



Lipofilling in Aesthetic Surgery: Indications, Outcomes, and Complications

Joan Fontdevila and Ariel Marshall

The indications of the lipofilling in aesthetic surgery have bloomed in the last years, embracing areas far from the early applications in the face [1]. The good results obtained in one area boost the interest of the surgeons to apply it in other. Usually, the first intention of use of lipofilling is to add volume, but its regenerative properties have expanded its indications to secondary surgeries, when we need a gentle procedure with the tissues, able to provide new healthy tissue and improvement of the fibrosis of the previous surgeries [2].

Volume increase maybe is the main goal we look for in aesthetics applications of fat grafting, and this is limited by the biological properties of any graft. In order to have satisfied patients, we should know the results desired by the patients and plan carefully the lipofilling procedure, in order to determine the amount of fat available for harvesting, how many grafting procedures we will perform, and how we will perform it. As with the reconstructive procedures, improvements and new technology in regenerative cell procurement,

growth factors, and biological scaffolds can contribute to expand the indications [3].

Many of the principles stated in the reconstructive indications chapter apply to the aesthetics, but unlike the reconstructive surgery, aesthetic surgery is a field where the use of synthetic materials has been the state of the art for many indications until the breakthrough of the lipofilling and the beginning of this century. So, depending on the material chosen, indications, outcomes, and potential complications may be different. It is important to inform the patients and make them aware about the differences of using one or other kind of treatment.

Face

The face is one of the main targets of lipofilling for aesthetic purposes because nice and natural results can be achieved, even in lean patients with limited volume donor areas, and because it does not require a huge amount of fat. Moreover, a regenerating effect of the grafts provides additional aesthetic improvement with dermal thickness and vascularization increase, and also a color and pigmentation improvement [4]. Even patients with facial bone anomalies can benefit a simpler approach to harmonize their face [5].

But the results differ quite depending on the unit of the face treated, being the cheek and the chin where the integration of the graft is best and

J. Fontdevila (✉)
Hospital Clinic, Barcelona, Spain

Surgical Specialties Department, University of
Barcelona, Barcelona, Spain
e-mail: joanfontdevila@ub.edu

A. Marshall
Hospital Clinic, Barcelona, Spain

the temple, nose, lip and frontal areas where integration is low [6]. Patient should be informed before of the limitations with fat grafting in some areas and consider the use of synthetic materials if with the lipofilling is not possible to achieve the expected result.

Regarding the synthetic materials, every patient requesting a lipofilling procedure should be questioned about previous synthetic filling materials use. If the patient has implanted a permanent filler (methacrylate, silicon, etc.), it should be rejected. The surgical procedure can stimulate a foreign body reaction against the allogenic material, with possible devastating consequences. If the material used was reabsorbable, then we should advise the patient to wait until 1 year after the treatment to enable us to assess the volume with accuracy.

Complications of lipofilling in the face are rare. The mild ones are the most common, such as edema, ecchymosis, pain, skin tattoos, nodules, asymmetries, reabsorption, displacement, hypocorrection, hypercorrection, or hypertrophy, while more serious complications may occur secondary to infection, injury of anatomical structures, and intravascular injection.

Despite they are more pronounced than those seen with synthetic injectable materials, edema, ecchymosis, and pain will be managed as usually is done in any other facial surgery: local cold, lymphatic drainage massages and soft pain killers.

If the injection is very superficial, it can result in visible or palpable nodules. This is especially relevant in the eyelids, where the skin is very thin and a superficial infiltration would generate an evident irregularity. In this zone the correct technique would be to make a deeper infiltration between the orbicular muscle and the periosteum. In case of immediate appearance, a massage of the area should be performed to remove the excess tissue. Nodules can appear immediately (due to superficial or excess infiltration), but may also appear months or years after infiltration as steatonecrosis, suggesting a technical deficiency: traumatic harvesting or processing altering the viability of the graft, or an indiscriminate infiltration of fat, which is prevented by properly infil-

trating in the form of small drops of graft. If its center shows liquefaction producing an oily cyst, puncture and drainage under local anesthesia could be an appropriate treatment.

Asymmetry can be very visible in the face since this is a very exposed area and slight differences are easily detected. We must identify asymmetries prior to surgery and make it note to the patient. Most of them are there before the surgery and can be difficult to correct if the problem is in the bone structures. A useful way to identify them is through photographs on every possible plane to compare the silhouettes from different angles. A usual origin of asymmetries is the lack teeth pieces, creating a depression that can hardly be fixed only with fat. The correct procedure would be to first apply dental implants and then perform fat infiltration.

Hypocorrection is generally masked by local inflammation and becomes visible once it disappears. To prevent it, it is for us important to use a very dense graft, using centrifuged fat rather than only decanted or filtered. Using high dense fat, the amount of injected fat and the retained fat will be as close as the 1:1 ratio, like happens with the synthetic materials. Hypocorrection usually requires one or more corrective infiltrations. It is recommended to wait at least 6 months to let the first graft stabilizes and avoid hypercorrection, with better uptake due to less fibrosis.

Fat hypertrophy may appear after more than 10 years and does not disappear spontaneously. It manifests as an increase in volume in the infiltrated area, usually after a rapid weight gain and more likely in patients treated in the youth. Hypertrophy can appear as a nodulation but, unlike steatonecrosis and oily cysts shows a normal consistency of fat. Its etiology is unknown, although it is believed that adipocytes that survive after the graft increase its content due to the weight gain, so patients should maintain a stable weight after surgery to avoid it.

