Minimally Invasive Procedures for Facial Rejuvenation

Chapter: Autologous Fat Transfer for Face Rejuvenation

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Abstract

The face aging is a physiological process that involves the cutis, subcutis, fascia, muscle and bone. Several different methods are available to correct these aging signs. It is only within the past 20 years that the popularity of Autologous Fat Transplantation (AFT) for facial recontouring has increased within the plastic surgery. The interest in this treatment has paralleled the development and popularity of liposuction for body contouring.

Adipose tissue has been used for volume restoration or augmentation of the face with contour irregularities, both via direct transfer and after various processing procedures. The recognition that soft tissue volume loss contributes to the aging of the face has driven the use of this procedure. At the present time AFT is the best means of restoring facial volume. It is a simple, effective and reproducible technique.

Introduction

Aging of the face as viewed on a cellular level occurs as a result of a decrease in adipocyte cell size, function and differentiation. In addition, structural and functional changes of epidermis and dermis, redistribution of facial fat and atrophy of muscles and bone leads to the several alterations in the face as one senescence.

The clinical signs are a variable amount of wrinkling, dischromic areas, thinned and dry cutis, and volume loss in some regions and SMAS ptosis. Such processes are related to factors that are both genetic and environmental (lifestyle, diet, photoexposure, smoking habits) [1-4].

Intrinsic and extrinsic factors are the reason of these changes.

Epidermal turnover is reduced, dermal collagen is decreased and elastic material is being accumulated (intrinsic factors). Wrinkles appear preferentially on sun-exposed areas (extrinsic factors), as a prominent sign of facial aging.

Dermatoporosis is the histological aspect of aging characterized by progressive thinning of cutis, reduction of dermal papillae, elastosis or depletion of collagen and elastic fibers, and thinner of muscle fibers [5]. The loss of extracellular matrix and its major component hyaluronate, induces a damage of the skin’s mechanical functions.

Several different methods are available to correct these aging signs. Treatment are as
different as infiltration of bio-revitalizing substances or filler implantation [6], or protheses [7], or chemical neurolysis [8], or tissue repositioning through lifting procedures [9]. Adipose tissue has been used for volume restoration for over a century, both via direct transfer and after various processing procedures, acutely or after cryopreservation [10]. Autologous Fat Transplantation (AFT) is widely regarded as an ideal method, addressing both biocompatibility and patient concerns [11].

Neuber [12] was the first to describe it in 1893. However, it did not attract much attention until the 1980s [10,13].

**Harvesting**

The procedure consists of fat transfer via liposuction and infiltration or implantation into the desired region. It is used in reconstructive and aesthetic surgery for facial and body contouring [11,13], but also in other specialties [14,15].

Different harvesting and preparation methods have been tested to achieve greater adipocyte survival and consequently more reliable clinical outcomes.

Preparation techniques include washing with physiological solutions [16-19] and centrifugation to separate cells from debris, to minimize inflammatory responses [20,21]. Over the past 20 years, the literature has seen numerous clinical reports highlighting the benefits of autologous fat transfer for facial recontouring.

A greater understanding of how to maintain viable fat has led to modifications in technique that are believed to improve clinical results. These modifications are intended to preserve the delicate structure of adipocytes and provide a robust blood supply on which fat cells are extremely dependent [8].

There are many conflicting studies and physician experiences that exist regarding the durability and integrity of autologous fat grafts [9]. It has been suggested that variations in donor site and tissue preparation make a difference in graft take and survival [10].

**Our Technique**

**Markings**

**Donor sites:** Fat was collected from the abdomen (most frequently used donor site), hips, outer thighs (saddle-bags), internal knee or thigh. Preoperative markings were performed prior to anesthesia, with the subject standing.

**Face:** Comparison of a photograph of the subject at the age of 20-25 years to the latest photographs allows evaluation of the areas requiring filling (Figure 1), those merely needing

![Figure 1: Facial marking](image)
rejuvenation, and those where filling would involve volume changes.

