Large Volume Breast Fat Transfer: Technical Evolution and Safety Aspects Based on over 800 cases and 26 years of follow-up

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Current techniques for augmentation mammoplasty involve the use of alloplastic materials and an open approach. The former may not be well tolerated and often can be the origin of undesirable effects such as capsule contracture. The latter implies residual scars, which can sometimes be less than satisfactory from an aesthetic point of view. Constant research in this field, progressive improvement in design and biocompatibility of breast implants, and the evolution of surgical techniques have led to shorter and better-hidden scars, reducing, however, only partially all the aforementioned shortcomings and problems.

Furthermore, the well known controversy over silicone gel-filled breast implants (resulting in law-enforced suspension of their clinical use for primary cosmetic augmentation mammoplasty in the early 1990s, first in the United States and then in many other countries), the non-acceptance of having artificial alloplastic materials in the body, and the evolution of surgical techniques have led to shorter and better-hidden scars, reducing, however, only partially all the aforementioned shortcomings and problems.

In the 1950s, Peer was the first plastic surgeon to conduct extensive studies on the long term survival of autologous fatty tissue grafts. He reported that these grafts lost more than 50% of their weight and volume after 1 year, and showed that most reabsorption occurred in the larger fatty tissue particles and during the first 3 months after the re-implantation.

In the 1960s, the interest in autologous adipose tissue grafting almost disappeared due to the ever-increasing use of dermal adipose grafts, which proved to be more reliable and long lasting. Furthermore, new artificial materials for soft tissue augmentation (paraffin, fluid silicone, methacrylate, and others) became very popular despite the high rate of complications.

Until the 1980s, fat transplantation had been performed only as a soft tissue graft harvested “en bloc” with open surgery, thus resulting in evident and ugly scars at both the donor and receiving sites [62-75]. Only in the mid-1980s did the diffusion of syringe liposuction, which standardized and popularized methods for harvesting fat in a simple and safe manner, arouse renewed interest in free fat transplantation. Since then, this has stimulated constant evolution and technical improvement.

Autologous adipose tissue has been used to correct soft tissue defects for more than a century. Their soft and natural textures, the absence of a line, and its versatility have always made adipose tissue the ideal physiologic filling material. The first surgeons using adipose tissue as a filling material were Neuber, [32] who used it in 1893 to correct facial defects, and Czerny, who used it in 1895 to treat the sequelae of mastectomy by transplanting a large lipoma resected from the dorsal region [11]. Since then, free grafts of adipose tissue have also been used extensively in several other fields of surgery including thoracic surgery (for filling tubercular cavities), general surgery (to stop bleeding after liver and kidney surgery), neurosurgery (for cranial defects to obviate cerebral adherence), and orthopedic surgery (to close bone defects).

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In 1986, Illouz[23] and Fournier[15,16] in France were the first to define lipofilling as microlipoextraction and reinjection for facial rejuvenation. Deeply involved in this field of investigation, already in 1989 we described and published a method for producing autologous collagen from fat manipulation for face sculpting and rejuvenation, outlining the great potential of this new technology [51-54].
In the same year, Fournier, [16] extending his great experience and knowledge of fat transfer to the face and other body areas, started, first in the history of plastic surgery, to implant fat tissue into the breast describing a personal technique of “en bloc intraparenchymal” pattern. However, this technique has never been accepted by the international scientific community due to its very high rate of complications and the lack of predictability and durability related to the almost complete ultimate reabsorption of the grafted fat.

**Technical Evolution**

Our surgical experience with breast fat transfer started in February 1991. The clinical outcome, based on over 800 patients, is mainly represented by aesthetic augmentation mammoplasties (92%) with fat transfer alone (pure) or combined with implants (hybrid). At the present time, it is still the largest in the world in cosmetic surgery for patient’s number and follow-up length. Our surgical technique evolved constantly and steadily aiming to achieve more consistent results and trying to increase at the same time patient safety and satisfaction. It is possible to identify four different phases in our technical evolution:

1. phase 1: the Fournier’s technique (1991>1993);
2. phase 2: the BBLS with modified lipostructure (1998>2008);
3. phase 3: the BBLS with lipocondensation (2008>present date);
4. phase 4: the BBLS with lipocondensation and Stromal Vascular Fraction (SVF) separation for Enriched Fat Graftings (EFG) (2010>present date).