There are no studies that demonstrate which fat donor area is the best, but in most cases of hypertrophy described, the donor area has been the abdomen, so to infiltrate very visible areas such as the face, it is preferred to obtain fat from other areas; for example, the inner part of the

knees, which do not fluctuate too much with the weight gain. Even though it's not necessary to perform imaging studies for its diagnosis, if an MRI is performed, the fibrous tracts in the infiltrated area can be seen increased; therefore, the correction through liposuction is harder than usual. Even supposing it can be corrected by liposuction, it can recur, and that's why the most effective treatment is surgical excision.

The most worrisome complications are those generated by the intravascular injection, ranging from cutaneous necrosis, blindness, paralysis, or death. The manifestations may appear within the first 24 h, although they usually emerge during infiltration. For this complication to occur, no large amounts of fat are necessary since cases have been described after infiltration of 0.5 mL. The highly vascularized periocular areas are frequently involved; for example, glabella, nasal root, nasolabial fold, and frontal and temporal regions.

Fat injected in small arteries of areas mentioned above can travel oppositely to blood flow through the arteries in the injection area to the ophthalmic artery and internal carotid artery due to the high pressure of infiltration. The ophthalmic artery occlusion causes a painful blindness and ocular ptosis. Meanwhile if it travels further reaching the internal carotid artery, it may occlude the anterior or middle cerebral artery, presenting with neurological manifestations that can be as severe as death.

Superficial lesions as cutaneous necrosis may improve after local treatment; therefore, if a change in coloration of the skin is observed during infiltration, it is recommended to stop immediately, apply topical nitroglycerine, and occlude the area. In addition, local infiltrations with sodium heparin have been reported.

In cases of cerebral involvement, supportive treatment, anticoagulant, and intravenous corticosteroids are advised, while in cases of blindness it is recommended to perform eye massage, pharmacological intraocular pressure reduction, and intravenous vasodilators. However, in most cases blindness is usually irreversible.

To avoid intravascular injection, several precautions must be taken, including the use of blunt

cannula, avoiding infiltrating deep planes with needles or pointed cannulas, always aspirate before infiltrating, withdrawal of infiltration and with low-pressure syringes, limiting the size of the syringe to 1 mL and the volume of fat to 0.1 mL in each pass, and using vasoconstrictors in the area of injection. Avoid treating areas with previous trauma, chronic inflammation, or scarring.

Skin marking with permanent pens can leave tattoos in the cannula entry orifice since the ink can infiltrate the dermis and remain in. The most suitable way to solve would be by laser. A different kind of pigmentation to avoid is that caused by sun exposure for a while as it can cause pigmentation of the skin that is then difficult to remove, requiring application of laser or chemical pilling. Ecchymosis can also be camouflaged with specific makeup.

Lids and Periorbital

Some signs of aging of the eyelids such as the tear trough depression, upper palpebral sulcus hollowing, and a marked eyelid to cheek transition are suitable to be treated using lipofilling [7–11].

Treatment of tear trough deformity has focused the interest of the surgery of this area in the last years, being suggested the use of hyaluronic acid and other synthetic fillers, orbital fat repositioning, and fat grafting [9, 12]. Fat grafting is becoming very popular, as a common graft or as the emulsion of the fat, known as “nanofat” [13], the latter being used more like a skin regenerating agent of this area rather than as a filling material.

This area is not easy to treat because the periorbital skin is very thin and soft and continuously exposed to the other's sight. These special features make this area sensitive to noticeable complications if the grafted lid shows irregularities, usually as a thread of small lumps in the orbital rim or in the upper eyelid (Fig. 1). To avoid this, graft should be very thin, harvested with cannulas with holes less than 1 mm of diameter, and injected in a small amount (from 1 cc to 2 cc for

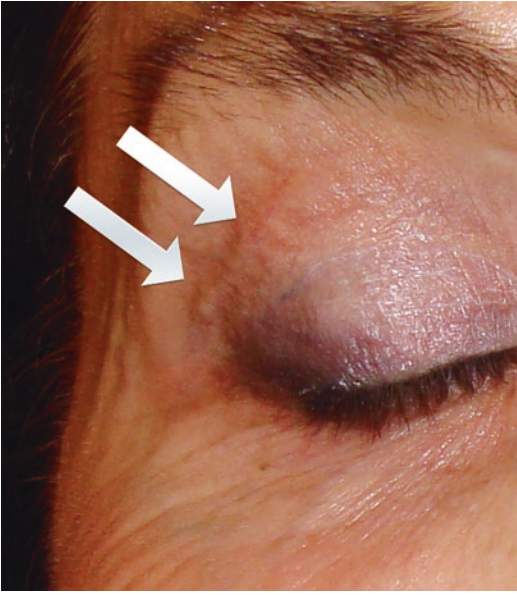


Fig. 1 Small lumps of grafted fat, noticeable in the upper eyelid after attempting the correction of sunken upper palpebral fold with fat. Meticulous technique should be used in this zone to avoid complications: small size of the graft (<1 mm), 21G cannula, and deep injection close to the periosteum

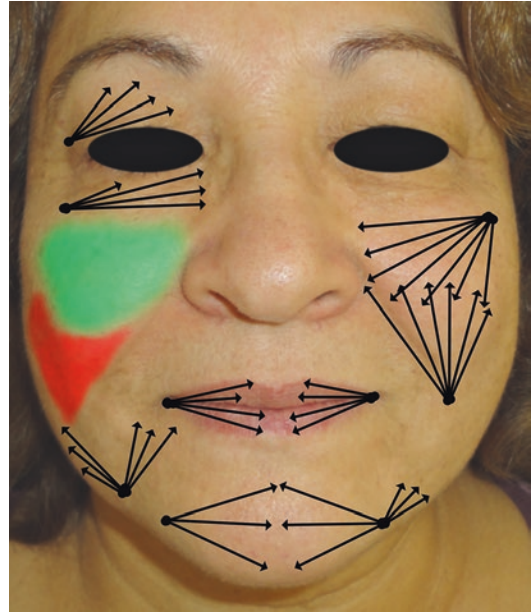


Fig. 2 Injection points recommended for the main areas tributary on fat grafting in the face. Over the malar bone (green area), the graft provides a lift effect that enhances the results obtained with the lipofilling. But in the lower cheek (red area), the extra weight of the graft can make it to sag, so moderate volumes should be used there

each unit of the periorbital area) deeply close to the periosteum using 21G cannula.

