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29.1 Short History

The history of autologous fat grafting begins with Neuber's [1] presentation to the 22nd Congress of the German Surgical Society in 1893. This was soon followed by other reports including papers by Czerny [2], Lexer [3], and Rehn [4]. As early as 1911, fat was injected into the superficial tissues for the purpose of soft tissue augmentation [5]. Fast forward into the 1980s and we see that Illouz [6] and Fournier [7] advanced us into the modern age of fat injections with their syringe technique. Around the same time as Illouz's paper in 1985, the author began performing what is referred to as micro fat cell transfer (MFCT) (Fig. 29.1).

Fournier referred to this technique as "Microlipoextraction et microlipoinjection" [7]. Today, many different techniques have evolved for transferring liquified fat, but there is no standard procedure that is widely accepted. Harvesting, washing, spinning, digesting, mixing, and PRP have all played an important role in the quest for better survival of our transplanted fat. In recent years, Lee [8] has made important contributions in the area of autologous fat grafting. Because of Lee's advances, the author has developed a new paradigm for facial rejuvenation, and this is the basis for this chapter.

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29.2 Early Introduction to Adivive™ (Lipokit™)

Lee developed the Lipokit™ system through his company Medikan International. Lipokit appealed to the author because it was simple, totally enclosed, and with relatively inexpensive disposables. The Lipokit Fat Processing Unit (FPU) proprietary name from Medikan was changed to Adivive™ in December 2011, but the unit is still produced by Medikan. Since the production of the 18.75-cm-diameter centrifuge system, Medikan now produces specialized harvesting syringes for smaller volumes.

29.3 Equipment and Technique Used with the Adivive™ FPU (Figs. 29.2, 29.3, 29.4, 29.5, 29.6, 29.7, 29.8, 29.9, 29.10, and 29.11)

The Lipokit™ (Adivive™) Fat Processing Unit was developed by Medikan in 2004. Palomar acquired FDA clearance and imported the system into the United States at the end of 2010. In contrast to other systems, it is a totally enclosed unit from the point of infusion to harvesting, processing, and final delivery of the processed fat into the patient. Therefore, sterility and low risk of infection is one of the primary attributes of such a system. The wide-base centrifuge (18.75 cm) provides increased G forces during centrifuging inside a sterile bucket. The system includes a



Fig. 29.1 (Above) Preoperative patient with idiopathic facial atrophy. (Below) One-year postoperative large-volume traditional syringe-harvested fat grafting (100 mL) performed in 1988

Fig. 29.2 Adivive™ (Adivive™) Fat Processing Unit



Fig. 29.3 Adivive™ harvesting syringe with weighted piston



60 mL sterile syringe with a weighted piston containing a unique filter. After spinning, the “lipo-condensed” or “squeezed” fat remains in the center and the filtrate with tumescence and blood cells separates to the bottom. The oil squeezed from the fat ends up above the weighted piston and may be easily poured off. The plug at the bottom of the syringe contains a large number of stem cells and comprises the stromal vascular fraction (SVF). The average product of concentrated fat per syringe is approximately 30 mL which contains about one million stem cells per mL. The SVF plug is added to this purified fat. The author recently added PRP (platelet-rich

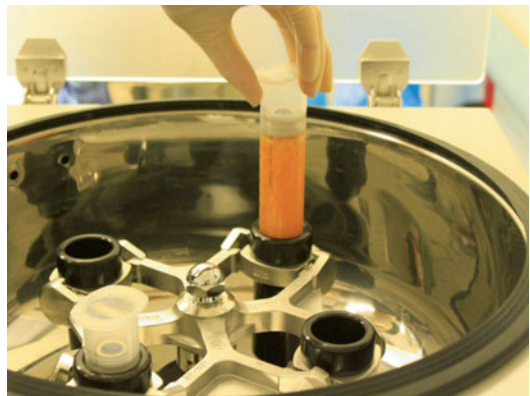


Fig. 29.4 Insertion of fat-filled syringe into sterile centrifuge bucket



Fig. 29.5 Centrifuged/filtered fat displaying three components

plasma utilizing the Arteriocyte™ Magellan system) to the Adivive-purified fat graft for several reasons. The advantage of PRP is that it contains eight separate growth factors, millions of platelets, and an antibacterial component. It is thought that PRP enhances the take of the adipose-derived stem cell (ASC) graft. In addition, the millions of platelets present in PRP minimize bruising and edema, and the plasma facilitates injecting the thickened Adivive fat through small blunt cannulas. The PRP actually lubricates the condensed fat, and therefore, it is easier to inject in smaller strands.