**Phase 1: Fournier’s technique**

Fascinated by this new technical alternative for breast enlargement and after an extensive experience on lipotransfer in many other body areas we used the Fournier technique in 41 patients from January 1991 to December 1993. Unfortunately, we experienced a very high rate of severe complications (above 35%): mainly oil cysts, liponecrosis, macro-calcifications and infections, and therefore we discontinued its use. Our negative experience with this technique reflected the controversial judgment of the international scientific community on it.

As a matter of fact, a thorough review of the literature clearly indicated that all the complications observed were strictly related to technical errors during the harvesting and preparation of the fat, and most of all, to the technique and the anatomic sites of its reimplantation; absolutely no evidence of specific problems related to the intrinsic features of adipose tissue itself as augmentation material has never been described. After this discouraging experience, we almost completely quit performing breast fat implants for more than 4 years, but we never stopped our research in order to find logical solutions to all the shortcomings observed in the earlier version of breast grafting.

**Phase 2: Bicompartamental Breast Lipostructuring (BBLS) with modified lipostructure**

Considering all the aforementioned problems and seeking to find safe and reliable alternatives, we developed a new personal technique of fat transplantation for breast augmentation trying to incorporate the new concepts of functional breast anatomy from M. Lejour [28,29] and of adipose tissue physiopathology from Lafontan and structural fat transfer from Coleman [7, 8]. This technique is called Bicompartamental Breast Lipostructuring (BBLS) due to the fact that fat tissue is rigorously reimplanted in two specific anatomic areas of the breast only, as will be extensively described in this work (Figure 16.1):

![Figure 16.1](image)

**Figure 16.1:** (A-D) The fat tissue is reimplanted in two specific layers only: the retroglandular prefascial plan and the subcutaneous plan, in multiple retrogradous microlines.

1. The retroglandular prefascial plan;
2. The subcutaneous plan.

Moreover, fat is inserted only with thin multiple retrograde lines [57-60]. At the time we started to develop this technique, the knowledge of adipose tissue physiopathology was still very limited and the prevalent concept was to avoid traumatizing the fat as much as possible, both during the harvesting phase and during the reinjection in the recipient site. Therefore, after the harvesting phase, the fat tissue was prepared in the BBLS with modified lipostructure with minimal manipulation.

Only a gentle washing with saline solution in the same syringe used for harvesting was done to remove all undesirable components (blood, saline, oil). During the preparation phase, the syringes full of harvested fat tissue were maintained in an upside-down position with specially designed syringe holders. Then, the syringes were placed for 30 seconds on a custom-made sterile vibrating stand to speed up the stratification process, leading to separation of the harvested material into two main layers: fat tissue in the upper level and fluid in the lower.

As a matter of fact, centrifugation was impossible to perform because, at that time, no surgical certified centrifuges were available in the market. Moreover, handling such a large quantity of fat...
(up to 2500 cc) would dramatically increase the duration of this step. After preparation, the harvested adipose tissue was preserved in the same sealed syringes used for harvesting plunged in cold saline so as to keep a strictly close system process and to ensure fat preservation.

**Clinical outcome of phase 2**
- From 1998 to 2008 we treated 246 patients with this technique;
- 205 bilateral and 41 monolateral with a total of 451 breasts;
- youngest 18/oldest 56 (average 32.7);
- grafted fat volume ranged from 160 cc to 1040 cc per breast, (average of 415 cc);
- Residual volume maintenance rate up to 60% (average <45%).

All the patients underwent major or mild body contouring at the same surgical time, and 60% were treated for augmentation and volume asymmetry. Of the patients presenting a severe degree of asymmetry (≥grade 2), 12% had a combined reductive mastoplasy for the contralateral breast using the ultrasound technique. Symmetric volume augmentation of both breasts was performed for 36% of patients, whereas 11% underwent correction of sequelae originating from previous breast surgery as well as augmentation (6%), reduction (2%), or mastopexy (3%).

**Complications of phase 2**
- Edema (consistent during the first 4 weeks);
- ecchymosis (common during the first 2 weeks);
- Dysthesia (common during the first 2 weeks);
- localized liponecrosis → 11 cases;
- oil cyst → 8 cases;
- Macro calcifications → 16 cases. 14.7%

The most common side effects during the first 2 weeks after surgery were localized edema and slight bruising. Analyzing the clinical data we realized that even if the rate of major complications was less than 50% of the one experienced during the first phase, these were strictly related to the oily content of the transplanted tissue, where more TGS in the recipient sites was clearly at the origin of a higher level of complications (Figure 16.2).