As previously commented, this area is more prone to intravascular injection and its complications, and a cautious injection should be performed [11, 14].

Cheek

The best area to observe the power of this technique in the face is the cheek. As the other mammals, humans loose fat from the peripheral areas of the body with aging, redistributing to central location. This atrophy is located mostly in the limbs and can also be evident in the cheek. So, in a different extent, with the time, everybody is eligible to improve his face with lipofilling. Due to the thick dermis in the upper cheek, we can use fatty tissue obtained with cannulas with holes wider than 1 mm and inject them with 16G. But the skin of the cheek gets thinner inferiorly, and any thick graft or excess of volume in the lower

cheek can be easily noticeable. We recommend applying the same principles of thin graft and few volume used for periorbital injection when injecting the cheek down from the level of the anterior nasal spine (Fig. 2).

The support of the malar bone provides a lift effect in the middle third of the face that contributes to the nice results obtained when applied in the upper cheek. But the lower cheek does not have the support of the bone and an excessive volume of fat will add weight in a bad supported area and this will sag easily, especially in older patients because of the flaccidity. In this case, it would be necessary to reconsider performing a repositioning technique of the facial soft tissues (face lift) (Fig. 3).

The entry point of the cannula in this area will be the upper lateral area of the malar bone and lower limit of the nasolabial fold. The plane of infiltration is from the deep dermis deep to the periosteum, including the facial muscles. Special attention should be paid to the emergency point



Fig. 3 In older patients we must consider first a face-lift surgery, because the skin flaccidity is unable to support the weight of the graft. In this case, an 80-year-old, 1 year after fat grating in the malar area, the skin of the cheek has displaced downward. A face-lift procedure with a simultaneous fat grafting could provide more predictable results

of the infraorbital nerve to avoid numbness, pain, or paresthesias of its innervation area.

Swelling and bruising, which can last up to 2 weeks after the treatment, are more evident than with the use of synthetic fillers, so we should warn the patient that this is not a rapid recovery treatment.

Combination of face-lift procedure and lipofilling has become a standard procedure nowadays in the facial rejuvenation surgery, based in the knowledge of this relative lack of fatty tissue in the face, which will not be improved by the face-lift techniques. Lipofilling is an easy maneuver that leads to better results in these surgeries [9, 15].

Nose

Lipofilling in the nose is indicated to treat secondary defects of rhinoplasty or to avoid a rhinoplasty if it is applied in strategic points as an augmentation technique to hide the hump [16, 17]. This area is not easy to treat if a previous surgery has created a fibrosis under such thin skin, so we do not recommend this indication to be used by those surgeons without huge experience in fat grafting. Moreover, retrograde fat embolism of the oph-

thalmic artery is a possible complication described in the nose lipofilling [16].

The technique here is like that used for the peri-orbital lipofilling, entering the cannula by a small stab incision in the nose tip and auxiliary entries at both sides of the upper dorsum can be also used.

Lips

The gold standard in lips enhancement is the hyaluronic acid. With this product the volume and profile of the lips can be improved by means of small-needle injection with precision and immediate results. The main limitation is the reabsorption over several months [5]. Lipofilling can provide an option for more lasting results but with the inconveniences of more swelling, bruising, and less control of the outcomes compared with the hyaluronic acid due to the unpredictability of the final volume or different rates of graft survival in each side which can hamper the symmetry [18]. Moreover, there is not agreement about the survival rates of the fat in the lips, and some authors think that this is not the most convenient indication of the lipofilling while we have other options as hyaluronic acid [6]. The plane of infiltration is also controversial, because it is not clear that a muscle with a constant movement like the orbicularis oris muscle is able to allow the graft integration. We suggest applying it only at subcutaneous and submucosal level.

The strategy used for the lips is harvesting of fat with cannulas with holes of 1.5 mm and 1 mm. The 1.5 mm fat will be used to increase the volume injecting under the vermillion, and the 1 mm fat will be used to improve the profile injecting under the white roll, and to improve the bar code, we will inject this under the lines of the skin of the lip. SNIF and nanofat can also be used to improve the skin of the lips.

Chin

Lipofilling can provide volume and projection to the chin [9, 18]. Chin implants are another option: they are easy to place and provide good projection

and volume, but, as any other synthetic material, can have undesired complications as displacement, palpability, mental nerve damage, and infection, especially whether the implant is placed by intraoral approach. Another option is the use of reabsorbable injectable materials such as hyaluronic acid or calcium hydroxyapatite, but the amount needed is high and the effect will not last far than 1 year.

Like for the malar area, here the bone supports the soft tissues, this guarantees a good projection, and the technique used is alike which is used there: fatty tissue obtained with cannulas with holes wider than 1 mm and injected with 16G cannula. Infiltration is performed from the lateral of the chin area, and only one incision for each side is needed. The graft can be placed both subcutaneously and intramuscularly.