**Anesthesia**

**Donor site:** A solution of 500ml saline, 25ml of 1% lidocaine, 0.5ml adrenaline, 0.25ml triamcinolone acetonide 40mg/ml and 2ml sodium bicarbonate is injected with a multi-hole infiltration cannula 1mm in diameter, whose entry point is first injected with 1% lidocaine. The solution is slowly injected into one area and then into the adjacent one in an amount that achieves optimum vasoconstriction. It is then left in place for 45 min to obtain both anesthesia and adipocyte hydrodissection (Figure 2).

![Figure 2: Donor site: Tumescent local anesthesia. It is then left in place for 45 min to obtain both anesthesia and adipocyte hydrodissection.](image)

**Implant site:** Supraorbital, infraorbital and mental nerve block is obtained with 1-2cc of 2% lidocaine. In the areas not innervated by these nerves 1% lidocaine is injected subcutaneously with adrenaline, fan-wise around the areas to be treated. No more than 2-3cc of anesthetic is injected in each hemiface to avoid excessive alteration of the oval.

**Fat harvesting:** Blunt cannulas 2mm in diameter and 10cc Luer lock syringes are used. Before collection, the syringe is filled with 1cc saline with the piston pulled back to make 2cc of void under manual regulation of the negative pressure (Figure 3).

![Figure 3: Donor site (A). Fat Harvested using 10-cc syringe aspiration (B).](image)

**Fat purification:** After collection the adipose tissue is washed with saline, to remove all blood and cell elements (Figure 4) and left to stand; 10-12 washes yield a layer of saline and a supernatant predominantly comprised of bright yellow adipocytes and growth factors (Figure 5).
The piston is never removed from the harvesting syringes during washing, to avoid tissue exposure to air, minimizing potential oxidation.

![Image](image1.png)

**Figure 4:** Graphic representation of fat purification’s with saline.

![Image](image2.png)

**Figure 5:** Purification of the fat.
Decanting in the harvesting syringe by placing the syringe in a vertical position (A,B). The piston is never removed from the harvesting syringes during this procedure, to avoid tissue exposure to air, minimizing potential oxidation (C).

**Fat implantation:** Small scalp incisions are made with a 18 G needle or a 11 blade to treat the temporal, supraorbital and frontal regions; at the level of the lower triangle of the malar fat pad (Figure 6); at the lateral base of the alar cartilage to treat nasolabial folds, marionette lines, and upper lip; at the corners of the mouth for upper and lower lip; and in the preauricular area for the masseter muscle and mandible regions.
The fat is implanted using a 17 G blunt-tipped Coleman cannula connected to a ratchet gun through which doses of approximately 0.1cc fat/cm³ are dispensed retrograde for each impulse. Fat is homogeneously deposited in the subcutis and above the SMAS to avoid grooves and cordons. Deposition of a single, deep subcutaneous layer provides only a rejuvenating effect, whereas multiple layers are required to achieve volume augmentation.

Careful fat deposition ensures its homogeneity. The region is gently massaged. Finally, the cannula access points are closed with steri-strip and an antibiotic cream is applied.

The method used by the authors involves fat harvesting under tumescent anesthesia and purification by washing [22,23] to preserve adipocyte viability throughout the procedure and to allow implantation under local anesthesia.

In the authors’ experience the technique involving tumescent anesthesia at donor sites makes harvesting painless, with benefits that persist after the operation as analgesia (slight postoperative pain in 5.1% patients only). In addition, the vasoconstrictor action of adrenalin effectively reduces bruising (0.5% of our patients).

Recipient site pain was acceptable (slight pain in 7% of subjects) in the areas treated by local anesthesia, due to the effectiveness of analgesia through the block of the sensitive branches of the trigeminal nerve and the deep dermal and subcutaneous anesthesia provided by 2% lidocaine.