![Figure 16.2](image)

**Phase 3: Bicompartmental Breast Lipostructuring (BBLS) with lipocondensation**

Highly motivated by the above mentioned data and in order to improve patient’s safety and to reduce the risk of complications, we focused our attention on developing a new “oil free” fat transfer technique (Figure 16.3).

![Figure 16.3](image)
procedure and improved the related surgical equipment (Lipokit).

**Technique**

1. The new technique involves eight technical steps:
2. Surgical planning;
3. Body contouring setup;
4. Infiltration of the donor areas;
5. Fat harvesting;
6. Fat condensation;
7. Intraoperative breast expansion and breast setup;
8. Fat reimplantation;
9. Manual reshaping;
10. Contralateral breast reshaping.

**Surgical planning**

In the bicompartmental breast lipostructuring procedure, careful and precise planning of both donor (body) and receiving (breast) areas must be performed.

**Donor site (body):** The donor sites selected the most are the trochanteric and gluteal regions, with respect, if possible, to the homolateral receiving hemi-soma (right to right/left to left). This marking, done with the patient in standing position, must be adapted to the different clinical situations. Whenever it is necessary to plan the harvesting of a large quantity of fat, it becomes mandatory to follow and respect the basic technical principles of a normal body contouring procedure. Therefore, a very accurate preoperative permanent marking are necessary to outline limits and thickness of the lipodistrofic areas, both in resting and dynamic situation, in order to avoid creating undesired irregularities in the donor sites.

**Receiving site (breast):** The most empty areas of the superior quadrants and any volume asymmetry or discrepancy in height and position of the submammary fold are carefully marked preoperatively on the breast while the patient is in standing position.

**Body-contouring set-up**

The bicompartmental technique is often used as a complement to large volume extensive circumferential body contouring surgery with Ultrasonic Assisted Lipoplasty (UAL). The patient is first disinfected in standing position with a nonalcoholic and non-iodine solution to reduce the chance that the preoperative marking will be wiped off or any skin chromatic changes masked during the surgery. General anesthesia is then induced on a surgical sterile bed and the patient is then turned in prone position onto another adjacent sterile bed [57].

**Infiltration of the donor areas**

After the preoperative markings have been made and the patient set-up is carefully achieved, the areas to be treated are infiltrated with room-temperature 0.9% saline with 3 mg of adrenaline per liter. No local anesthetic is added to the solution. The function of this infiltration is to reduce the density of the subcutaneous tissue facilitating the harvesting. The infiltration is made through a very small incision realized with the 11 blade, with long and flexible micro cannulas usually connected to an infiltration pump set to a level of 250/300 ml per minute to facilitate the introduction of the large volume of fluid necessary to induce the tumescent status. The infiltration is realized by area as surgery proceeds, in order to avoid delivering all the fluid simultaneously in one step usually starting from the left side of the upper body. In a total body remodeling, it is suggested to treat the gluteal area completely and the posterior thigh in one side first and then to switch to the other side, thus minimizing the possibility of fluid absorption.

In minor cases and whenever the patient is asking for it, it is possible to use neurolepto-anesthesia under constant monitorization. In this case, the infiltration primarily functions as a local anesthetic when an anesthetic (lidocaine or bupivacaine), vasoconstrictor (epinephrine), and sodium bicarbonate are added to the hypotonic solution. The sodium bicarbonate stabilizes the solution and facilitates the effect of the anesthetic.

**Fat harvesting**

Fat must be harvested in a rigorous closed system avoiding any exposure to the air using a 2-mm single-hole Teflon-coated special cannula with a vacuum control in the grip. The fat is collected in special custom-made sterile containers featuring a filter mesh for separating the dense tissue from the fluid fraction. The most relevant part of the fluid after 30’ of decantation can be eliminated from a small outlet placed in the bottom of the container (Figure 16.4).
Usually, the fat tissue is preferably harvested only in the posterior areas of the body, with care to avoid, whenever possible, the inner face of the thighs and the abdominal area. During the harvesting phase, the surgeon must constantly remember to avoid creating asymmetries or irregularities at the donor sites. The relevant quantity of fat necessary for a bilateral breast lipostructuring requires an extensive knowledge of the basic principles of traditional body contouring and a careful respect for all its technical steps (planning, infiltration, deep plane, superficial plane).