Some older patients show a very deep wrinkle between the chin and the lower lip. This wrinkle can improve dramatically if we place fat underneath, and additionally performing inside the wrinkle a SNIF technique, because the surrounding dermis here is very thick and SNIF will help us to restore its thickness.

Perimandibular

In selected cases, adding volume to the skin surrounding the mandible can provide a youthful look [18]. Before deciding to perform lipofilling in the tissues surrounding the mandible, we should think if the patient actually needs to increase the volume in this area or in fact needs a skin-tightening procedure. In the case that the skin over the mandible is sagging, we should consider to perform a face-lift because the lipofilling can add an extra weight that can worsen the sagging. We do not recommend this technique for those without experience in face rejuvenation surgery and with lipofilling.

The goals in this area are to hide the transition between the jowls and the mandible and to smooth the mandible contour with the neck [9, 19].

Even with a good skin quality, we will avoid to graft this area with high volumes and thick grafts, using a thin graft harvested with less than 1-mm-holes cannula and injecting with a cannula of 18G. The infiltration level is only at the subcutaneous tissue.

Temple

There are patients who are worried about the hollow aspect of this area, requesting to fill it. Some authors have noticed that the results are not as good as in other locations because reabsorption rates here are high [6]. This is anatomically a singular area with factors hampering the potential of fat grafting as volumizer: the skin is thin, with the temporal vessels just underneath, and the soft tissue contains the temporal deep fascia, which is a hard and non-expandable structure. So we can only place the graft under a thin space where overcorrection is difficult to compensate high reabsorption rates. Moreover, given that this is a flat area with thin skin, irregularities in the distribution of the fat will be easily noticeable.

The technique will be the same than that used for areas with thin skin as the periorbital fat grafting. Entry points are placed in the infero-anterior angle of the temporal fossa and in the implantation line of the hair.

Breasts

As was discussed in the breast reconstruction indications, concerns about the safety of fat grafting in the breast make many surgeons to avoid its indication also in patients without health disease. Nowadays there is no clinical evidence of this risk to discourage the surgeons to apply it [20, 21].

The main benefit as a breast volumizing method in front of the implants are the long-lasting results avoiding implant limitations as capsular contracture, displacement, rupture, and implant replacement over the years, along with the versatility to reshape the breast with a material that should not be placed in a specific plane of the breast. The fat will follow the breast in its aging without secondary surgeries over time to update the breast position regarding the implant. Given this natural shape and touch provided by this technique, patients should be warned that the results are pretty different from those obtained with the implants: some patients prefer a round tight shape and hard touch of the breast. The main drawback of the use of fat as a method of breast enlargement is that it is not able to fill the

upper poles as the implants do, and we must advise this to those patients looking specifically for a corrective surgery of these breast areas, mostly women with atrophy after pregnancies.

Because we cross the breast tissue blindly with cannulas to perform the lipofilling, it is important to check the breast thoroughly before the surgery to discard any disease that can contraindicate the technique [22]. Breast should be palpated in search of any lump, and mammogram or ultrasonography should be performed close to the date of the surgery (we recommend less than 3 months). If any benign nodule is detected, we should consider removing it in the same surgery before performing the lipofilling. If a suspected malignant lesion appears, then we will not perform the lipofilling and patient will be studied to establish the diagnosis. Those patients with a difficult radiological evaluation of the breast, who previously need biopsies to discard malignancy, or having a gene mutation increasing the risk of breast cancer, should better opt for a surgery with implants because lipofilling will create changes in the breast that can compromise the imaging follow-up. Women with very dense breast can be also difficult kind of patients for lipofilling because the radiological assessment is not easy and the hard breast tissue hinders the fat infiltration.

The recommendation to not overcorrect in excess because this will create oily cysts and fat

necrosis (Fig. 4) applies especially for all the indications of breast lipofilling because this kind of benign complications can hamper the cancer screening of the breast, can alter the shape of the breast, and make the patient feel pain or make them hypersensitive [23].

Negative pressure to expand the breast tissues before grafting has been proposed as a way to increase the volume, vascularization, and softening of the receiving tissue [24]. This can help to perform higher volume grafting reducing the complication rates [25]. The drawback is wearing an uncomfortable vacuum device for some weeks.

We recommend performing a mammogram after 1 year of breast lipofilling. This will be the baseline record of how is her breast after the treatment. In the future, if the patient has any suspicious change in the mammogram, this can be compared with the basal mammogram to know if the changes existed before or are new [22]. Patients should make their radiologists aware about the previous lipofilling procedures in the breast, because they can see changes difficult to explain not knowing that fat grafting has been performed before.

As for most of lipofilling procedures, serious complications are rare. The most common include the previously commented oily cyst and steatonecrosis (fat necrosis) that should be identified and treated [26]. In fact, both of them are

