperative care	Proper immobilization of the grafted area Swelling is always expected Additional injection may be necessary
Timing for subsequent injection	3–6 mo after previous injection

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