**Fat condensation**

The rational of lipocondensation technique is based on a pretreatment in vitro of the adult mature adipocytes with low survival rate before the reimplantation to separate and remove the oily contents (TGS) still preserving SVF viability. The harvested decanted fat is then transferred in special Fat Processing Units (FPU) for undergoing the condensation phase. The FPUs are then placed in the Lipokit where they are submitted to a cycle of high-speed centrifugation (4500 rpm) for 9 minutes (Figure 16.5). Due to the centrifugal force, the metal plunger of the FPU, weighting 32 g, is able to apply a pressure of 120 kg/cm² to the fat tissue. Under this high mechanical stress, the larger portion of the adipocytes is destroyed and the oily content (TGs) is collected in the upper part of the FPU, totally separated from the other components. After the condensation process, 60 cc of already decanted fat are reduced to less than 30 cc. Adult mature adipocytes are destroyed while Stromal Vascular Fraction (SVF) is preserved.

**Intraoperative breast expansion and breast setup**

The preparation of the recipient site for condensed fat grafts, especially when enriched with Stromal Vascular Fraction (EFG), is extremely important for ensuring a better metabolic reintegration of the transferred tissue and a better cells intake, both for reconstruction or for aesthetic purposes.

In the past, we used different technical approaches in order to achieve this goal. Among these, a special Breast Expansion Device (BRAVA) invented and commercialized by an American plastic surgeon (R. Khouri), has demonstrated to be helpful to create a better situation for fat reimplantation, stimulating vasculogenesis and lymphatic activity and opening the spaces of the area to be injected. Unfortunately, this step requires high patient compliance and cooperation and, because of the discomfort in wearing the device for 30 days before surgery for 12 hours a day, it is not always accepted. As a matter of fact, the two bulky acrylic vacuum cups are poorly compatible with a normal social life.
We have been among the very first surgical groups in Europe adopting this technique, more than 10 years ago, but unfortunately the original procedure, as described by its developer, very often has not been accepted by our patients or discontinued during the treatment.

However it should be pointed out that whenever the patients have been cooperative in wearing BRAVA, the reimplantation phase has been facilitated and the rate of fat survival seemed to be higher. For the above mentioned problems, we then tried to realize an intraoperative external breast skin expansion using a modified BRAVA device reinforced with methacrylate and applying alternate rapid cycles of inflation and deflation (4 times per minute) during all the time the patient is laying in supine position on the surgical table for the completion of the anterior body contouring procedure. This step was obviously not achieving the same metabolic results than traditional BRAVA but has been helpful for improving and facilitating the grafting phase, especially in severe breast hypoplasia with poor skin elasticity (Figure 16.8). As a matter of fact, this step is slightly facilitating the fat re-implantation by opening the spaces in the breast, but is not stimulating the neovasculogenesis or improving the metabolic exchanges in the recipient site.

Figure 16.8: (A,B) Intraoperative external breast skin expansion using a modified BRAVA.

In 2015, we discontinued the use of this modified BRAVA as well, due to its relevant cost and to the objective difficulties in applying it intra-operatively. Looking for better and easier alternatives for expanding and conditioning the breast before the reimplantation of the condensed fat, at the end of 2015 we have been positively impressed by a new technical option proposed by the Argentinian surgeon Guillermo Blugerman [5] called pneumocarbobodissection, allowing to obtain excellent results even in complicated cases of breast reconstruction. This technique is a revolutionary application of the traditional carboxytherapy used for almost 20 years for aesthetic purposes for regenerating and improving the skin texture and elasticity for facial rejuvenation, striae and minor scare release. With this technique, the recipient site is extensively inflated with CO2 creating a guided subcutaneous emphysema for releasing and separating the superficial planes and all those areas where skin adhesion and poor skin elasticity can represent a major obstacle for transferring condensed fat (Figure 16.9).

Figure 16.9: (A-C) The recipient areas are conditioned and expanded using pressurized inflation with CO2.

On top of this mechanical action, the pneumo dissection with CO2 is also stimulating the metabolic reintegration of the transferred tissue by two major biophysical effects induced by its contact with living tissues:

1. The hypercapnia;
2. The Bohr Effect.

The subcutaneous inflation of the recipient site with CO2 leads to an increase of CO2 concentration in the blood stream of the surrounding tissues, inducing a consequential decrease in blood pH. The hemoglobin proteins release their load of oxygen increasing the oxygenation of the recipient site stimulating metabolic exchanges and facilitating cell survival. Another important advantage of this technique is that it can be used in any anatomic area and is not limited, like BRAVA, to the breast area only.

At the present time, after more than 1 year of use of pneumocarbobodissection on more than 30 patients, we are very confident that it is the most promising and reliable tool for expanding and preparing the recipient site whenever performing condensed or enriched fat grafting in the breast.