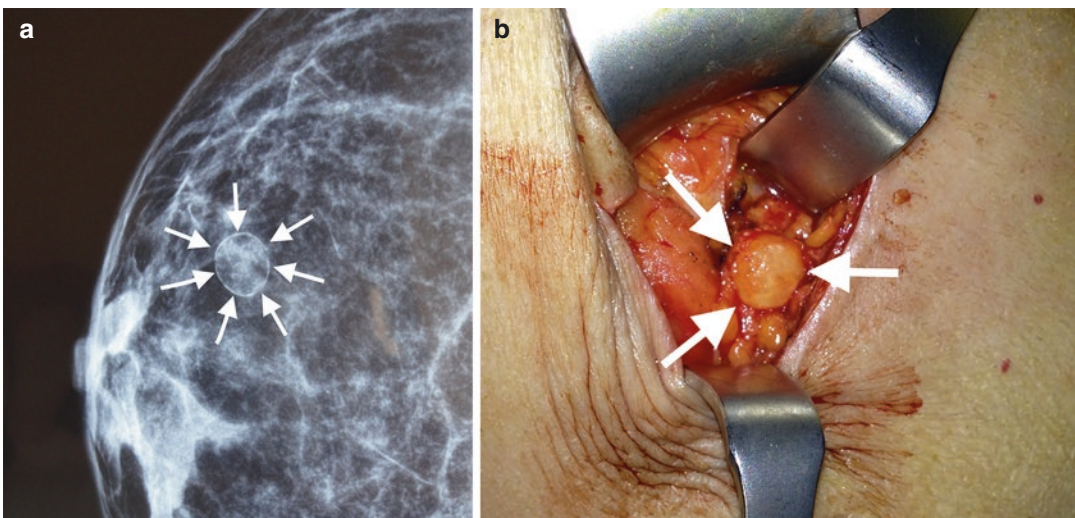


Fig. 4 Oily cyst. (a) (left) In the mammogram. (b) (right) Intraoperative image of the oily cyst

benign conditions and small lesions are usually painless, so they can be untreated but patient should be advised that these can appear in the mammogram. Bigger lesions are palpable and cause discomfort to the patient and can also hamper the radiological evaluation of the breast. These can be treated by direct excision or in the case of the oily cyst can be punctured to empty them and reduce their volume.

Augmentation

Usually patients demanding a breast augmentation procedure are young lean patients who need a considerable increase of the initial volume and do not have much fat to harvest. For this reason, breast implants still are nowadays the gold standard in breast augmentation. The outcomes are different to those achieved using implants, and we should warn the patients that the breast will not be firmer and round as with an implant. But being a noninvasive surgery without incisions in

the breast, sensibility and breastfeeding will be preserved, and the recovery will be faster, painless, and with fewer restrictions regarding movements and weight lifting because there is no risk of displacement like with the prostheses.

If the patient considers achieving the same volume than with a breast implant, then she should plan two procedures of fat grafting separated as less by 6 months. We will advise the patient to harvest only the fat necessary for the first procedure in order to keep fat sources for the second procedure.

The injection of the fat will be done from a stab incision by sharp needle of 16G in every quadrant in the color-changing area of the areola and another entry point in the middle of the newly designed inframammary fold. Another one can be done at the outer limit of the new inframammary fold, in the inferior-lateral quadrant. The inframammary fold approach lets us graft the subglandular plane easily. Injection from the parasternal area must be avoided due to the risk of hypertrophic scars (Fig. 5).

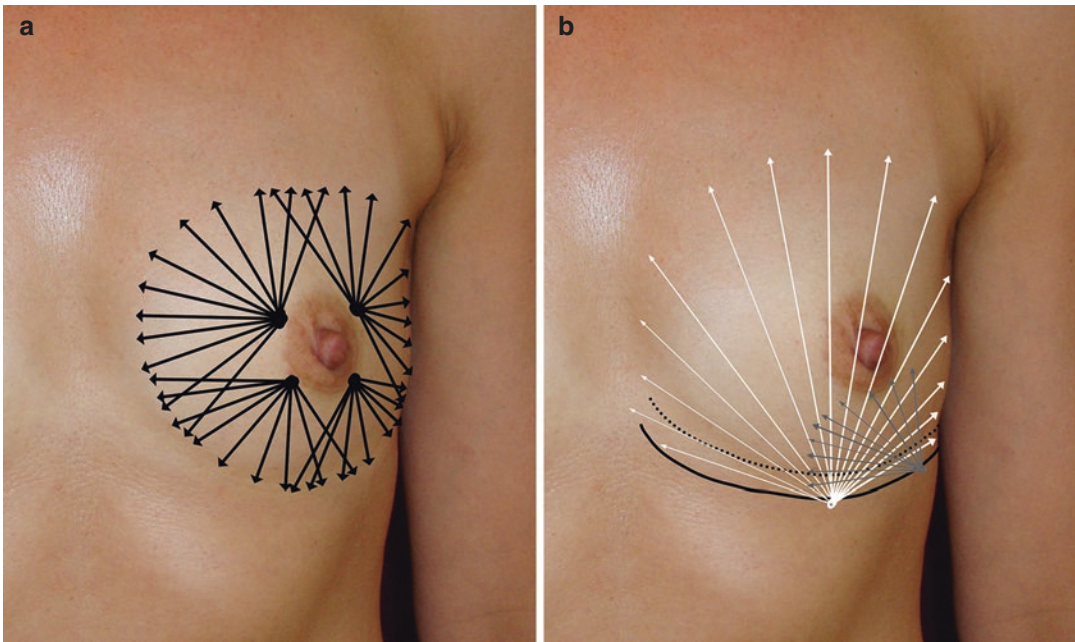


Fig. 5 Entry points for breast lipofilling. (a) (left) Four points in each quadrant of the outer rim of the areola. (b) (right) White arrows show another access for submammary plane infiltration in the new inframammary fold

(black line, dotted line shows existing inframammary fold). If needed, as for very wide breasts, another one in the lateral inframammary fold can be done (gray arrows)

Injection will be mostly subcutaneous and subglandular, and depending of the quality of the breast, also in the gland. Older patients with softer breast, with less glandular tissue and more fatty tissue, are more likely to receive fat in the gland. The amount of fat will be around 40–50 cc for every quadrant and 50–70 cc for the subglandular plane. Additional 30–50 cc can be placed inside and under the pectoralis muscle, remembering that only its caudal portion is of interest in breast augmentation; otherwise the breast will look excessively full in the upper quadrants.