The efficiency of the Adivive™ FPU is enhanced by integrating a well-trained team of technicians and assistants. The infusion and harvesting is performed and then the harvested fat is passed to the assistants. While the assistants process the fat, the author anesthetizes the face and neck. As soon as the fat is processed, the face is

Fig. 29.6 Transferring processed fat into smaller syringes



Fig. 29.7 Droplet of processed fat

injected with the purified fat/PRP mixture. Simultaneous with infusion and harvesting, the nurse draws 60 mL of blood and spins it down to 6–9 mL of PRP. The fat is processed and mixed

with PRP while the face and neck are anesthetized. Timing is critical so that the Adivive fat/PRP is grafted soon after it is prepared.

Additional treatments such as SlimLipo of the neck, brow lift, and facelifts are performed after the fat grafting is performed. With this type of team approach, 40–80 mL of graft material may be harvested, prepared, and delivered within a period of 60–90 min. With the addition of surgical procedures such as short incision facelift and brow lift, the total treatment time rarely exceeds 2 1/2 h.



Fig. 29.8 Injecting patient with Adivive™ fat



Fig. 29.9 Magellan™ PRP processing unit



Fig. 29.10 Drawing blood for PRP processing

Fig. 29.11 Operating room, setup, and personnel



29.4 Specifics Regarding Anatomic Placement, Graft Volume, and Cannula Size

Prior to surgery, careful markings are made with the patient in the upright position. The projected volume for each area is based on degree of soft tissue deficiency (Fig. 29.12), patient's goals, and ancillary surgical procedures. The patient markings outline the areas of deficiency (Fig. 29.13). The neck markings were made in anticipation of neck tightening with the SlimLipo laser platform. The carotids and cervical branches of the facial nerve are marked as areas of avoidance, whereas the oblique lines are areas for intended skin tightening. The laser neck treatment avoids the need for submental platysmaplasty and effects a progressive post-laser neck tightening for at least 4–6 months.

Cannula sizes, fat deposition depths, volume of fat injected, and 16-gauge needle access punctures are noted. The location and amounts of Adivive fat injected vary from patient to patient. An effort to establish fat volume needs as well as invasiveness of the procedure evolved into the Opera Lift nomenclature. The three categories established are designed to fit the cosmetic and economic goals of the patient. The various types of Opera Lifts will be defined later in this chapter.

More limited Adivive grafting sessions may require under 40 mL of processed fat. These limited



Fig. 29.12 The anatomic basis of midfacial aging

procedures may be performed in an office setting using the smaller Adivive system. Larger volumes, especially if the fat grafting is performed in conjunction with surgical procedures, should be conducted in an operating room setting. With low-risk patients, most of these procedures are

performed with monitored intravenous conscious sedation.

During the evolution of the Adivive FPU, the author found it useful to categorize patients based on the degree of complexity of the treatment plan. For many reasons, patients are requesting less invasive, less expensive cosmetic procedures with less downtime. Beyond the use of synthetic fillers and Botox™, Adivive and various lasers have added a whole new dimension to the practice. The categories used are largely based on the economic and treatment goals of the patient. The acronym “Opera Lift” may not be appropriate for other plastic surgeons, but this labeling has been useful in the author’s practice:

Opera (Obi-Palomar External Rejuvenation Aesthetic Lift) Minor, Opera Lift Major, and Opera Lift Plus are the categories the author has utilized during the past 18 months. Opera Lift is a proprietary name and not authorized by Palomar Medical. It stands for s.



Fig. 29.13 Preoperative patient markings

29.5 Opera Lift Minor

The minor suffix indicates an office procedure using the minor Adivive system with one syringe of approximately 35 mL of processed fat. The patient is given Valium and Percoset preoperatively if requested, and the total procedure is performed in approximately 1 h. The donor site is first anesthetized (Fig. 29.14) followed by dental blocks (Fig. 29.15). Syringe harvesting is performed (Fig. 29.16) at one donor site and centrifuged at 2,500 rpm for 5 m. (Speed and duration of centrifugation is determined by BMI and the color of the aspirate.) For these cases, the Medikan™ short blunt 16–18-gauge disposable needles are extremely useful.