Fat reimplantation

Fat is reimplanted through a small incision made with a N. 11 blade in the medial portion of the inframammary fold. Two specially designed self-lubricated 2 mm cannulas are used for this step: a straight flexible 27cm long cannula for the deeper retroglandular plane and a stiffer 25cm long curved one for reinjection of the fat in the subcutaneous plane and for reddefining the breast crease and the inframammary fold. The fat transplantation technique is performed only into the retroglandular/ prefascial plane and into the superficial subcutaneous tissue of the upper pole of the breast following the principles of the bicompartmental grafting, in hundreds of retrograde paths, with care to avoid any intraparenchymal placement.After insertion, the cannula should stay parallel to the chest-wall and then proceed upward through the retroglandular
space, always in touch with the pectoralis muscle aponeurosis until it reaches the superior preoperative marks. As its tip goes beyond the gland, keeping on the same level in this area, it actually ends up being in the subcutaneous plane.

The first fat-filled FPU is then connected to a special injector allowing a very precise and micrometric control of the quantity of transplanted tissue. The surgical assistant uses his/her flat hand as a barrier to prevent condensed accidental spreading of fat in undesired areas (Figure 16.10).

Figure 16.10: (A,B) The assistant’s hand should be used as a barrier to prevent any accidental spreading of fat in undesired areas.

After completion of fat insertion behind the gland, the adipose tissue is then injected along the inframammary crease and the breast medial border (Figure 16.11).

Figure 16.11: (A,B) After completion of fat insertion behind the gland, the adipose tissue is then injected along the inframammary crease and the breast medial border.

At this time, a curved cannula should be used to allow grafting along the rounded outline. The curved cannula is kept in a strictly subcutaneous plane and must be rotated by 90°. At the end, its tip will be oriented upward, with its hole facing the dermis, to prevent fat from being injected too deeply. The adipose tissue is injected only as the cannula is withdrawn. The amounts should be limited to the bare minimum needed to fill up the tunnels left by the cannula (i.e., 2-3 mL of fat for each tunnel). Any excess could determine surface irregularities. At the end of the procedure, the skin incisions must be meticulously and tightly sutured with a re-absorbable monofilament thread (Monocrill 5/0).

Manual reshaping

Once the phase of fat grafting has been completed, the adipose tissue is then redistributed and molded so as to flatten out any irregularities along the borders and to obtain a very regular and smooth surface in the superficial plans. The aim of this important and delicate phase is also to reproduce the shape of an anatomic implant, especially in the upper pole, where it is important to create a natural and physiologic fullness, avoiding excessive roundness or unaesthetic stepping (Figure 16.12).

Figure 16.12: Once the phase of fat grafting has been completed, the adipose tissue is then redistributed and molded so as to flatten out any irregularity along the borders and superficial plans to obtain a very regular and smooth surface.

This maneuver is performed using both finger tips and the radial edge of the hand, and requires much pressure because compression is exerted on the tough bony surface of the upper pole rather than on the grafted fat itself. Peripheral squeezing maneuvers are performed along the marked curved mammary outline while the whole breast surface is carefully checked for detection of any superficial unevenness. To facilitate this maneuver, the TGs fraction separated during the lipocondensation phase is used as a lubricant. It should be noted that all of this will not displace the fat in undesired areas because the latter has been inserted following crisscross vectors. Consequently, septa of connective tissue act as a barrier, preventing any adipose tissue from sliding beyond the traced breast border. This desirable “fence” effect will last during the whole healing process allowed to avoiding adhesive taping and simplifying postoperative care. As a matter of fact, at the end of the treatment, an elastic roll is fixed to maintain the space between the breasts, and a sports bra with shaped cups and no wire is used to support the breast for 4 weeks.

Controlateral breast reshaping

In all those cases of breast asymmetry, where a mild or medium level of ptosis is evident, we realize simultaneously a minimal invasive mastopexy with a new personal technique called “scarpexy”. In this technique, hundreds of retrograde strokes with a specially designed instrument are applied in the upper pole of the ptotic breast in order to stimulate a strong skin retraction and the consequential upward repositioning of the Nipple Areola Complex (NAC) (Figure 16.13).
Figure 16.13: (A, B) Scarpey: hundreds of retrograde subdermal strokes are applied in the upper pole of the ptotic breast in order to stimulate the skin retraction and the repositioning of the Nipple-Areola Complex (NAC); (C) the special surgical instrument for scarifying the deeper face of the dermis; (D) detail of the barbed tip of the instrument.