Care should be taken to control the volume placed in every quadrant, to ensure symmetry. Not all the fat are the same and the fat origin also matters to avoid asymmetries due to the different behavior regarding different fat metabolism: fat from the same origin will be used for every quadrant (e.g., if fat from the abdomen is used for the upper quadrants in the right side, we will use the same origin for the upper quadrants of the left side).

Stitches are not used to close the entry points; we will only place an adhesive strip over them.

A soft bra will be worn for the first month, without limitations about exercises or positioning. Patient should be warned that the initial swelling will gone, so the volume that she sees the days after the surgery is not the final volume. Compared with submuscular implant placement, this procedure is almost painless. Over the months, the breast will become softer, and the volume at the third month usually is definitely.

Composite Breast Augmentation

This technique combines a lipofilling procedure and simultaneous breast augmentation with implants. The advantage is an increased thickness of soft tissue over the implant hiding the presence of this, allowing a more superficial placement (over the pectoralis muscle), reducing the volume of implant needed, and improving the cleavage definition in a smooth transition with the breast, therefore providing a more natural

result [27–30]. The disadvantages are an increased surgery time and a more expensive procedure.

Lipofilling can be also used after any other breast surgery as an ancillary procedure to achieve better results or to treat some complications and as a method to hide the implant rippling, release and volumize retracted scars, add some volume, and improve the contour [31]. In these cases where the breast has an implant, a very cautious injection should be performed in order to avoid implant puncture, using a blunt cannula and rather injecting closer to the dermis than deep.

Tuberous Breast

Tuberous breast is a congenital deformity of the breast with the onset in the puberty when the female breast develops. Constriction of unknown origin of the soft tissues surrounding the breast is responsible of a limited growth especially noticeable in the lower quadrants, which creates an elevated inframammary fold and a lack of volume (hypoplasia). The breast can only grow by the areola, where the skin is always thin and elastic, resulting in a wide and protruding areola. This condition is usually bilateral and asymmetrical; therefore both breasts are treated and this treatment should be personalized considering the differences between every breast.

The classic proposed treatment is based on the use of breast implants to provide volume and try to expand the hypoplastic inferior pole, usually creating multiple incisions inside the gland with the aim of helping the implant to round the breast and adding a periareolar mastopexy to reduce and retrude the areola [32, 33]. This approach is very aggressive to the breast tissues, which can lead to complications and usually fail to provide the desired round shape to the breast because the lack of soft tissue in the lower pole creates a double-bubble deformity [34, 35].

Fat grafting can provide just what this kind of breast needs: release of the constriction and volume in the inferior pole. If the deformity is severe, two procedures separated by at least

6 months are advisable to assure the integration of the grafted tissue, resorption of the non-viable tissue, and benefit of the antifibrotic effect. Breast implant can be avoided if the patient only wants to improve her breast shape. However, if the patient desires more volume, as any other breast augmentation using lipofilling, a second procedure of fat grafting can be performed, or an implant can be placed with better results once the breast shape was normalized with the first procedure of lipofilling. We should keep in mind that especially the young women may prioritize more volume and firmness over only shape restoration [36].

The technical principles are the same than those described for breast augmentation, but in the lower pole the surgeon should be more aggressive with the cannula breaking the breast tissue to reduce the constriction and fill this space with fat [33, 34, 37]. We do not recommend performing “percutaneous fasciotomies” (the so-called rigottomies after Dr. Gino Rigotti) because these can leave a permanent white spotting in the lower pole skin. We rather perform the same maneuver internally with a spatulated cannula, feeling a “click” every time that a tight fiber of breast tissue is disrupted.

When marking the tuberous breast before the surgery, we should pay attention to how much we want to lower the inframammary fold. Descends of 2 cm are easily achievable in a single step, but if more descent is needed, a second surgery should be planned or the inferior pole will not get the desired rounded shape. Patient should wear soft bra for some months after the surgery to allow the fat grafts to provide the round shape of the lower pole (Fig. 6).

Breast Asymmetry

When the volume of both breasts is different and these are of small size, the common approach is performing a breast augmentation surgery using implants of different sizes in each side. The drawback of this approach is that we are in fact creating a new asymmetry using different implants with different diameter or different profile, which

can be noticeable after some months and worsens over time. If one breast is small and the other one has a good size, the use of implant in the smaller one will mean a different behavior of both breasts with aging, with more sagging over time in the bigger side compared with the augmented side.

Lipofilling is a better option for these cases because we can correct the volume differences using a tissue with a natural behavior and evolution in the breast, and we can be more precise and individualize more with the volumes than with the implants, which have definite sizes and volumes [38]. If the patient desires a high volume in