With these limited volume procedures (30–35 mL), there is enough graft material to treat the glabellar lines, full tear troughs, malar regions, nasolabial folds, marionette creases, and lips (Fig. 29.17). Also, there is a better take with the smaller-volume procedures. Preoperative and postoperative oral Arnica Montana, avoidance of blood thinning substances, control of blood pressure, etc., is a universal treatment plan for all patients. Irrigation of the graft sites with ice saline delivered with the blunt needles (cannulas) at the end of the procedure significantly reduces



Fig. 29.14 Limited donor site with adequate fat

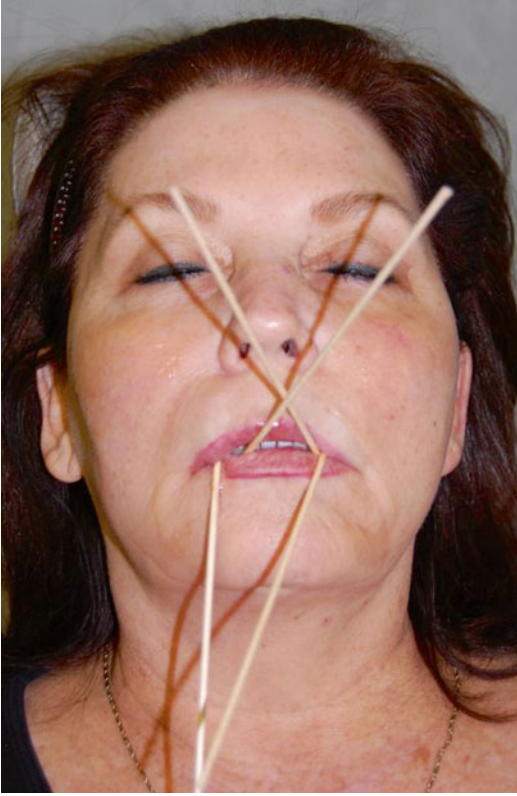


Fig. 29.15 Preparation for dental blocks

bruising also. Levels of fat injections will be described under Opera Lift Major.

Obviously, the cost of an Opera Lift Minor is at a lower fee level and therefore attractive to a larger population of patients. Since most patients return to work after 3–5 days, the author prefers to perform the Opera Minor procedures on a Thursday or Friday and most patients return to work on the following Monday.

29.6 Opera Lift Major

The major suffix indicates a larger volume of Adivive fat plus laser neck tightening utilizing the SlimLipo™ (18) plus PRP. Volumes of 40–80 mL with a mean volume of 60 mL are most often injected into these patients. Opera Lift Major procedures are always performed in a formal operating room setting and most often with conscious intravenous (IV) sedation. Caution regarding larger volumes should be observed in full-faced “cheeky” patients. Most of the more mature patients with normal BMIs as well as patients who have undergone significant weight