Clinical outcome of phase 3

- From October 2008 to March 2017 we have treated 416 patients with this procedure;
- 403 bilateral and 13 monolateral with a total of 829 breasts;
- youngest 17 / oldest 63 (average 29.2);
- grafted fat volume ranged from 95 cc to 785 cc per breast (average 287 cc);
- Residual volume maintenance rate at 1 year up to 90%, (average 74%).

The majority of the patients who had undergone simultaneous extensive body contouring (ultrasonic lipoplasty) and had lost significant weight after the surgery often complained about an insufficient volume increase of the breast. For this reason, in the above mentioned type of patient, we decided to plan an overcorrection of ~30% to compensate the physiologic volume reduction. More often, patient satisfaction was even higher than surgeon satisfaction (Figures 16.14,16.15).

Complications of phase 3

Thanks to the improved harvesting and grafting technique and, above all, to the new and improved way to treat and condensing the fat before the implant, we observed a consistent reduction
of the complications rate.

- Edema (common during the first 2 weeks);
- Ecchymosis (common during the first 2 weeks);
- Dysthesia (few cases);

Overall, complications are minimal and temporary. Six cases of pseudocysts resolved spontaneously over a period of 6 months. In a series of 416 patients treated with the described procedure during a 9-year period, to date, only few cases of microcalcifications have been monitored (rate of > 2%). All the patients were carefully monitored with preoperative and serial postoperative mammograms and ultrasonograms. This close follow-up evaluation allowed us to clarify the most controversial aspect of microcalcifications, which has been the main point of criticism for this procedure over the years. The dramatic drop of these 3 latter complications is strictly related to the important reduction of the oily content of the transferred tissue. Less TOS = less complications!

Phase 4: Bicompartmental Breast Lipocondensation (BBLS) with lipocondensation and Stromal Vascular Fraction (SVF) for Enriched Fat GrafS (EFG)

In some specific cases, where the abundance of adipose tissue in the donor areas allowed the possibility of harvesting large quantity of fat and where, besides the volumetric replacement, it was necessary to enhance the regenerative action, we enriched the implant with additional stromal vascular fraction (SVF), insulated and separated from already condensed fat. The SVF is the tissue fraction surrounding and incorporating the adipocytes and is extremely rich in cell precursors, pericytes and adipose derived stem cells (ADSC). Enriching the condensed fat with this element, additional cellular dramatically enhances the regenerative potential of the graft whenever this action is needed.

Our experience with EFG started in 2010 and so far we already treated 106 patients with this technique. The ratio of enrichment varied from 200% to 500% depending on the clinical needs and the abundance of fat sources. It is important to underline that the residual volume of SVF after enzymatic digestion is very limited (~2/4 cc every 100 cc of processed fat) therefore the ratio of enrichment of the grafts often cannot go over 200%. To insulate the SVF from the condensed fat it is necessary to realize an enzymatic digestion of the condensed fat with collagenase and then to centrifugate for 2 minutes at 1000 rpm in order to separate the different fractions, to comply with Laws and regulations and to stay within the limits of a “low grade” manipulations. All these steps are realized in the operating room and during the same surgical session (Figure 16.16).

Figure 16.16: (A-C) A case of a 24 y.o. lady presenting a severe breast asymmetry associated with a ptosis of medium degree and emptiness of the upper pole; (D-F) 2.5 years postoperatively after one session of lipocondensation enriched with an additional 300% of SVF. In this specific case, a minimally invasive mastopexy procedure has been performed on the right breast with the new technique called “scarpexy”.

Enzymatic digestion

The surgical use in the operating room of collagenase has been, especially in the recent years, very controversial. This is mainly due to the burden of problems related to the difficult and unsafe manipulation of this enzyme, not mentioning its relevant cost and its potential mutagenic activity. Therefore, even if in a lack of precise regulations, its use in the operating room should be strongly discouraged. Due to all the above mentioned issues and following the latest suggestions endorsed by the Italian Drugs Administration (AIFA), from March 2014 we decided to definitely stop using the enzymatic digestion with collagenase during our surgical procedures.

In order to have the possibility, whenever necessary and when the patient’s adipose reserves are abundant, to enrich the fat grafts with additional stromal vascular fraction, it has been necessary to search for an alternative method to obtain the mechanical disruption of the condensed fat tissue. This alternative was supposed to be rapid, reliable, efficient, safe and, if possible, inexpensive. Furthermore, it must be able to preserve integrity and the viability of the stromal vascular fraction while ensuring the separation from all the other cellular debrees.