Progressive infiltration of the solution and the protracted rest phase ensure bloodless, non-traumatic tissue collection. The saline wash ensures adipocyte integrity. In addition, all steps involving adipocyte manipulation are performed using Luer lock syringes, to avoid exposure to air and the risk of oxidation.
Careful deposition of small amounts of fat in multiple layers significantly reduces the risk of fat necrosis and of subcutaneous nodules (respectively 0.9% and 4.6% in our patients). Implantation in subcutaneous regions and above the SMAS is ideal to remodel areas that have lost large amounts of fat with age.

The improved skin trophism (Figure 7) can be explained by the fact that adipose tissue deposition involves implantation of mesenchymal cells capable of differentiating, in the presence of growth factors, into fat, vessel, bone, and cartilage tissue, thus forming cells that improve dermal and subcutaneous trophism [24,25].

![Figure 7](image)

Figure 7: A 60-year-old woman who underwent total facial augmentation. Preoperative views (by left to right), postoperative views of AFT (in the middle) and post the second treatment in sequences.

The long-term survival of the implanted fat is due to its complete integration at the recipient site; this is achieved by bearing in mind Coleman’s concept of lipostructure [26] and through careful adipocyte manipulation during collection, purification and implantation.

Preservation of adipocyte viability with our technique is ensured by tumescent anesthesia with slow, progressive injection of the anesthetic and its permanence in the donor site for about 45 min, to ensure adipocyte hydrodissection and virtually bloodless collection; fat harvesting and washing without exposure to air, thus preventing oxidative stress; saline washing according to Khater et al., [27]; and methodical fat implantation in multiple layers by dispensing doses of 0.1cc/cm³ with a 17 G blunt-tipped Coleman cannula.

Despite its drawbacks, i.e. the time constraints (max 90-120min) and its contraindication in subjects who cannot bear to remain awake during any surgical procedure, the method is an effective option to treat face aging, it is reproducible, carries a low rate of complications.
since the autologous graft material prevents allergic reactions, and enables discharge on the same day due to lack of general anesthesia or sedation.

**Postoperative care:** No sutures are needed on implant areas, steri-strip and antibiotic cream is applied. Patients remove steri-strip after 2 days. After a further 7 days they come for a first check, and then after 3 months. Pictures are taken on both occasions.

After 3 months, the restored area is evaluated further and additional augmentation is performed (Figure 8,9).

**Figure 8:** A 36-year-old woman who underwent facial augmentation. Preoperative views (by left to right), postoperative views (in the middle) and post second AFT treatment.

**Figure 9:** A 54 year-old woman who underwent facial AFT. Preoperative views (by left to right), postoperative views (in the middle) and post second AFT treatment.

**Discussion**

Autologous fat has often been referred to as the almost ideal filler.

Nevertheless, its use remains relatively limited compared to commercial fillers. It also appears that surgically trained and oriented cosmetic practitioners are far more likely to use fat, and often as a complement to other surgical procedures such as face–neck lifts and blepharoplasty. Facial recontouring is one of the more sought after plastic surgery procedures for correction of congenital defects, traumatic injuries, or the aging face.

Numerous surgical approaches and methods have been investigated using either alloplastic materials or autologous tissue [11].
The search for an ideal soft tissue filler for use in reconstructive and plastic surgery dates back to more than a century [9]. Processed bovine collagens have been used with limited success [10]. Paraffin and silicone oil, albeit inert, highly purified, non-biodegradable and non-allergenic, have the potential for migration and/or misalignment, and secondary infections may develop as with any other product [11,12].

Hyaluronic Acid (HA), a natural component in the extracellular matrix of tissues, is found in all vertebrate animals. In the skin, hyaluronic acid provides structure and volume; the amount of HA decreases with age leading to dehydration and wrinkle formation [28]. HA is highly hydrophilic and cross-linking its polysaccharide chains slows its degradation [29,30]. Depending on the degree of cross-linking, several hyaluronic acid-based dermal filler products with varying duration of effect (6-12 months) is available [28,31]. The long-lasting effect of the HA depends on 3 factors: concentration, size, cross-linking.