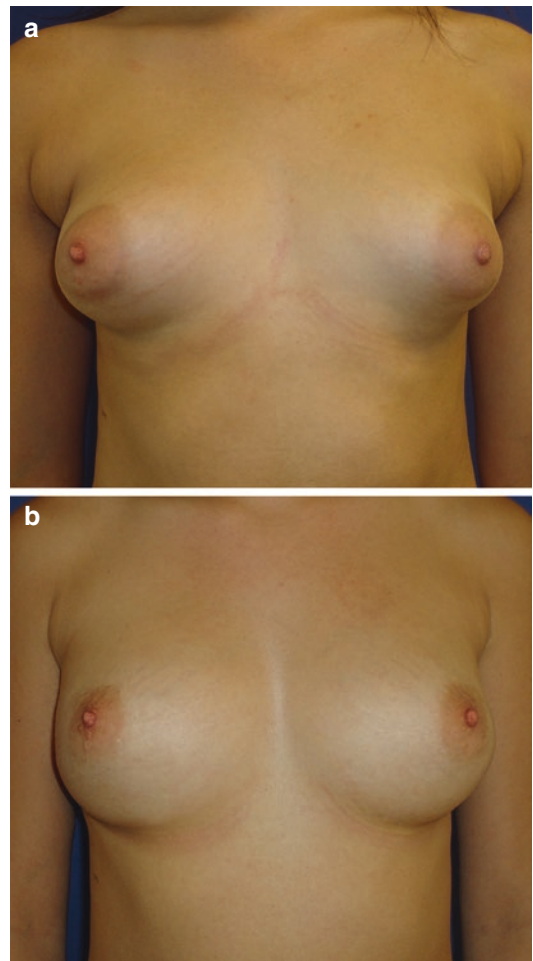


Fig. 6 (a) (upper) Tuberous breast with severe constriction of the lower quadrants and widened areola. (b) (lower) After two fat grafting procedures, the breast is rounder and the constriction release helps to relax areola protrusion

her breast, a good option is the “composite” breast augmentation, applying lipofilling to the smaller breast to compensate the lack of gland volume, using the same size of implant in each side. This strategy ensures better outcomes in terms of symmetry in the long run.

Implant Explantation and Simultaneous Fat Augmentation

Patients who have suffered of complications with implants for breast augmentation (capsular contracture, implant displacement or rotation, implant extrusion, etc.) frequently request a treatment of these complications without the use of implants but without resigning to the volume provided by these. Lipofilling has emerged as a more convenient option for these patients. An explantation with simultaneous fat grafting, with or without mastopexy, can provide the patient a good breast shape and volume with more comfort [39, 40].

The basic principles of the surgery are the same than those for breast augmentation with lipofilling, with some tricks to do the surgery easier. Fat grafting should be performed before the implant removal; this provides a tight breast, being the infiltration more comfortable than with a deflated breast. Periprosthetic capsule is removed only partially, leaving the anterior and posterior capsule in site with the purpose of placing fat grafts under the well-vascularized capsule tissue and also helping to retain the graft. Mastopexy, if needed, is performed after grafting, keeping in mind that the markings can change after the volume changes of implant removal and lipofilling.

Arms

Surgical procedures to enhance the aesthetics of the arms are not usually reported, even when the patients, commonly women, are concern about a body zone that is very exposed with short sleeve dresses or tank tops. Proposed treatments range from surgical excision of skin and fat (brachio-

plasty), liposuction, or a combination of both. Recently, the focus also went on fat grafting as a way to improve the results, combined with liposuction [41, 42].

The arms are evaluated in order to check the harmony of its fat distribution, removing fat from the exceeding areas as those between the muscle groups, defining more the muscle shape, and grafting this fat where the muscles use to protrude more, as the deltoid prominence [41, 43, 44]. The approach is be different in women than in men, wherein the volume of muscle infiltration in men can be higher than in women.

The technique is the same as the one previously described for the breast, but here larger cannulas, 12 cm long, 14G, and holes of 2 mm, can be used for infiltration to make it faster and more comfortable.

Hands

Technical options to rejuvenate effectively the hands are scarce, being one of the most exposed areas of the body, which can disclose the age of the person. Fat atrophy, pigmentations, noticeable dorsal veins, tendons, and bones are some of the features of hand aging. Lasers and chemical peelings can contribute to improve the superficial changes of the hands skin, but tissue thickness can only be corrected by means of synthetic fillers or lipofilling. Synthetic filler is an effective option but expensive in the long run because the volume needed is far high than what is needed in facial treatments, and furthermore, the volume fades totally in a year.

Lipofilling provides an inexpensive option for the volume restoration of the dorsum of the hands, which is durable, autologous, and with regenerative parallel effects [45–48]. Fat will be obtained with a cannula with holes of medium size (from 1 to 2 mm) and infiltrated from stab incisions in every web space and at ulnar and radial sides of the hand. The dorsum of the distal phalanxes will be also treated from these incisions (Fig. 7).

Here it is very important to use a blunt cannula, to avoid damaging the veins, tendons, and nerves that run just where we will place the fat:



Fig. 7 Entry points for hands lipofilling. Black arrows for dorsal hand infiltration, and this access can be also used for proximal dorsal aspect of finger infiltration

the subdermal plane. Marking these anatomical structures before the surgery is useful to locate them when the swelling hinders their visibility. It is also noteworthy that patients requiring treatment of the hands will have atrophy of the skin, so injection should be done evenly avoiding clumps of fat, which will be very noticeable.

Injection will be done by means of 1 cc syringes, like the other sensitive areas of the body. Cannulas will be of 17G, with a length of 9 cm (or 7 cm for short hands). For each hand, 20–30 cc of fat will be used. At the end of the surgery, stab incisions are protected by means of adhesive strips, and the patient is advised to keep the hands in an elevated position and avoid massaging the treated area to prevent displacement of the fat.

Complications of hands lipofilling are not usual, being the prolonged edema the only issue to discuss with the patients because it takes weeks to resolve. Infections have been reported occasionally [49, 50].

Buttocks

Together with breast augmentation with lipofilling, buttocks augmentations by means of fat grafts have risen notoriously in the last years since it

became one of the most popular procedures in many countries, especially in Latin America [51]. As for the breast augmentation, the standard for buttocks augmentations has been the silicone implants. But in this location, which is mechanically very demanding (sitting, walking, exercising, etc.), complications of the implants are more common and concerning than in the breast (extrusion, displacement, pain, discomfort, etc.) [52, 53]. Postoperative course is also tough because the usual intramuscular plane for the implants means many days of pain and limitations for walking.