Mechanic disruption with ultrasonic energy

After several trials with many different tools and techniques with unclear and unpredictable results, we finally found the solution in the surgical use of the ultrasonic energy, which has a very high efficiency and specificity toward the adipose tissue. Using our long-term experience with ultrasonic energy, we modified in-
Instrumentation and protocols and we started to treat the fat tissue with in-vitro sonication in order to disrupt and emulsify the harvested fat. The separation of the stromal vascular fraction is then obtained by high-speed centrifugation (2 minutes at 1500 rpm) (Figure 16.17).

Figure 16.17: The condensed fat tissue is treated with ultrasonic energy in order to disrupt and emulsify the remnant adipocytes facilitating the separation of the stromal vascular fraction.

**Clinical outcome of phase 4**

To date, we have used this new technique to “enrich the condensed graft” on 38 patients and, even if the cell sorting and viability are lesser than the ones obtainable with enzymatic digestion (-25%), results and patient satisfaction are really excellent. Our patient series and follow-up length is now enough to merge with a first technical and clinical evaluation and we really believe that, at the time of publishing this book, it is the fastest and more efficient way to separate SVF.

**Oncologic Issues**

Analyzing our clinical series, post-oncologic reconstructive cases represent less than 7% (Table 16-1). Therefore our oncologic concerns has always been more oriented in the evaluation of an increased incidence of breast cancer in our patient’s population compared to the published data of patients never submitted to breast lipotransfer. In private practice, this type of statistic investigation is indeed very difficult to achieve, both for long term follow-up issues and for the consistent risk of emotional distress for the patient. For this reason, we mostly focused our attention to the most controversial aspects related to breast fat transfer for reconstructive purposes after oncologic resection. More specifically:

<table>
<thead>
<tr>
<th>Patients</th>
<th>n.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cosmetic mammaplasty</td>
<td>751 (93.5%)</td>
</tr>
<tr>
<td>Post-oncologic reconstruction</td>
<td>52 (6.5%)</td>
</tr>
<tr>
<td>total number</td>
<td>803</td>
</tr>
<tr>
<td>Breasts</td>
<td>n.</td>
</tr>
<tr>
<td>Cosmetic mammaplasty</td>
<td>1502 (94.7%)</td>
</tr>
<tr>
<td>Post-oncologic reconstruction</td>
<td>83 (5.3%)</td>
</tr>
</tbody>
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**Table 16-1**: Clinical outcome. Patients operated since 1991.

1. Interference with Ca detection;
2. The potential risk of increased recidives in some specific types of breast cancers;
3. The destiny of the aromatase contained in the fat tissue and its real role in oncogenic mechanisms.

**Interference with Ca detection**

Macro and microcalcifications cannot be completely prevented or avoided, and they can occur in response to any trauma or surgery to the breast. However, they are very different in appearance and location and generally can easily be distinguished from those appearing in the context of a neoplastic focus. For instance, it is also very important to clarify that all the other breast surgeries lead to the formation of microcalcifications, with the highest rate related to reduction mammaplasty (15%, Gorman). A correct radiologic followup assessment and a meticulous record of the surgical procedure usually have been sufficient to clear any diagnostic concern. Good communication with the radiologists is mandatory. In those rare instances of persistent doubt, we could be however confronted by a false-positive, and although this generates distress in the patient, it can be easily clarified with a simple stereotastic biopsy (FNA) (Figure 16.18).

Figure 16.18: Mammographical follow-up: A) preoplastically; B) six months postoperatively. The postoperative image shows an increased retroglandular radiotransparency due to persistence of the grafted condensed adipose tissue.

**The potential risk of increased recidives in some specific types of breast cancers**

One of the most controversial points has always been whether the autologous fat grafting (lipofilling) either for aesthetic augmentation mammaplasty or for breast reconstruction after oncologic surgery can increase the risk of breast cancer recurrence. Until very recently, this important point has not been clearly established. Many studies have been carried out by several groups of researchers. Among these, Petit, Rietjens and Mc Millian 35
highlighted the possibility of a potential increased risk of recidives in some specific type of Ca after lipofilling. This warning is strictly related to:

1. In-situ Ca;
2. Patients under 50 years old;
3. with a Ka 67 index above 14.

This category of patients is however very limited (less than 3%). The conclusion of this research is that, for more extensive data, it is more reasonable to wait at least 2 years before performing a fat graft in this specific population of patients.