It should be noted that adverse events such as swelling, redness, and bruising are associated with the use of these products.

Long-acting dermal fillers include calcium hydroxylapatite and injectable PLLA, and each is thought to produce their effects by inducing cellular responses that are hypothesized to result in the formation of collagen.

Common adverse events associated with the use of collagens, hyaluronic acid derivatives, calcium hydroxylapatite, or injectable PLLA include swelling, bruising, and erythema, are related to the injection procedure, and resolve within a few days. Nodules and papules, which have been reported for all the injectable devices, can appear immediately or in the weeks to months after the injection. Although most nodules/papules resolve spontaneously over several months, subcision or excision may be needed to remove visible nodules.

The guidelines for selecting AFG over available commercial fillers are not easy to set. It is difficult to justify AFG for treatment of relatively shallow nasolabial and commissural folds which can be adequately corrected with HA, or other equivalent commercial filler. AFG should be seriously considered: As cost-efficient alternative to temporary fillers; as a complement to temporary fillers, combining and layering AFG with intradermal fillers; as a possibly safer, though less predictable, alternative to permanent fillers.

Autologous fat does not cause an allergic response, has no risk of rejection, and has an effect lasting from several months to several years, although the actual duration of effect can be unpredictable. However, autologous fat requires surgical harvest and may require frequent retreatment of dynamic areas, such as the nasolabial folds and marionette lines [32-36]. In addition, adequate fat sources may be difficult to obtain in slender patients. The risk profile for AFT compares favorably to surgery, and in terms of infection, it is equal to favorable when compared to hard implants. When compared to injectable fillers, AFG has a cost advantage, especially when larger volumes are needed to treat multiple areas.

Coleman, Berman, and most other advocates of widespread use of fat grafts to increase the volume of the face (temporal forehead, brows, inferior orbital rims, malar areas, perioral areas including lips and chin, etc.), focused more on fat grafting technique, and placing the fat where it seemed to be both needed and accessible, be it supraperiosteal, sub- or perimuscular, or subcutaneous [37].

Lipostructure is a natural, long-lasting method of filling and supporting the face using intricate layering of infiltrated autologous tissue. This method allows the tissues to be sculpted to enact three-dimensional augmentation of facial elements. Because the grafted fat becomes integrated into the host tissues, it is almost undetectable after transplantation, except by photography. To successfully use fatty tissue as such a graft, attention must be paid to the nature of fatty tissue; to the methods of harvesting, transfer, and placement; and to the preparation of the patient. Fatty tissue is a complex, delicate structure that is easily
damaged by mechanical and chemical insults. Successful fat transplantation demands that every step be practiced with attention to this fragile nature of fatty tissue. Precision is an important consideration in the augmentation of millimeters of facial elements. The true volume of infiltration is difficult to judge if too much blood, lidocaine, or oil is present in the tissue being placed. Fat is living tissue that must be in close proximity to a nutritional and respiratory source to survive. Therefore, placement of small amounts of fatty tissue in multiple tunnels assumes the utmost importance in the quest for both survival of fatty tissue and an aesthetically appropriate correction. Successful, three-dimensional sculpting requires attention to patient preparation, meticulous planning, and fastidious photographic evaluation. AFT for facial soft tissue contouring is simple, inexpensive, and effective. Its ready availability, natural integration into host tissues, and potentially permanent correction make it particularly useful for this application. All patients were satisfied with the soft, natural appearance [38].

The potential applications in aesthetic and reconstructive surgeries of this new tool are profound. Lipostructure represents an important advance in plastic surgery: a safe, long-lasting method of recontouring the face with autologous tissue.

References