Fig. 29.16 Medikan™ small-volume harvesting device

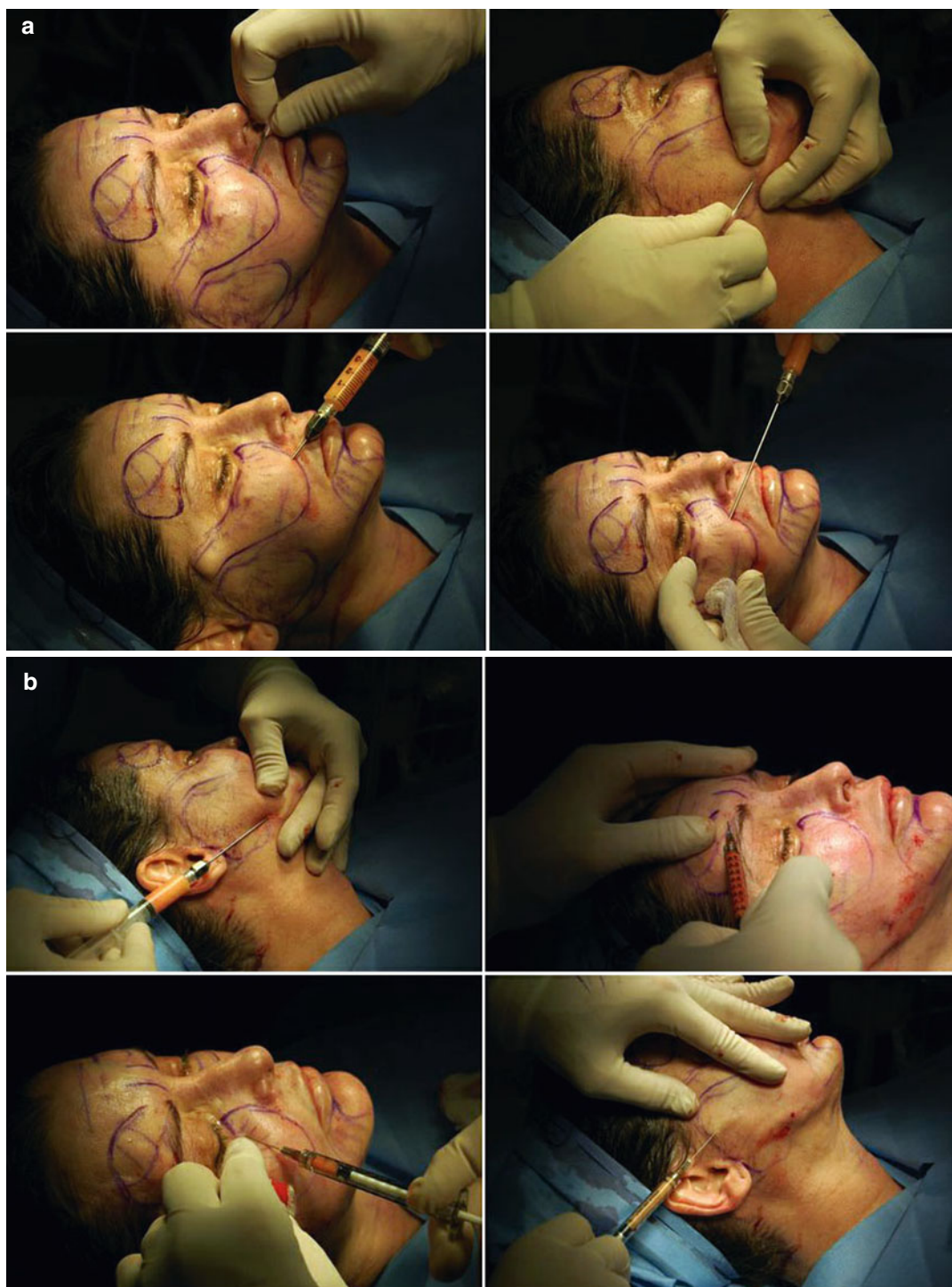


Fig. 29.17 (a, b) 16-gauge needle punctures the skin with large needles to provide access for the blunt cannula

loss are best treated with these larger volumes. The squeezed fat with PRP added is delivered in micro strands at different levels depending on anatomic location. The addition of PRP, in addition to the benefits previously mentioned, facilitates a smoother delivery through smaller cannulas. One of the difficulties with Adivive compressed fat is high density that leads to clogging of small cannulas.

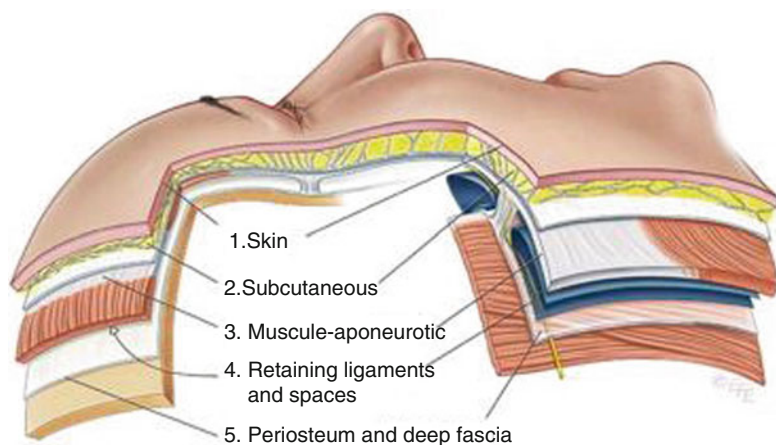
The sequence of injection is to fat graft the right side of the face first, beginning superiorly in zones 1 and 3 (Figs. 29.18 and 29.19). The forehead and brow as well as the supraorbital rim are treated at a deep periosteal level. The mid forehead and glabella are also treated at a deeper level with some injection into the corrugators, frontalis, and the superficial frown lines. Next, the lateral forehead and temporal hollows are injected deep to the veins with some preauricular fat injected subcutaneously. If the earlobe is atrophic and with creases, a 22-gauge needle is used. Next is the lateral fat compartment of the cheek and continues inferiorly to the border of the mandible. The mid and medial cheek compartments are treated with the nasolabial, malar, and tear trough zones at variable but primarily deeper levels. The marionette crease/notch and lips are treated last as these are areas of bruising. Pressure as well as ice saline cannula irrigations reduce bruising. In order to reserve some touch-up fat, approximately 45 % of the processed fat is injected into the right face before proceeding to the left side.