Finally, in 2016, a Key Stone article assessing the risk of locoregional and systemic recurrence in patients who underwent lipofilling for breast reconstruction has been published by Steven Kronowitz 26, one of the world leaders of oncologic breast surgery. The Authors identified all patients who underwent segmental or total mastectomy for breast cancer (719 breasts) (i.e., cases) or breast cancer risk reduction or benign disease (305 cancer-free breasts) followed by breast reconstruction with lipofilling as an adjunct or primary procedure between June 1981 and February 2014. They also then identified matched patients with breast cancer treated with segmental or total mastectomy followed by reconstruction without lipofilling (670 breasts) (i.e., controls). The probability of locoregional recurrence was estimated by the Kaplan-Meier method. The study results showed no increase in locoregional recurrence, systemic recurrence, or second breast cancer. These findings support the total oncologic safety of fat transfer in breast reconstruction and in aesthetic augmentation. The destiny of the aromatase contained in the fat tissue and its real role in oncogenic mechanisms The aromatase, also called estrogen synthetase, is the enzyme responsible for the biosynthesis of estrogens. The importance of local estrogen biosynthesis within the breast tissues and its strict relation with some oncogenic mechanisms in the evolution of many types of breast cancer has been clearly outlined many years ago. Moreover, it has been demonstrated that its highest activity has always been detected in the quadrant containing the tumor.

The evidence of aromatase activity in adipose tissue and therefore a consistent evidence of significant relation between breast adipose tissue and breast cancer is as follows (J.S. O’Neill, R.A. Elton, W.R. Miller. Edinburgh, Scotland). In the adipose tissue the aromatase is mainly contained in the fluid oily fraction (TG2) of the adipocyte. There-fore, if we discard the most relevant part of it submitting the adipose tissue to the lipocondensation process before the transfer, we dramatically reduce if not eliminate the aromatase minimizing this potential oncogenic risk. Once again, less TGs in the grafted tissue mean less complications and less risks for the patients.

Conclusions

All recent technical and clinical advances have minimized complications and dramatically increased transferred fat survival and volume persistence. If well performed, Bicompartmental Breast Liposculpture (BBLs) can be the most viable and safe alternative to the use of prosthetic material for breast augmentation alone or combined with small implants (hybrid or composite technique) in those cases where the fat reserve is insufficient to ensure enough condensed tissue. It offers many benefits and advantages to both patients and surgeon. A very common observation is the fact that the majority of the patients treated with bicompartamental breast liposculpture present with consistently improved skin quality in terms of both elasticity and texture. Skin stretch marks, especially in the lateral area and around the nipple areola complex, are very often less evident.

This evidence confirms that the transfer of fat tissue acts not only as a volume replacement, but also as a tissue regenerator. This observation is supported by the most recent studies on adult stem cells contained in adipose tissue, conducted by us and other groups worldwide. The most advanced research has been able to demonstrate that adipose tissue presents a higher growth potential than mesenchymal totipotential bone marrow stem cells and, furthermore, the harvesting of bone marrow is definitely more traumatic and limitative. In contrast, adipose tissue can represent an inexhaustible source of easy and immediately available adult mesenchymal stem cells for clinical application in all areas of medicine that care for the regeneration of autologous tissue.

In fact, as was well demonstrated, with a modest quantity of adipose tissue, it is possible to obtain, through rigorous isolation and culture techniques, a large quantity of totipotential mesenchymal stem cells that can eventually be differentiated easily according to various needs (adipose, cartilaginous, bone, endothelial, muscular, hepatic tissues and pancreatic cells). For all the aforementioned benefits, if well performed following all the technical steps, bicompartamental breast liposculpture should be considered a safe and viable alternative to traditional augmentation mammoplasty especially in those cases in which additive mastoplasty with implants is either unsuitable for the patient or unacceptable to her. The achievable volume and projection of the mammary cone is sometimes limited, compared to silicone implants; but it is important to highlight that with appropriate training it is possible to emphasize the augmentation effects mainly localized at the upperpole of the breast, the most critical area of early aging and volume loss. This mimicks the very natural appearance usually obtained with anatomic breast implants.

References


Citation: Zocchi ML (2017) Large Volume Breast Fat Transfer: Technical Evolution and Safety Aspects Based on over 800 cases and 26 years of follow-up. Plastic Surgery Mod Tech 2017: PSMT-117.
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