For this reason the use of lipofilling has meant a shift in this region surgery, because it is almost painless; if there is enough donor areas, it provides more volume than the implants can (submuscular plane here has a limited capacity for solid implants); volume can be placed where the surgeons want instead of placing an implant in a specific anatomical pocket; and the combination with liposuction of the flanks and hips harmonize all the area [54].

An important limitation of buttocks lipofilling is the amount of graft necessary to obtain a noticeable change. Volumes close to 500 cc for each side are advisable for a satisfactory result. If is not expected to obtain this amount, the patient should be informed that maybe an implant is a better option. Like for the breast augmentation, the combination of implants and fat grafting leads to better results because the fat hide the contour of the implants and can be also placed in locations not indicated for the implants, e.g., the lower pole or outer quadrants.

The cannulas used here can be larger than those used in the breast and the face: 12–14 cm long, 14–12G, and holes of 2–2.5-mm are acceptable. Infiltration is performed from the peripheral limits of the buttocks, being very important to avoid high pressures of infiltration deep in the area of emergence of the gluteal vessels, because it is considered a dangerous area for intravascular fat injections and subsequent fatal fat embolism (Fig. 8).

Patient is warned to avoid long periods of sitting on the same area of the buttocks during the first month after the surgery to allow the graft to vascularize. As this surgery implies extensive liposuction to harvest a high volume of graft,

compression garment must be worn; this should be designed with a low-pressure zone in the buttocks area to ensure good blood flow to the grafted area (Fig. 9).

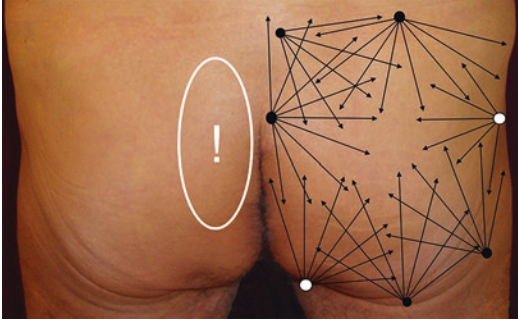


Fig. 8 Injection points for the gluteal lipofilling. As many as needed can be done at the peripheral of the buttocks, but as shown in the right side, deep injection in the inner quadrants should be avoided because of the risk of injection in the gluteal vessels

Concern about complications of buttocks lipofilling have raised recently, as this procedure has become more popular, especially fat embolism because of its potential fatal outcomes [51, 55, 56]. Common complications with other liposuction and lipofilling procedures can appear, such as fat necrosis or contour irregularities, but the most worrisome is fat embolism in the pulmonary vessels or right ventricle, which does not have a specific treatment and is usually fatal when diagnosed. These should be suspected when the patient presents a sudden cardiovascular collapse during the surgery or the first hours after the surgery. Supportive measures should be established as soon as possible. To limit this risk, avoiding deep infiltration in the gluteal veins emergence points, in the piriformis muscle area, is recommended. This problem does not seem to have a direct relationship with the volume of fat injected.



Fig. 9 Buttocks lipofilling. (a) (left) Before. (b) (right) After. If enough fat is available, nice results in terms of volume and projection can be achieved

Thighs and Calves

These areas are not the most popular for fat grafting, although calves augmentation with implants is a procedure requested from some patients. Results can be different to those obtained using implants, which usually are placed submuscularly creating an effect of hypertrophied gastrocnemius muscles. Lipofilling can provide wider calves but not defined muscle shape. Therefore, the best indications will be women with thin legs who are looking for more defined calves [57].

For the thighs, indications are more restricted to lean patients looking for a less skeletonized appearance. This applies to the HIV+ patients affected of lipoatrophy in whom the limb muscle boundaries are very noticeable.

In the limbs, fat will be injected subcutaneously, avoiding muscles because these distal areas differ from the buttocks in having important vascular and nervous structures more superficial, prone to be damaged. However, as for the buttocks, high amounts of fat are necessary for satisfactory results, up to 300 cc for each thigh or each calf. The cannulas recommended for this area are the same than for the buttocks.

Female Genitalia

In women, different signs of aging can be noticeable at the genitalia level. In those overweight women, a sagging bulky pubis can indicate the need of pubis liposuctions and skin reduction. But in lean women, sometimes the problem is a deflated and wrinkled appearance of the labia majora, with more exposed and visible labia minora.

Lipofilling in the labia majora is an easy way to provide a fleshier look, hiding the labia minora [58]. The procedure is easy and can be performed under local anesthesia and sedation, and the volumes used for each side range from 20 to 40 cc, applied in multiple layers, from deep to superficial, with a single-holed blunt-tip 16G cannula 9 cm long.

Male Genitalia

Penile girth enlargement is an indication of the lipofilling [59]. It is only a cosmetic indication, because it is not reported that sexual performance improves after this kind of procedure. Different options include dermal fat grafts, vein grafts, and acellular dermal matrix, among others. These options are more invasive and complications should be discussed thoroughly with the patients.

Due to the particular features of this area, technique is very specific. Fat is injected by means of a blunt cannula of 16G in four stab incisions around the penis at the 1, 5, 7, and 11 o'clock positions. Up to 15 cc are injected from each of these locations. The plane of injection is under the superficial fascia, in the areolar tissue over the Buck's fascia. Fat graft should be of small size, obtained with cannulas with holes of 1 mm, and due to the thin and soft tissue over the grafted plane, this area becomes at high risk of developing lumps.

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