After treating the right side, the contralateral side is treated in a similar sequence compensating for facial asymmetries. At the completion of both sides, a critical look for optimal correction and symmetry is conducted. The reserve volume allows for touch-ups and also may be used to treat the hands. During this process of inspection,



Fig. 29.18 Fat compartments of face numbered and color-coded

Fig. 29.19 Levels and depths for deposition of fat grafts (anatomic levels of the face is a reference for injection depths of the Adivive fat grafts). (Copyright permission courtesy of Dr. Bryan C. Mendelson, Melbourne, Australia)



the patient is viewed both in a supine and upright position. If additional work is to be done after the fat injections, the following sequence is followed: (1) laser neck, (2) brow lift, (3) blepharoplasty, (4) face and neck lift.

The technique of beginning the injections superiorly and working your way inferiorly and then medially provides an interesting perspective of the facial anatomy in terms of symmetry. The inverted image of the face forces the right brain to play a predominant role in assessing symmetry. However in clinical practice, what is most useful in assessing symmetry is to view the patient from multiple perspectives, i.e., right side up, upside down, left side, right side, and any which way that provides the surgeon optimal three-dimensional perception.

An important aspect of any technique of facial fat grafting is the level and volume of fat deposited in various anatomic areas of the face. It is imperative that micro strands of fat graft (ASCs) are deposited at these various levels using small blunt cannulas of various lengths. Care should be exercised to avoid vessels and to understand the variable depths of the facial nerve branches in the entire face. Small micro strands of fat are dispensed only during withdrawal of the cannula. Vascular intrusion around the orbit may result in catastrophic visual consequences which is fortunately a rare occurrence. A quick glance summary of the various levels where the Adivive fat should be deposited for the different facial zones is (Table 29.1) (Figs. 29.18 and 29.19):

1. Orbital rims and tear troughs: level 5–17 gauge
 2. Malar and zygomatic: levels 3 and 4–16–17 gauge
 3. Forehead: levels 4 and 5–16–17 gauge; Pre-parotid: levels 2–3–17 gauge
 4. Nasolabial and marionette notch: level 2–17 gauge
 5. Cheek hollow and border mandible: level 2–17 gauge
 6. Lips (upper and lower): levels 2 and 4 (dry space, muscle and white roll) – 20–22 gauge
Enlarge cannula size if Adivive fat is too thick.
- The addition of PRP facilitates injecting with smaller cannulas.

Access for the entry points is made with a superficial 16-gauge needle stick in the direction

Table 29.1 Depth of deposition, cannula size, and volumes for Adivive graft

Zone	Injection depth	Cannula gauge and length	Adivive volume (per side)
1	5	17 short	Tear trough 1–2 mL supraorbital 3–4 mL
2	3 and 4	16–17 medium	5 mL
3	4 and 5	16–17 medium	5–8 mL
4	2	17 short	3–5 mL
5	2 and 5	17 medium	5–10 mL
6	2 and 4	20–22 medium	2–4 mL

+cannula lengths: *short* 2.5 cm, *medium* 3–5 cm, *long* 6–10 cm

of cannula orientation. These puncture sites are also suitable for repeated ice saline infusion which minimizes bruising. It is recommended that only blunt cannulas be used for injecting the fat. The only sharp needle used for injection is for the treatment of earlobe creases (22–25 gauge) (Fig. 29.20).

ASCs that have survived attrition at 3 months should indicate an accurate clinical retention rate. Patient results at 3 months are indicative of long-term results (Personal communication Lee Yoshimura, Berman M). Their experience has confirmed that these surviving adipose-derived stem cells indeed have a longevity of several years. The general consensus of most experienced surgeons performing fat grafting procedures is confirmatory in that fat graft volume that persists at 4 months will be in place for several years.

Berman has popularized the term “3D space lift” which is very appropriate for the larger volume procedures. Three-dimensional space lift provides yet another dimension in describing the concept of “facelifting.” By filling the loose facial skin envelope rather than tightening with surgical procedures, volumetric restoration as well as skin tightening occur. However, as plastic surgeons, we do have the armamentarium to perform the more invasive surgical techniques if indicated and/or requested by the patient. This will be discussed in more detail with the Opera Lift Plus.



Fig. 29.20 (a) (Left) Preoperative Opera Lift Major patient. (Right) 21½ weeks postoperative (b) Close-up of eyes of the same patient at 7 months. (Top) Preoperative.

(Bottom) Seven months postoperative. (c) (Top) Preoperative. (Bottom) 1½ years postoperative

29.7 Opera Lift Plus

The plus suffix reflects that surgical procedures are being performed with the injection of Adivive fat. Adivive fat volumes generally utilized are somewhere between that used for the minor and major procedures (35–80 mL), depending on the amount of soft tissue deficiency. A variety of surgical procedures may be performed simultaneously with the OL+ procedure including the brow lift, limited to total facelifts, blepharoplasties, etc. The majority of these patients are also treated with laser neck tightening with the SlimLipo laser.

With surgical facelift procedures, the majority of these patients have Adivive fat grafting, PRP, and SlimLipo laser neck tightening. A primary component of the aging face is loss of fat in the various facial fat compartments resulting in creases and folds, as well as sagging skin. Surgical tightening alone not only does not fully address the cosmetic issue, but adds an element of distortion. In addition to Adivive grafting, SlimLipo laser neck tightening is usually performed in Opera Lift Plus patients. A major advantage of laser neck tightening with face lifts is that the central neck skin continues to tighten for at least 6 months after laser application. This technique limits recurrent mid-neck sag and

avoids extensive submental surgical procedures. There has only been one minor complication among the 250 SlimLipo neck patients performed by the author during the past 4 years.

The Opera Lift Plus procedures are always performed in a licensed ambulatory surgery center that also provides 23-h short-stay accommodations. The extent of the Opera Lift Plus warrants the use of an anesthesiologist who generally utilizes intravenous (IV) Propofol with most of these patients (Fig. 29.21).

29.7.1 Sequence of Procedures for a Typical Opera Lift Plus

1. Harvest fat from the abdomen or thighs. The volume of harvested fat needs to be 2–3 times the desired end volume of processed Adivive fat. SlimLipo laser treatment for donor area is optional and performed after harvesting.
2. The staff processes fat while the surgeon lasers fat donor site and injects neck and face (1/3 % lidocaine plus 1:300,000 epinephrine).
3. SlimLipo laser of central neck between carotids is performed with 924/975 nm 3" wand with settings of 10–12 W/5–7 W and a total fluence between 1,500 and 4,000 J.



Fig. 29.21 (a) (1) Preoperative 69-year-old without makeup. (2) Preoperative with makeup (b) Eight days postoperative after brow lift, total facelift, 60 mL Adivive fat graft, upper blepharoplasty, SlimLipo central neck, and PRP

4. Inject Adivive in facial areas noted on diagram – levels and volumes as indicated but avoiding planes of dissection of any surgical procedures planned for the patient. It is very difficult to inject the face after a surgical lift because of distortion and the dangers of free fat in surgical planes. Also, the trauma of depositing large volumes of Adivive fat to the face increases the potential for hematoma if these injections are performed after the surgical facelift.
5. Brow lift.
6. Upper blepharoplasty. Lower blepharoplasty if needed, but a minimal deformity of the lower lid is best treated with Adivive.
7. Mid-face or total facelift. Submental incisions and platysmaplasties are rarely necessary with the advent of the laser neck tightening.
8. Final assessment for symmetry and correction using the reserve Adivive fat graft. Ideally, the fat graft should be transferred to the face within 20 min of processing. All graft material is routinely placed in sterile ice saline trays while awaiting transfer. The total time for the surgical procedures on the above patient was 2 h and 36 min.

29.8 Operating Room Staff and Environment

It should be noted that a wide variety of physicians and specialists are qualified to perform fat grafting procedures and in perhaps a less complex environment. However, as a plastic surgeon, fat grafting procedures including the Adivive technique are most often performed with larger volumes and in conjunction with other procedures. Specifically, this level of staffing and advanced technology allowed the author to complete the patient's surgery in

approximately two and a half hours. In addition, the integration of PRP has objectively diminished bruising and edema thereby also shortening recovery time. One-half of the PRP is mixed with the Adivive and the other half sprayed into the facial wounds prior to closure.

The majority of patients were treated in the facial area (Opera Lifts). Both Lee and Yoshimura have assessed their long-term results with an average long-term volume persistence in excess of 50 %. A retrospective analysis of the patients with inclusion of only those who are beyond a 3-month assessment point confirms the findings of Lee and Yoshimura. With the integration of PRP with Adivive, there is a definite decrease in early postoperative bruising and edema especially in the Opera Lift Plus patients. There is an enhancement of fat graft volume retention since adding the PRP.

29.9 Maxstem and SVF Enhancement of ADIVIVE

In August of 2011, the Maxstem incubator was acquired from Medikan. This system allows for the digestion of the Adivive fat with the use of collagenase thereby developing a more concentrated clear SVF product (stromal vascular fraction) product. With the addition of collagenase, 35 mL of Adivive fat is incubated, tossed, centrifuged, and rinsed resulting in 2–3 mL of clear material. This clear concentrated product contains approximately 35 million adipose-derived stem cells (ASC-SVF) that is then added to the remaining syringes of Adivive graft material. In essence, the Adivive fat is a matrix for the Maxstem product which results in a higher percentage take of the fat graft (80 % plus). There are no clearly defined FDA guidelines in this area of fat grafting.

29.10 Clinical Cases

Clinical case includes Opera Lift Minor (no PRP and no SlimLipo) (Figs. 29.22, 29.23, 29.24, and

29.25), Opera Lift Major (Figs. 29.20 and 29.26), and Opera Lift Plus (Figs. 29.27 and 29.28).

This 65-year-old female underwent breast reconstruction and as a gesture of benevolence,



Fig. 29.22 (a) Preoperative 66-year-old patient. (b) Immediately after injection of 35 mL Adivive (c) Two weeks after Adivive injection. (d) Three years after Adivive injection

Fig. 29.23 (*Left*) Preoperative 76-year-old patient. (*Right*) Three months following injection of small-volume Adivive



enough Adivive was reserved for an Opera Lift. She has retained 90 % of her 3-month appearance for more than a year (Fig. 29.26).

This 72-year-old female requested eyelid surgery as well as noninvasive facial and neck rejuvenation. In addition to the brow and eyelid procedures, large-volume facial fat grafting and laser neck tightening were provided as an alternative to surgery (Fig. 29.27).

As an example of combining Adivive fat grafting with surgical procedures, this 68-year-old female had a facelift 10 years previously.

Recommendations included large-volume Adivive, lower blepharoplasty, and laser neck tightening (Fig. 29.28).

29.11 Long-Term Results with Adivive Fat Grafting to the Face

The benchmark for predicting long-term results is generally noted at about 3 months post grafting (Figs. 29.29, 29.30, 29.31, and 29.32).

Fig. 29.24 (a) (Left) Preoperative 47-year-old patient. (Right) Two weeks post upper blepharoplasty and injection of 35 mL Adivive. (b) Close-up of patient. (Top) Preoperative. (Bottom) Two weeks postsurgery



Fig. 29.25 (Left) Preoperative 61-year-old male. (Right) Three months after injection of 37 mL Adivive



Fig. 29.26 (Left) Preoperative 66-year-old patient. (Middle) One month following injection of 54 mL Adivive. (Right) Three months after surgery



Fig. 29.27 (Left) Preoperative 72-year-old patient. (Right) Two weeks after brow lift, upper and lower blepharoplasty, SlimLipo neck, and 72 mL Adivive to face

Fig. 29.28 (a) (Left) Preoperative 69-year-old female. (Right) Nine days following lower blepharoplasty, 72 mL Adivive, and SlimLipo neck. (b) Close-up of eyes of patient



Fig. 29.29 (Left) Preoperative 70-year-old male. (Right) Eleven months post-Adivive fat grafting to face and SlimLipo neck





Fig. 29.30 (Left) Preoperative 58-year-old female. (Middle) Postoperative facelift. (Right) One month after Adivive face and SlimLipo neck



Fig. 29.31 (Left) Preoperative 59-year-old female. (Right) Long-term post large-volume (60 mL) Adivive to face



Fig. 29.32 (*Left*) Preoperative 60-year-old patient. (*Middle*) One month after Opera Lift Plus. 80 mL Adivive, SlimLipo neck, and upper blepharoplasty. (*Right*) Seventeen months postsurgery

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